STATE OF CALIFORNIA

DEPARTMENT OF TRANSPORTATION

NOTICE TO BIDDERS

AND

SPECIAL PROVISIONS

FOR CONSTRUCTION ON STATE HIGHWAY IN THE CITY AND COUNTY OF SAN FRANCISCO FROM 1.3 MILE TO 0.3 MILE SOUTH OF THE ROUTE 101/1 SEPARATION

In District 04 On Route 101

Under

Bid book dated December 28, 2009	Standard Specifications dated 2006
Project Plans approved December 14, 2009	Standard Plans dated 2006

Identified by

Contract No. 04-163744

04-SF-101-8.2/9.2

Federal-Aid Project
SARRA-Q101(153)N
ACNH-Q101(164)N

Bids open Wednesday, February 3, 2010 OSD

Dated December 28, 2009 IH

****

SPECIAL NOTICES

****

- Refer to Section 8-1.07, "Liquidated Damages," of the Amendments to the Standard Specifications for your project-specific liquidated damages based on your total bid.

- Effective August 1, 2009, the Department is implementing electronic notification of construction contract addenda for all projects. For addenda information, go to:

  http://www.dot.ca.gov/addenda/

- See Section 2, "Bidding," of these special provisions regarding SSPC QP certification.

- The Department is providing an electronic Information Handout for this project. Refer to Section 2-1.03B, "Supplemental Project Information," in the Amendments to the Standard Specifications for the location of this information.

- See Section 2, "Bidding," of these special provisions regarding a mandatory prebid meeting.

- The Department is implementing new Disadvantaged Business Enterprise requirements for Underutilized Disadvantaged Business Enterprises (UDBE). Section 2, "Bidding," under subsection titled "Disadvantaged Business Enterprises" and Section 5, "General," under subsection titled "Performance of UDBEs" of these special provisions cover the UDBE requirements.

- The time allotted for the successful bidder to sign and return the contract documents to the Department has been reduced for this project. Refer to Section 3, "Contract Award and Execution," of these special provisions.

- Attention is directed to Section 5, "Federal Requirements (American Recovery And Reinvestment Act)," of these special provisions.

- The Department is implementing new contract requirements for the submittal of:

  1. Data Universal Numbering System (D-U-N-S) Number form: Refer to section titled "Data Universal Numbering System (D-U-N-S) Number" under Section 3, "Contract Award and Execution," of these special provisions.
  2. Monthly Employment Report forms: Refer to section titled "Monthly Employment Report (American Recovery and Reinvestment Act)" under Section 5, "General," of these special provisions.

- The Department has replaced Section 8, "Prosecution and Progress." This replacement affects references in a large number of other specifications. Due to the extent of affected specifications, these references will not be corrected until there is a change in technical content that merits a specification revision. Section 0, "Global Revisions," of the Amendments to the Standard Specifications covers references affected by the Section 8 replacement.

- The Department is allowing contractors to submit electronic payroll records to the District Labor Compliance Office. Refer to section titled "Electronic Submission of Payroll Records" under Section 5, "General," of these special provisions.

- See Section 2, "Bidding," of these special provisions regarding a mandatory prebid meeting.

- For this contract, the trigger threshold for asphalt price fluctuations is reduced from 10 to 5 percent. See section titled "Compensation Adjustments for Price Index Fluctuations" in Section 5 of these special provisions.

- The bidder's attention is directed to "Owner Controlled Insurance Program (OCIP)" of the special provisions for insurance requirements.

CONTRACT NO. 04-163744

The special provisions contained herein have been prepared by or under the direction of the following Registered Persons.

HIGHWAY

12-14-09

REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER
ANDREW F. YEE
No. C 48678
Exp. 06/30/10
CIVIL
STATE OF CALIFORNIA

GEOTECHNICAL

12/14/2009

REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER
TUNG NGUYEN
No. 72143
Exp. 06/30/2010
CIVIL
STATE OF CALIFORNIA

STRUCTURES

12/15/09

REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER
Karla F. Meier
No. C 41066
Exp. 3-31-11
CIVIL
STATE OF CALIFORNIA

ARCHITECT

LICENSED ARCHITECT

LICENSED ARCHITECT
DONALD E ALSEY
No. C 26676
Exp. 07/31/11
STATE OF CALIFORNIA

CONTRACT NO. 04-163744

The special provisions contained herein have been prepared by or under the direction of the following Registered Persons.

ELECTRICAL

REGISTERED ELECTRICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER
Mahmood Noii
No. 13717
Exp. 6-30-11
ELECT.
STATE OF CALIFORNIA

TRAFFIC

12/14/09

REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER
S. NOORBAKHSH
No. C 46036
Exp. 12/31/10
CIVIL
STATE OF CALIFORNIA

Hazardous Waste

12/14/09

REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
Ray R Boyer
No. C49929
Exp. 09/30/10
CIVIL
STATE OF CALIFORNIA

WATER POLLUTION CONTROL

12/14/09

REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER
JENG G. TSAI
No. C 62753
Exp. 06/30/10
CIVIL
STATE OF CALIFORNIA

CONTRACT NO. 04-163744

Design Oversight Approval	Registration No.	Date
Printed Name: Randy R. Anderson Signature: Randy R. Anderson	45461	12/17/2007

Complete for projects prepared by consultants or local agencies only

Approved as to impact on State facilities and conformance with applicable State standards and practices as described in the A&E Consultant Services Manual.

The special provisions contained herein have been prepared by or under the direction of the following Registered Persons.

STRUCTURES

REGISTERED PROFESSIONAL ENGINEER
KANG CHEN
C051395
Exp. 06/30/10
CIVIL
STATE OF CALIFORNIA

REGISTERED CIVIL ENGINEER

MECHANICAL

REGISTERED PROFESSIONAL ENGINEER
BOBBY J. MELVIN
No. M28685
Exp. 6/30/11
MECHANICAL
STATE OF CALIFORNIA

REGISTERED MECHANICAL ENGINEER

TABLE OF CONTENTS

NOTICE TO BIDDERS 1
COPY OF BID ITEM LIST 3
SPECIAL PROVISIONS 15
SECTION 1 (BLANK) 15
SECTION 2 BIDDING 15
2-1.01 MANDATORY PREBID MEETING 15
2-1.02 TIE BID RESOLUTION 15
2-1.03 DISADVANTAGED BUSINESS ENTERPRISES 15
2-1.04 SSPC QP CERTIFICATION PREAWARD QUALIFICATION 17
SECTION 3 CONTRACT AWARD AND EXECUTION 17
3-1.01 SMALL BUSINESS PARTICIPATION REPORT 17
3-1.02 CALTRANS BIDDER - DBE INFORMATION FORM 17
SECTION 4. BEGINNING OF WORK, TIME OF COMPLETION, AND LIQUIDATED DAMAGES 17
SECTION 5 GENERAL 19
5-1.01 EMISSIONS REDUCTION 19
5-1.02 PERFORMANCE OF DBEs 19
5-1.03 PERFORMANCE OF UDBEs 20
5-1.04 PARTNERING DISPUTE RESOLUTION 20
5-1.05 FEDERAL REQUIREMENTS (AMERICAN RECOVERY AND REINVESTMENT ACT) 20
5-1.06 MONTHLY EMPLOYMENT REPORT (AMERICAN RECOVERY AND REINVESTMENT ACT) 21
5-1.07 SURFACE MINING AND RECLAMATION ACT 21
5-1.08 ELECTRONIC SUBMISSION OF PAYROLL RECORDS 22
5-1.09 TRAINING 22
5-1.10 FORCE ACCOUNT PAYMENT 22
5-1.11 RESPONSIBILITY TO OTHER ENTITIES 23
5-1.12 COMPENSATION ADJUSTMENTS FOR PRICE INDEX FLUCTUATIONS 23
5-1.13 AREAS FOR CONTRACTOR'S USE 25
5-1.14 PAYMENTS 26
5-1.15 SUPPLEMENTAL PROJECT INFORMATION 26
5-1.16 SPECIES PROTECTION 28
5-1.17 BIRD PROTECTION 28
5-1.18 RELATIONS WITH CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD 28
5-1.19 RELATIONS WITH UNITED STATES ARMY CORP OF ENGINEERS 29
5-1.20 NATIONAL PARK REGULATIONS 29
5-1.21 NATURALLY OCCURRING ASBESTOS 30
5-1.22 ENVIRONMENTALLY SENSITIVE AREA 30
5-1.23 ARCHAEOLOGICAL MONITORING AREA 31
5-1.24 ARCHITECTURAL MONITORING AREA 31
ARCHITECTURAL RESOURCES 32
ARCHITECTURAL MONITOR 32
5-1.25 NONHIGHWAY FACILITIES (INCLUDING UTILITIES) 32
5-1.26 AIR QUALITY – DEMOLITION NOTIFICATION 34
5-1.27 UNEXPLODED ORDNANCE (UXO) 34
5-1.28 TUNNEL SAFETY ORDERS 34
5-1.29 OWNER CONTROLLED INSURANCE PROGRAM (OCIP) 35
SECTION 6. (BLANK) 44
SECTION 7. (BLANK) 44
SECTION 8. MATERIALS 44
SECTION 8-1. MISCELLANEOUS 44
8-1.01 PREQUALIFIED AND TESTED SIGNING AND DELINEATION MATERIALS 44
8-1.02 STATE-FURNISHED MATERIALS 49
SECTION 8-2. CONCRETE 50
8-2.01 PORTLAND CEMENT CONCRETE 50
8-2.02 CONTRACTOR QUALITY CONTROL (CONCRETE PAVEMENT) 50

SECTION 8-3. WELDING....52
8-3.01 WELDING....52
WELDING QUALITY CONTROL....54
SECTION 9. DESCRIPTION OF STRUCTURAL WORK....57
SECTION 10. CONSTRUCTION DETAILS....58
SECTION 10-1. GENERAL....58
10-1.00 CONSTRUCTION PROJECT INFORMATION SIGNS....58
10-1.01 ORDER OF WORK....59
10-1.02 WATER POLLUTION CONTROL....61
10-1.03 CONSTRUCTION SITE MANAGEMENT....68
10-1.04 TEMPORARY STORM WATER RUN-ON BYPASS AND EXCAVATION DEWATERING....78
MONITORING AND REPORTING PROGRAM (MRP)....83
10-1.05 STREET SWEEPING....85
10-1.06 TEMPORARY HYDRAULIC MULCH (BONDED FIBER MATRIX)....86
10-1.07 TEMPORARY EROSION CONTROL BLANKET....88
10-1.08 TEMPORARY COVER....90
10-1.09 TEMPORARY CHECK DAM....93
10-1.10 TEMPORARY CONCRETE WASHOUT (PORTABLE)....97
10-1.11 TEMPORARY FIBER ROLL....98
10-1.12 TEMPORARY SILT FENCE....100
10-1.13 TEMPORARY REINFORCED SILT FENCE....103
10-1.14 TEMPORARY FENCE....106
10-1.15 TEMPORARY FENCE (TYPE CL-6, SLATTED)....107
10-1.16 TEMPORARY FENCE (TYPE ESA)....107
10-1.17 TEMPORARY GRAVEL BAG BERM....109
10-1.18 TEMPORARY CONSTRUCTION ENTRANCE....111
10-1.19 MOVE-IN/MOVE-OUT (TEMPORARY EROSION CONTROL)....114
10-1.20 TEMPORARY DRAINAGE INLET PROTECTION....114
10-1.21 TEMPORARY TIRE WASH SYSTEM....122
10-1.22 CONFINEMENT SYSTEM....125
10-1.23 VIBRATION MONITORING....127
10-1.24 SURVEY OF EXISTING NON-HIGHWAY FACILITIES....129
PHOTO SURVEY....132
VIDEO SURVEY....132
CRACK MONITORING....133
ELEVATION SURVEY....133
REPORTS AND SUBMITTALS....133
PAYMENT....134
10-1.25 TEMPORARY ACCESS PLAN....134
10-1.26 TRAFFIC MANAGEMENT PLAN....135
10-1.27 SOUND CONTROL AND MONITORING REQUIREMENTS....137
10-1.28 COOPERATION....139
10-1.29 PROGRESS SCHEDULE (CRITICAL PATH METHOD)....140
10-1.30 TIME-RELATED OVERHEAD....145
10-1.31 SMALL BUSINESS UTILIZATION REPORT....147
10-1.32 RIGHT OF WAY OBSTRUCTIONS....148
10-1.33 CONSTRUCTION AREA TRAFFIC CONTROL DEVICES....148
10-1.34 CONSTRUCTION AREA SIGNS....149
10-1.35 MAINTAINING TRAFFIC....150
10-1.36 CLOSURE REQUIREMENTS AND CONDITIONS....159
10-1.37 IMPACT ATTENUATOR VEHICLE....161
10-1.38 TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE....162
10-1.39 BARRICADE....163
10-1.40 PORTABLE CHANGEABLE MESSAGE SIGNS....163
10-1.41 TEMPORARY TRAFFIC SCREEN....164
10-1.42 TEMPORARY CRASH CUSHION MODULE....164
10-1.43 QUICKCHANGE MOVEABLE BARRIER SYSTEM....166
COST BREAK-DOWN....166

PAYMENT....169
10-1.44 REMOVE YELLOW TRAFFIC STRIPE AND PAVEMENT MARKING (HAZARDOUS WASTE)....169
10-1.45 TREATED WOOD WASTE....171
10-1.46 EXISTING HIGHWAY FACILITIES....173
EARTH MATERIAL CONTAINING LEAD....173
ABANDON MANHOLE....174
ABANDON CULVERT....174
ABANDON INLET....174
REMOVE SIGN STRUCTURE....174
REMOVE PAVEMENT MARKER....175
REMOVE TRAFFIC STRIPE AND PAVEMENT MARKING....175
REMOVE DRAINAGE FACILITY....175
REMOVE ROADSIDE SIGN....175
ADJUST INLET....175
COLD PLANE ASPHALT CONCRETE PAVEMENT....175
CAP INLET AND MANHOLE....177
BRIDGE REMOVAL....177
10-1.47 CLEARING AND GRUBBING....178
10-1.48 WATERING....178
10-1.49 EARTHWORK....178
SOLDIER PILE WALL EARTHWORK....180
TIEBACK WALL EARTHWORK....181
10-1.50 ROCK EXCAVATION (CONTROLLED BLASTING)....182
10-1.51 STRUCTURE BACKFILL (LIGHTWEIGHT AGGREGATE)....186
10-1.52 TUNNEL EXCAVATION MONITORING....187
WORKING DRAWINGS....187
DOCUMENTATION....187
REPORT SUBMITTALS....188
MONITORING DATA....188
INCLINOMETER CASING....188
REFLECTIVE MONITORING TARGETS....189
MAXIMUM ALLOWABLE MOVEMENT....189
PAYMENT....189
10-1.53 CONTROLLED LOW STRENGTH MATERIAL....189
10-1.54 MATERIAL CONTAINING NATURALLY OCCURRING ASBESTOS....190
10-1.55 IMPORTED BORROW (LIGHTWEIGHT AGGREGATE)....192
10-1.56 LIGHTWEIGHT FILL (EPS BLOCK)....194
10-1.57 GEOMEMBRANE (GASOLINE RESISTANT)....195
INSTALLATION....196
MEASUREMENT....196
PAYMENT....196
10-1.58 EROSION CONTROL (SEQUENCING)....197
10-1.59 ROLLED EROSION CONTROL PRODUCT (NETTING)....197
10-1.60 MOVE-IN/MOVE-OUT (EROSION CONTROL)....198
10-1.61 EROSION CONTROL (HYDROSEED)....199
10-1.62 EROSION CONTROL (COMPOST BLANKET)....201
10-1.63 FIBER ROLLS....203
GENERAL....203
10-1.64 IRRIGATION CROSSOVERS....204
10-1.65 IMPORTED TOPSOIL....204
10-1.66 CLASS 3 AGGREGATE SUBBASE....205
10-1.67 CLASS 4 AGGREGATE SUBBASE....205
10-1.68 AGGREGATE BASE....206
10-1.69 LEAN CONCRETE BASE....206
10-1.70 TREATED PERMEABLE BASE....207
10-1.71 HOT MIX ASPHALT....207
10-1.72 MINOR HOT MIX ASPHALT....209
10-1.73 HOT MIX ASPHALT AGGREGATE LIME TREATMENT - SLURRY METHOD....210

10-1.74 HOT MIX ASPHALT AGGREGATE LIME TREATMENT - DRY LIME METHOD....212
10-1.75 LIQUID ANTISTRIP TREATMENT....215
10-1.76 CONTINUOUSLY REINFORCED CONCRETE PAVEMENT....217
10-1.77 CONCRETE PAVEMENT JUST-IN-TIME-TRAINING....221
10-1.78 GRIND EXISTING CONCRETE PAVEMENT....222
10-1.79 DISPOSAL OF PORTLAND CEMENT CONCRETE (PCC) PAVEMENT GROOVING AND GRINDING RESIDUES....222
10-1.80 PILING....224
CAST-IN-DRILLED-HOLE CONCRETE PILES....224
STEEL PIPE PILING....236
STEEL SOLDIER PILING....238
10-1.81 DRILLED HOLES....239
10-1.82 TIEBACK ANCHORS....240
MATERIALS....240
CONSTRUCTION....241
MEASUREMENT AND PAYMENT....244
10-1.83 CONCRETE STRUCTURES....244
SWELLING RUBBER WATERSTOP....244
FALSEWORK....245
MEASUREMENT AND PAYMENT....246
10-1.84 DRILL AND BOND DOWELS....246
10-1.85 SEALING JOINTS....247
10-1.86 ARCHITECTURAL SURFACE (TEXTURED CONCRETE)....247
TEST PANEL....247
FORM LINERS....247
RELEASING FORM LINERS....248
CURING....248
MEASUREMENT AND PAYMENT....248
10-1.87 REINFORCEMENT....248
MEASUREMENT AND PAYMENT....248
10-1.88 SHOTCRETE....248
10-1.89 TUNNEL WATERPROOFING SYSTEM....250
WORKING DRAWINGS....250
PRE-INSTALLATION MEETING....251
MATERIALS....251
MOCK-UP TESTS....253
MANUFACTURER REPRESENTATIVE....253
SURFACE PREPARATION....253
APPLICATION....253
WATER TEST....254
JOB COMPLETION....254
MEASUREMENT AND PAYMENT....254
10-1.90 WATERPROOFING....254
10-1.91 STEEL STRUCTURES....255
GENERAL....256
WORKING DRAWINGS....256
MATERIALS....256
ROTATIONAL CAPACITY TESTING PRIOR TO SHIPMENT TO JOB SITE....256
INSTALLATION TENSION TESTING AND ROTATIONAL CAPACITY TESTING AFTER ARRIVAL ON THE JOB SITE....260
SURFACE PREPARATION....260
SEALING....260
WELDING....261
STRUTS PRE-LOADING AND STRUCTURAL STEEL COMPONENTS REMOVAL....261
MEASUREMENT AND PAYMENT....261
10-1.92 SIGN STRUCTURE FOUNDATION....261
10-1.93 ROADSIDE SIGNS....262
10-1.94 FURNISH SIGN....262

SHEET ALUMINUM 264
RETROREFLECTIVE SHEETING 264
PROCESS COLOR AND FILM 264
SINGLE SHEET ALUMINUM SIGN 264
MEASUREMENT AND PAYMENT 265
10-1.95 TIMBER LAGGING 265
10-1.96 PREPARE AND PAINT CALIFORNIA ST-10 BRIDGE RAIL 265
10-1.97 ANTI-GRAFFITI COATING 267
10-1.98 ALTERNATIVE PIPE 268
10-1.99 PLASTIC PIPE 268
10-1.100 REINFORCED CONCRETE PIPE 268
10-1.101 CORRUGATED METAL PIPE 269
10-1.102 SPIRAL RIB PIPE 269
10-1.103 UNDERDRAIN 270
10-1.104 OVERSIDE DRAIN 270
10-1.105 SLOPE PROTECTION 270
10-1.106 MISCELLANEOUS CONCRETE CONSTRUCTION 270
10-1.107 MISCELLANEOUS IRON AND STEEL 271
FALL PROTECTION DEVICE 271
10-1.108 MISCELLANEOUS METAL (TUNNEL) 271
10-1.109 BRIDGE DECK DRAINAGE SYSTEM 272
10-1.110 ARCHITECTURAL FENCE 273
10-1.111 METAL BEAM GUARD RAILING 273
ALTERNATIVE IN-LINE TERMINAL SYSTEM 273
10-1.112 METAL RAILING 274
10-1.113 CALIFORNIA ST-10 BRIDGE RAIL 274
10-1.114 CONCRETE BARRIER (TYPE K) 275
10-1.115 TRANSITION RAILING (TYPE WB) 275
10-1.116 THERMOPLASTIC TRAFFIC STRIPE AND PAVEMENT MARKING 276
10-1.117 PAINT TRAFFIC STRIPE AND PAVEMENT MARKING 276
10-1.118 PAVEMENT MARKERS 276
SECTION 10-2. (BLANK) 277
SECTION 10-3. ELECTRICAL SYSTEMS 277
10-3.01 DESCRIPTION 277
10-3.02 COST BREAK-DOWN 277
10-3.03 EQUIPMENT LIST, DRAWINGS, AND REPORTS 278
10-3.04 MAINTAINING EXISTING TRAFFIC MANAGEMENT SYSTEM ELEMENTS DURING CONSTRUCTION 278
10-3.05 CAST-IN-DRILLED-HOLE CONCRETE PILE FOUNDATIONS 280
10-3.06 STANDARDS, STEEL PEDESTALS, AND POSTS 280
10-3.07 CONDUIT 280
10-3.08 PULL BOXES 281
10-3.09 CABLES, CONDUCTORS AND WIRING 281
10-3.10 SERVICE 281
10-3.11 NUMBERING ELECTRICAL EQUIPMENT 281
10-3.12 MODEL 334 CONTROLLER CABINETS 281
10-3.13 STATE-FURNISHED CONTROLLER ASSEMBLIES 282
10-3.14 PROGRAMMED VISIBILITY VEHICLE TRAFFIC SIGNAL HEADS 282
10-3.15 DETECTORS 282
10-3.16 LUMINAIRES 282
10-3.17 CAMERA STATION 282
GENERAL 282
INSTALLATION OF CAMERA STATION 283
CAMERA STATION TESTING 283
10-3.18 CAMERA CONTROL UNIT 284
10-3.19 HYBRID CAMERA CABLE AND CONNECTORS 286
INSPECTION AND TESTING 287
10-3.20 INTEGRATED CAMERA UNIT 288

GENERAL 288
CAMERA 288
PHYSICAL AND MECHANICAL REQUIREMENTS 290
POWER REQUIREMENTS 290
ENVIRONMENTAL REQUIREMENTS 290
CAMERA PIGTAIL AND CONNECTOR 290
10-3.210 INTERFACE CABLES 291
GENERAL 291
NETWORK STRAIGHT THROUGH DATA CABLE 291
VIDEO PATCH CABLE 291
10-3.22 VIDEO ENCODER UNIT 292
GENERAL 292
ABBREVIATIONS 292
PHYSICAL AND MECHANICAL REQUIREMENTS 292
ELECTRICAL REQUIREMENTS 292
POWER REQUIREMENTS 293
ENVIRONMENTAL REQUIREMENTS 293
10-3.23 EQUIPMENT SHELF WITH BRACKETS 293
10-3.24 RACK-MOUNT POWER STRIP 294
ELECTRICAL 294
MECHANICAL 294
10-3.25 GENERAL PACKET RADIO SYSTEM WIRELESS MODEM ASSEMBLY 294
10-3.26 SERVICE MANUAL REQUIREMENTS 297
GENERAL INFORMATION SECTION 297
THEORY OF OPERATIONS SECTION 297
MANINTENANCE SECTION 297
REPLACEMENT PARTS SECTION 297
DIAGRAM SECTION 298
PHYSICAL REQUIREMENTS 298
10-3.27 TRAFFIC OPERATIONS SYSTEM EQUIPMENT TESTING 298
10-3.28 VARIABLE MESSAGE SIGN SYSTEM 299
10-3.29 VARIABLE MESSAGE SIGN CONTROL CABLE 299
10-3.30 REMOVING, REINSTALLING OR SALVAGING ELECTRICAL EQUIPMENT 299
10-3.31 PAYMENT 299
10-3.32 BATERY SUBSTATION AND TUNNEL WORK 300
ABBREVATIONS 300
BASIC MATERIALS AND METHODS 305
ELECTRICAL EQUIPMENT 314
DC UPS 321
INDUSTRIAL DC TO DC CONVERTER 321
POWER SUPPLY 322
RACK-MOUNTED DC TO DC CONVERTER 322
RACK-MOUNTED INVERTER 325
REDUNDANT POWER SUPPLY CONTROLLER 327
10-3.33 FIBER OPTIC CABLE AND EQUIPMENT 328
10-3.34 FIRE ALARMS 332
ADDRESSABLE RELAY OUTPUT DEVICE 332
ADDRESSABLE CONTACT INPUT DEVICE 333
FIRE ALARM CABLE 334
FIRE ALARM POWER SUPPLY 334
FIRE ALARM SIREN 335
FIRE CONTROL DISPLAY STATION 335
ADDRESSABLE PULL STATION 336
FIRE PULL STATION 336
LINEAR HEAT DETECTOR 337
TUNNEL FIRE ALARM CONTROL PANEL 339
SUBSTATION FIRE ALARM CONTROL PANEL 343
SUBSTATION SMOKE DETECTOR 344

ANNUNCIATOR DRIVER 344
FIBER OPTIC MODEM 345
REMOTE DISPLAY AND CONTROL MODULE 346
SELF-HEALING MULTI-DROP FIBER OPTIC MODEM 347
ADDITIONAL EQUIPMENT 348
REMOTE RELEASE MODULE 348
10-3.35 SCADA EQUIPMENT 349
SCADA CONTROL AND INDICATION RELAYS 349
FIELD CONTROL STATION 350
SCADA SUBMASTER SERVER 353
SOLATING SIGNAL CONVERTER 355
SIGNAL CONVERTER 356
PROGRAMMABLE AUTOMATION CONTROLLER 357
REDUNDANT POWER SUPPLY CONTROLLER 374
REMOTE DISPLAY AND CONTROL MODULE 375
REMOTE RELEASE MODULE 376
DOOR ALARM 377
10-3.36 CARBON MONOXIDE MONITORING 377
CARBON MONOXIDE CALIBRATION SERVER 377
CARBON MONOXIDE MONITOR 380
CO MONITOR CALIBRATOR 381
CO MONITOR CONTROLLER 382
10-3.37 SECONDARY UNIT SUBSTATION 383
PRIMARY EQUIPMENT 385
TRANSFORMER 390
SECONDARY EQUIPMENT 392
10-3.38 RELAYS 402
PROTECTIVE RELAY 402
BACKUP PROTECTIVE RELAY 407
LINE CURRENT DIFFERENTIAL PROTECTIVE RELAY 411
POWER CONTROL RELAYS 416
SCADA CONTROL AND INDICATION RELAYS 417
TRANSFER RELAYS 417
10-3.39 POWER DISTRIBUTION EQUIPMENT 418
3 PHASE POWER SUPPLY AND BATTERY CHARGER 418
INDICATORS 420
CURRENT LIMIT 420
CONSTRUCTION 420
REMOTE SENSING 422
12-20 kVA MODULAR UPS SYSTEM 424
MEDIUM VOLTAGE POWER CABLE 432
INSULATION 433
PRODUCTION TESTING 433
FEEDER CIRCUIT BREAKER 433
MOTOR CONTROL CENTER 435
SOFT START CONTROLLER 441
POWER SUPPLY AND BATTERY CHARGER 443
INVERTER 449
SWITCHBOARD 455
SUBSTATION BUILDING TRANSFOMER 458
10-3.40 NETWORK COMMUNICATION SYSTEM 459
ETHERNET ROUTER 462
ETHERNET SWITCH 464
INDUSTRIAL ROUTER 467
RACK-MOUNTED ETHERNET SWITCH 469
TELEPHONE EXTENDER 471
T1 FIBER OPTIC MULTIPLEXER 472
FIXED WIRELESS TERMINAL 473

T1 FIBER OPTIC MULTIPLEXER 474
10-3.41 MISCELANEOUS 475
RADIO ANTENNA POLE 475
RS-232 CABLE 475
RS-485 CABLE 476
RS-232 TO RS-485 CONVERTER 476
RS-485 ISOLATOR 477
SUBSTATION LIGHTING 477
10-3.42 RADIO REBROADCAST SYSTEM 479
AM AND FM RADIO REBROADCAST SYSTEM 479
AM/FM RADIO REBROADCAST WITH OVERRIDE SYSTEM 481
MULTI-CHANNEL 800 MHz DIGITAL BI-DIRECTIONAL SIGNAL BOOSTER 481
TUNNEL ANTENNA SYSTEM 484
10-3.43 TUNNEL TRAFFIC OPERATIONS SYSTEM 487
CALLBOX SIGN ASSEMBLIES 487
MAINTENANCE CAMERA UNIT 488
OTHER SPECIFICATIONS OR STANDARDS 488
10-3.44 TUNNEL LIGHTING 492
LIGHTING CONTROLLER 492
LIGHTING CONTACTOR 493
PANELBOARDS 493
WALL MOUNTED LUMINAIRES 493
LIGHTING CONTROL EQUIPMENT 496
PROGRAMMABLE LOGIC CONTROLLER SYSTEM 498
SCADA TUNNEL LIGHTING SYSTEM 500
TUNNEL LIGHTING UNINTERRUPTIBLE POWER SUPPLY 502
10-3.45 GROUNDING, CONDUITS EMBEDDED IN STRUCTURES 507
CONDUCTIVE CEMENT 508
GROUND CLAMP 508
GROUND WELL 509
GROUNDING BAR 511
GROUNDING ELECTRODE 512
GROUNDING ELECTRODE SYSTEM TESTING 512
SECTION 10-5. TUNNEL MECHANICAL 513
10-5.01 MECHANICAL MATERIALS AND METHODS 513
GENERAL 513
SUBMITTALS 513
QUALITY ASSURANCE 515
PRODUCTS 515
INSTALLATION 520
DEMONSTRATION AND TRAINING 520
PAYMENT 521
10-5.02 MECHANICAL IDENTIFICATION 521
GENERAL 521
SUBMITTALS 521
QUALITY ASSURANCE 521
PRODUCTS 521
INSTALLATION 524
PAYMENT 524
10-5.03 FIRE EXTINGUISHERS 524
GENERAL 524
REFERENCES 524
SUBMITTALS 524
QUALITY ASSURANCE 524
MANUFACTURER'S 524
COMPONENTS 524
INSTALLATION 524
IDENTIFICATION 524

SERVICING....524
PAYMENT....525
10-5.04 HANGERS AND SUPPORTS....525
GENERAL....525
SUBMITTALS....525
QUALITY ASSURANCE....525
PRODUCTS....525
INSTALLATION....527
PAINTING....528
PAYMENT....528
10-5.05 MECHANICAL VIBRATION CONTROLS AND SEISMIC RESTRAINTS....528
GENERAL....528
SUBMITTALS....529
QUALITY ASSURANCE....529
PRODUCTS....529
INSTALLATION....530
PAYMENT....530
10-5.06 TUNNEL FIRE PROTECTION SYSTEM....531
GENERAL....531
SUBMITTALS....531
QUALITY ASSURANCE....531
PRODUCTS....532
INSTALLATION....534
TESTING AND DISINFECTING....535
PAYMENT....535
10-5.07 ROADWAY DRAINAGE SYSTEM....535
GENERAL....535
SUMMARY....535
SUBMITTALS....535
PRODUCTS....536
INSTALLATION....536
PAYMENT....537
SECTION 11. (BLANK)....537
SECTION 12. SUBSTATION BUILDING WORK....537
SECTION 12-1. GENERAL REQUIREMENTS....537
12-1.01 SCOPE....537
12-1.02 ABBREVIATIONS....537
12-1.03 COOPERATION....538
12-1.04 SUBMITTALS....538
12-1.05 SCHEDULE OF VALUES....539
12-1.06 INSPECTION....540
12-1.07 UTILITY CONNECTION....540
12-1.08 SANITARY FACILITIES....540
12-1.09 MEASUREMENT AND PAYMENT....540
12-1.10 PROJECT RECORD DRAWINGS....540
SECTION 12-2. SITEWORK....541
12-2.01 ROUGH GRADING....541
SUMMARY....541
EXCAVATION....541
FILL....542
COMPACTION....542
FIELD QUALITY CONTROL....542
12-2.02 EARTHWORK FOR BUILDING WORK....542
SUMMARY....542
QUALITY ASSURANCE....543
SITE CONDITIONS....543
BACKFILL MATERIALS....543
PREPARATION AND RESTORATION....544

STRUCTURE EXCAVATION....544
STRUCTURE BACKFILLING....545
COMPACTION....545
DISPOSAL....546
FIELD QUALITY CONTROL....546
12-2.03 AGGREGATE BASE....546
SUMMARY....546
SPREADING AND COMPACTING....547
12-2.04 FREE DRAINING GRANULAR MATERIAL....547
SUMMARY....547
SPREADING AND CONSOLIDATING....547
SECTION 12-3. CONCRETE AND REINFORCEMENT....548
12-3.01 CAST-IN-PLACE CONCRETE....548
SUMMARY....548
SUBMITTALS....548
QUALITY ASSURANCE....548
CONCRETE MIXES....548
CONCRETE MATERIALS....548
FORM MATERIALS....549
REINFORCING MATERIALS....549
EPOXY....549
RELATED MATERIALS....550
ADMIXTURES....551
BAR REINFORCING STEEL....551
MIXING AND TRANSPORTING CONCRETE....552
PREPARATION....552
PLACING CONCRETE....553
FINISHING CONCRETE SURFACES....554
CURING CONCRETE....554
PROTECTING CONCRETE....555
SPECIAL TREATMENTS....555
12-3.02 DRILL AND BOND DOWELS....555
SUMMARY....555
SECTION 12-4. (BLANK)....556
SECTION 12-5. (BLANK)....556
SECTION 12-6. (BLANK)....556
SECTION 12-7. THERMAL AND MOISTURE PROTECTION....556
12-7.01 BITUMINOUS WATERPROOFING....556
SUMMARY....556
SUBMITTALS....557
QUALITY ASSURANCE....557
PREPARATION....557
INSTALLATION....557
12-7.02 WATER REPELLENT COATING....558
SUMMARY....558
SUBMITTALS....558
QUALITY ASSURANCE....558
12-7.03 THROUGH-PENETRATION FIRESTOPPING....559
12-7.04 JOINT SEALANT....560
SUMMARY....560
SUBMITTALS....560
PREPARATION....560
INSTALLATION....561
12-7.05 SEALANTS AND CAULKING....561
SUMMARY....561
QUALITY ASSURANCE....561
SUBMITTALS....561
MATERIALS....562

APPLICATION 562
SECTION 12-8. DOORS AND WINDOWS 562
12-8.01 HINGED DOORS 562
SUBMITTALS 562
INSTALLATION 563
12-8.02 FINISH HARDWARE 563
SUMMARY 563
SUBMITTALS 564
FINISHES 564
KEYING INSTRUCTIONS 564
GENERAL 564
INSTALLATION 567
DOOR HARDWARE GROUPS AND SCHEDULE 567
GROUP 1 567
GROUP 2 568
GROUP 3 568
SECTION 12-9. FINISHES 568
12-9.01 PAINTING 568
SECTION 12-10. SPECIALTIES 572
12-10.01 LOUVERS 572
SUBMITTALS 572
INSTALLATION 573
PAINTING 573
12-10.02 SIGNS 573
SUMMARY 573
SUBMITTALS 573
QUALITY ASSURANCE 573
INSTALLATION 574
12-10.03 FIRE EXTINGUISHERS AND CABINETS 574
SUMMARY 574
REFERENCES 574
SUBMITTALS 574
QUALITY ASSURANCE 574
MANUFACTURER'S 575
COMPONENTS 575
INSTALLATION 575
IDENTIFICATION 575
SERVICING 575
SECTION 12-11. (BLANK) 575
SECTION 12-12. (BLANK) 575
SECTION 12-13. (BLANK) 575
SECTION 12-14. (BLANK) 575
SECTION 12-15. MECHANICAL 575
12-15.01 MECHANICAL WORK 575
12-15.02 HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT AND SYSTEMS 577
AMENDMENTS TO THE STANDARD SPECIFICATIONS 581

STANDARD PLANS LIST

The Standard Plan sheets applicable to this contract include, but are not limited to, those indicated below. Applicable Revised Standard Plans (RSP) and New Standard Plans (NSP) indicated below are included in the project plans as Standard Plan sheets.

STANDARD OUTPUTS	High-Speed Outputs
A10A	Acronyms and Abbreviations (Sheet 1 of 2)
A10B	Acronyms and Abbreviations (Sheet 2 of 2)
A10C	Symbols (Sheet 1 of 2)
A10D	Symbols (Sheet 2 of 2)
A20A	Pavement Markers and Traffic Lines, Typical Details
A20B	Pavement Markers and Traffic Lines, Typical Details
A20C	Pavement Markers and Traffic Lines, Typical Details
A20D	Pavement Markers and Traffic Lines, Typical Details
A24A	Pavement Markings – Arrows
A24B	Pavement Markings – Arrows
RSP A24C	Pavement Markings – Symbols and Numerals
A24D	Pavement Markings – Words
A24E	Pavement Markings – Words and Crosswalks
A62A	Excavation and Backfill – Miscellaneous Details
A62B	Limits of Payment for Excavation and Backfill – Bridge Surcharge and Wall
A62C	Limits of Payment for Excavation and Backfill – Bridge
A62D	Excavation and Backfill – Concrete Pipe Culverts
RSP A62DA	Excavation and Backfill – Concrete Pipe Culverts
A62F	Excavation and Backfill – Metal and Plastic Culverts
A73A	Object Markers
A73B	Markers
A73C	Delineators, Channelizers and Barricades
RSP A77J4	Metal Beam Guard Railing – Transition Railing (Type WB)
A77L2	Metal Beam Railing – Terminal System (Type SKT)
A77L3	Metal Beam Railing – Terminal System (Type ET)
A82A1	Crash Cushion (Type CAT)
RSP A85	Chain Link Fence
NSP A85A	Chain Link Fence Details
NSP A85B	Chain Link Fence Details
RSP A87A	Curbs and Driveways
A87B	Asphalt Concrete Dikes
RSP A88A	Curb Ramp Details
RNSP P4	Continuously Reinforced Concrete Pavement
NSP P13	Continuously Reinforced Concrete Pavement – Single Piece Transverse Bar Assembly
NSP P31A	Continuously Reinforced Concrete Pavement – Terminal Joint Details
NSP P31B	Continuously Reinforced Concrete Pavement – Expansion Joint and Anchor Details
D73	Drainage Inlets
RSP D74B	Drainage Inlets
D74C	Drainage Inlets Details
RSP D77A	Grate Details
D77B	Bicycle Proof Grate Details
D78A	Gutter Depressions
D87A	Corrugated Metal Pipe Downdrain Details
D87B	Plastic Pipe Downdrain Details
D87C	Cable Anchorage System
D87D	Overside Drains

D88	Construction Loads on Culverts
D88A	Strut Details for Structural Steel Pipes, Arches and Vehicular Undercrossing
D97A	Corrugated Metal Pipe Coupling Details No. 1 – Annular Coupling Band Bar and Strap and Angle Connections
D97C	Corrugated Metal Pipe Coupling Details No. 3 – Helical and Universal Couplers
RSP D97D	Corrugated Metal Pipe Coupling Details No. 4 – Hugger Coupling Bands
RSP D97E	Corrugated Metal Pipe Coupling Details No. 5 – Standard Joint
RSP D97F	Corrugated Metal Pipe Coupling Details No. 6 – Positive Joint
RSP D97G	Corrugated Metal Pipe Coupling Details No. 7 – Downdrain
D97H	Reinforced Concrete Pipe or Non-Reinforced Concrete Pipe – Standard and Positive Joints
NSP D97I	Corrugated Polyvinyl Chloride Pipe with Smooth Interior – Standard and Positive Joints
NSP D97J	Composite Steel Spiral Rib Pipe with Smooth Interior – Standard Joint
D99A	Structural Section Drainage System Details
D99B	Edge Drain Outlet and Vent Details
D99C	Edge Drain Cleanout and Vent Details
D99D	Cross Drain Interceptor Details
RSP H2	Planting and Irrigation – Symbols
H9	Planting and Irrigation Details
RNSP H51	Erosion Control Details (Fiber Roll)
NSP H52	Erosion Control Details (Compost Sock)
NSP H53	Rolled Erosion Control Product
RSP T1A	Temporary Crash Cushion, Sand Filled (Unidirectional)
RSP T1B	Temporary Crash Cushion, Sand Filled (Bidirectional)
RSP T2	Temporary Crash Cushion, Sand Filled (Shoulder Installations)
T3	Temporary Railing (Type K)
T4	Temporary Traffic Screen
RSP T7	Construction Project Funding Identification Signs
T10	Traffic Control System for Lane Closure On Freeways and Expressways
T10A	Traffic Control System for Lane and Complete Closures on Freeways and Expressways
T13	Traffic Control System for Lane Closure on Two Lane Conventional Highways
T51	Temporary Water Pollution Control Details (Temporary Silt Fence)
T53	Temporary Water Pollution Control Details (Temporary Cover)
T54	Temporary Water Pollution Control Details (Temporary Erosion Control Blanket)
T55	Temporary Water Pollution Control Details (Temporary Erosion Control Blanket)
RSP T56	Temporary Water Pollution Control Details (Temporary Fiber Roll)
T57	Temporary Water Pollution Control Details (Temporary Check Dam)
T58	Temporary Water Pollution Control Details (Temporary Construction Entrance)
T59	Temporary Water Pollution Control Details (Temporary Concrete Washout Facility)
NSP T60	Temporary Water Pollution Control Details (Temporary Reinforced Silt Fence)
NSP T61	Temporary Water Pollution Control Details (Temporary Drainage Inlet Protection)
NSP T62	Temporary Water Pollution Control Details (Temporary Drainage Inlet Protection)
NSP T63	Temporary Water Pollution Control Details (Temporary Drainage Inlet Protection)
NSP T64	Temporary Water Pollution Control Details (Temporary Drainage Inlet Protection)
NSP T65	Temporary Water Pollution Control Details [Temporary Fence (Type ESA)]
B0-3	Bridge Details
B0-13	Bridge Details
B2-3	16" and 24" Cast-In-Drilled-Hole Concrete Pile
B3-1	Retaining Wall Type 1 – H = 4' through 30'
B3-7	Retaining Wall Type 5
B3-8	Retaining Wall Details No. 1
B3-9	Retaining Wall Details No. 2
RSP B6-21	Joint Seals (Maximum Movement Rating = 2")
B7-6	Deck Drains – Types D-1 and D-2
B7-11	Utility Details
B11-47	Cable Railing

B11-52	Chain Link Railing Type 7
RSP B11-68	California ST-10 Bridge Rail (Sheet 1 of 3)
B11-69	California ST-10 Bridge Rail (Sheet 2 of 3)
B11-70	California ST-10 Bridge Rail (Sheet 3 of 3)
RS1	Roadside Signs, Typical Installation Details No. 1
RS2	Roadside Signs – Wood Post, Typical Installation Details No. 2
RS4	Roadside Signs, Typical Installation Details No. 4
S36	Overhead Signs – Tubular, Single Post and Two Post Type – Square Pedestal Pile Foundation
S89	Roadside Sign – Formed Single Sheet Aluminum Panel
S93	Framing Details for Framed Single Sheet Aluminum Signs, Rectangular Shape
S94	Roadside Framed Single Sheet Aluminum Signs, Rectangular Shape
S95	Roadside Single Sheet Aluminum Signs, Diamond Shape
RSP ES-1A	Electrical Systems (Symbols and Abbreviations)
RSP ES-1B	Electrical Systems (Symbols and Abbreviations)
RSP ES-1C	Electrical Systems (Symbols and Abbreviations)
RSP ES-2C	Electrical Systems (Service Equipment Notes, Type III Series)
RSP ES-2D	Electrical Systems (Service Equipment and Typical Wiring Diagram, Type III – A Series)
ES-3C	Electrical Systems (Controller Cabinet Details)
RSP ES-4D	Electrical Systems (Signal Heads and Mountings)
ES-4E	Electrical Systems (Signal Faces and Mountings)
RSP ES-5A	Electrical Systems (Detectors)
ES-5B	Electrical Systems (Detectors)
ES-5D	Electrical Systems (Detectors)
RSP ES-6A	Electrical Systems (Lighting Standard, Types 15 and 21)
ES-6B	Electrical Systems (Lighting Standard, Types 15 and 21, Barrier Rail Mounted Details)
RSP ES-6E	Electrical Systems (Lighting Standard, Types 30 and 31)
RSP ES-7B	Electrical Systems (Signal and Lighting Standard – Type 1 Standards and Equipment Numbering)
RSP ES-7C	Electrical Systems (Signal and Lighting Standard – Case 1 Arm Loading, Wind Velocity = 100 mph, Arm Lengths 15' to 30')
RSP ES-7D	Electrical Systems (Signal and Lighting Standard – Case 2 Arm Loading, Wind Velocity = 100 mph, Arm Lengths 15' to 30')
RSP ES-7E	Electrical Systems (Signal and Lighting Standard – Case 3 Arm Loading, Wind Velocity = 100 mph, Arm Lengths 15' to 45')
RSP ES-7F	Electrical Systems (Signal and Lighting Standard – Case 4 Arm Loading, Wind Velocity = 100 mph, Arm Lengths 25' to 45')
RSP ES-7K	Electrical Systems (Signal and Lighting Standard - Cantilever Flashing Beacon, Types 9, 9A and 9B)
ES-7M	Electrical Systems (Signal and Lighting Standards – Details No. 1)
ES-7N	Electrical Systems (Signal and Lighting Standards – Details No. 2)
ES-8	Electrical Systems (Pull Box Details)
ES-10	Electrical Systems (Isofootcandle Diagrams)
ES-11	Electri*cal Systems (Foundation Installations)
ES-13A	Electrical Systems (Splicing Details)
ES-13B	Electrical Systems (Wiring Details and Fuse Ratings)
ES-15A	Electrical Systems (Sign Illumination Equipment)
ES-15C	Electrical Systems (Sign Illumination Equipment)
RSP ES-15D	Electrical Systems (Lighting and Sign Illumination Control)
ES-16A	Electrical Systems (Closed Circuit Television, Pole Details)

NOTICE TO BIDDERS

Bids open Wednesday, February 3, 2010

Dated December 28, 2009

General work description: Construct tunnel, retaining walls, roadways, bridge and substation.

The Department will receive sealed bids for CONSTRUCTION ON STATE HIGHWAY IN THE CITY AND COUNTY OF SAN FRANCISCO FROM 1.3 MILE TO 0.3 MILE SOUTH OF THE ROUTE 101/1 SEPARATION.

District-County-Route-Post Mile: 04-SF-101-8.2/9.2

Contract No. 04-163744

The Contractor must have either a Class A license or a combination of Class C licenses which constitutes a majority of the work.

The UDBE Contract goal is 5 percent.

Federal-aid project no.:
SARRA-Q101(153)N
ACNH-Q101(164)N

Bids must be on a unit price basis.

Complete the work within 605 working days.

The estimated cost of the project is $99,000,000.

A mandatory prebid meeting is scheduled for this project at 3:00 pm, on January 6, 2010, at The Golden Gate Club, 135 Fisher Loop, San Francisco, Ca 94129.

The Department will receive bids until 2:00 p.m. on the bid open date at 1120 N Street, Room 0200, MS 26, Sacramento, CA 95814. Bids received after this time will not be accepted.

The Department will open and publicly read the bids at the above location immediately after the specified closing time.

District office addresses are provided in the Standard Specifications.

Bidders' inquiries may be presented to the Department by following the instructions at:

http://www.dot.ca.gov/hq/esc/oe/project_status/bid_inq.html

The Department posts responses to the questions at the District Web sites.

Questions about alleged patent ambiguity of the plans, specifications, or estimate must be asked before bid opening. After bid opening, such questions will not be treated as bid protests.

Submit your bid with bidder's security equal to at least 10 percent of the bid.

Prevailing wages are required on this Contract. The Director of the California Department of Industrial Relations determines the general prevailing wage rates. Obtain the wage rates at the DIR Web site, http://www.dir.ca.gov, or from the Department's Labor Compliance Office of the district in which the work is located.

The federal minimum wage rates for this Contract as determined by the United States Secretary of Labor are available at http://www.dot.ca.gov/hq/esc/oe/federal-wages.

If the minimum wage rates as determined by the United States Secretary of Labor differs from the general prevailing wage rates determined by the Director of the California Department of Industrial Relations for similar classifications of labor, the Contractor and subcontractors must not pay less than the higher wage rate. The Department does not accept lower State wage rates not specifically included in the Federal minimum wage determinations. This includes helper, or other classifications based on hours of experience, or any other classification not appearing in the Federal wage determinations. Where Federal wage determinations do not contain the State wage rate determination otherwise available for use by the Contractor and subcontractors, the Contractor and subcontractors must not pay less than the Federal minimum wage rate that most closely approximates the duties of the employees in question.

DEPARTMENT OF TRANSPORTATION

KEB

COPY OF BID ITEM LIST

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
1	070012	PROGRESS SCHEDULE (CRITICAL PATH METHOD)	LS	LUMP SUM
2	070013	SMALL BUSINESS UTILIZATION REPORT	EA	9
3	070018	TIME-RELATED OVERHEAD	WDAY	605
4	071321	TEMPORARY FENCE (TYPE CL-6)	LF	20,400
5	017884	TEMPORARY FENCE (TYPE CL-6, SLATTED)	LF	16,800
6	071324	TEMPORARY REINFORCED SILT FENCE	LF	750
7	071325	TEMPORARY FENCE (TYPE ESA)	LF	3,660
8	074016	CONSTRUCTION SITE MANAGEMENT	LS	LUMP SUM
9	074019	PREPARE STORM WATER POLLUTION PREVENTION PLAN	LS	LUMP SUM
10	017885	TEMPORARY TIRE WASH SYSTEM	LS	LUMP SUM
11	017886	TEMPORARY STORM WATER RUN-ON BYPASS AND EXCAVATION DEWATERING	LS	LUMP SUM
12	074027	TEMPORARY EROSION CONTROL BLANKET	SQYD	12,400
13	074028	TEMPORARY FIBER ROLL	LF	1,300
14	074029	TEMPORARY SILT FENCE	LF	500
15	074031	TEMPORARY GRAVEL BAG BERM	LF	7,200
16	074033	TEMPORARY CONSTRUCTION ENTRANCE	EA	3
17	074034	TEMPORARY COVER	SQYD	4,750
18	074035	TEMPORARY CHECK DAM	LF	250
19	074037	MOVE-IN/MOVE-OUT (TEMPORARY EROSION CONTROL)	EA	9
20	074038	TEMPORARY DRAINAGE INLET PROTECTION	EA	27

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
21	074040	TEMPORARY HYDRAULIC MULCH (BONDED FIBER MATRIX)	SQYD	23,800
22	074041	STREET SWEEPING	LS	LUMP SUM
23	074042	TEMPORARY CONCRETE WASHOUT (PORTABLE)	LS	LUMP SUM
24	017887	CONFINEMENT SYSTEM	SQYD	460
25	017888	SURVEY OF EXISTING NON-HIGHWAY FACILITIES	LS	LUMP SUM
26	017889	VIBRATION MONITORING	LS	LUMP SUM
27	120090	CONSTRUCTION AREA SIGNS	LS	LUMP SUM
28	120100	TRAFFIC CONTROL SYSTEM	LS	LUMP SUM
29	017890	TRAFFIC MANAGEMENT PLAN	LS	LUMP SUM
30	017891	TEMPORARY ACCESS PLAN	LS	LUMP SUM
31	120120	TYPE III BARRICADE	EA	220
32	017892	TEMPORARY CHAIN LINK GATE	EA	9
33	128650	PORTABLE CHANGEABLE MESSAGE SIGN	LS	LUMP SUM
34	129000	TEMPORARY RAILING (TYPE K)	LF	2,650
35	129150	TEMPORARY TRAFFIC SCREEN	LF	2,320
36	017893	SOUND CONTROL AND MONITORING	LS	LUMP SUM
37	141101	REMOVE YELLOW PAINTED TRAFFIC STRIPE (HAZARDOUS WASTE)	LF	1,100
38	150206	ABANDON CULVERT	LF	550
39	150221	ABANDON INLET	EA	10
40	150224	ABANDON MANHOLE	EA	3

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
41	150605	REMOVE FENCE	LF	5,770
42	150655	REMOVE BARRIER	LF	3,800
43	150711	REMOVE PAINTED TRAFFIC STRIPE	LF	4,450
44	150714	REMOVE THERMOPLASTIC TRAFFIC STRIPE	LF	9,990
45	150715	REMOVE THERMOPLASTIC PAVEMENT MARKING	SQFT	1,460
46	150722	REMOVE PAVEMENT MARKER	EA	1,500
47	150742	REMOVE ROADSIDE SIGN	EA	53
48	150760	REMOVE SIGN STRUCTURE	EA	2
49	150805	REMOVE CULVERT	LF	840
50	150820	REMOVE INLET	EA	3
51	150826	REMOVE MANHOLE	EA	1
52	150830	REMOVE RETAINING WALL (PORTION)	LF	820
53	152430	ADJUST INLET	LF	4.8
54	152440	ADJUST MANHOLE TO GRADE	EA	6
55	152609	MODIFY INLET TO MANHOLE	EA	2
56	017894	MODIFY MANHOLE TO INLET	EA	1
57	153103	COLD PLANE ASPHALT CONCRETE PAVEMENT	SQYD	2,130
58	155003	CAP INLET	EA	16
59	155007	CAP MANHOLE	EA	2
60	156585	REMOVE CRASH CUSHION	EA	2

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
61	042338	BRIDGE REMOVAL (STAGE 1)	LS	LUMP SUM
62	042339	BRIDGE REMOVAL (STAGE 2)	LS	LUMP SUM
63	160101	CLEARING AND GRUBBING	LS	LUMP SUM
64	190101	ROADWAY EXCAVATION	CY	44,500
65	190110	LEAD COMPLIANCE PLAN	LS	LUMP SUM
66	190115	ASBESTOS COMPLIANCE PLAN (NATURALLY OCCURING ASBESTOS)	LS	LUMP SUM
67	190116	DUST CONTROL PLAN (NATURALLY OCCURRING ASBESTOS)	LS	LUMP SUM
68	042340	STRUCTURE EXCAVATION (TUNNEL)	CY	65,000
69 (F)	192003	STRUCTURE EXCAVATION (BRIDGE)	CY	1,465
70	042341	STRUCTURE EXCAVATION (SERPENTINE)	CY	6,300
71	192035	STRUCTURE EXCAVATION (ROCK)	CY	21,590
72 (F)	192037	STRUCTURE EXCAVATION (RETAINING WALL)	CY	4,698
73	192049	STRUCTURE EXCAVATION (SOLDIER PILE WALL)	CY	4,050
74 (F)	192050	STRUCTURE EXCAVATION (TIEBACK WALL)	CY	2,180
75 (F)	193003	STRUCTURE BACKFILL (BRIDGE)	CY	590
76 (F)	193039	STRUCTURE BACKFILL (TUNNEL)	CY	215
77 (F)	193006	STRUCTURE BACKFILL (SLURRY CEMENT)	CY	985
78 (F)	042342	STRUCTURE BACKFILL (LIGHTWEIGHT AGGREGATE)	CY	5,700
79 (F)	193013	STRUCTURE BACKFILL (RETAINING WALL)	CY	2,784
80 (F)	193026	STRUCTURE BACKFILL (TIEBACK WALL)	CY	580

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
81 (F)	193029	STRUCTURE BACKFILL (SOLDIER PILE WALL)	CY	150
82	193114	SAND BACKFILL	CY	34
83 (F)	193118	CONCRETE BACKFILL	CY	2,570
84 (F)	193119	LEAN CONCRETE BACKFILL	CY	2,130
85	194001	DITCH EXCAVATION	CY	400
86	042343	TUNNEL EXCAVATION MONITORING	LS	LUMP SUM
87	198001	IMPORTED BORROW	CY	31,400
88	198009	IMPORTED BORROW (LIGHTWEIGHT AGGREGATE)	CY	10,900
89	017895	LIGHTWEIGHT FILL (EXPANDED POLYSTYRENE BLOCKS)	CY	13,200
90	017896	GEOMEMBRANE (GASOLINE RESISTANT)	SQYD	11,000
91	200101	IMPORTED TOPSOIL	CY	630
92	203002	EROSION CONTROL (COMPOST BLANKET)	CY	840
93	203021	FIBER ROLLS	LF	17,000
94	203026	MOVE-IN/MOVE-OUT (EROSION CONTROL)	EA	4
95	203031	EROSION CONTROL (HYDROSEED) (SQFT)	SQFT	270,000
96	203034	ROLLED EROSION CONTROL PRODUCT (NETTING)	SQFT	270,000
97	208304	WATER METER	EA	1
98	208738	8" CORRUGATED HIGH DENSITY POLYETHYLENE PIPE CONDUIT	LF	240
99	250301	CLASS 3 AGGREGATE SUBBASE	CY	20
100	250401	CLASS 4 AGGREGATE SUBBASE	CY	2,630

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
101 (F)	260201	CLASS 2 AGGREGATE BASE	CY	10,680
102	260301	CLASS 3 AGGREGATE BASE	CY	14,200
103 (F)	280000	LEAN CONCRETE BASE	CY	3,910
104	290201	ASPHALT TREATED PERMEABLE BASE	CY	550
105	390131	HOT MIX ASPHALT	TON	19,400
106	391031	PAVING ASPHALT (BINDER-PAVEMENT REINFORCING FABRIC)	TON	3
107	393001	PAVEMENT REINFORCING FABRIC	SQYD	2,200
108	394060	DATA CORE	LS	LUMP SUM
109	397005	TACK COAT	TON	42
110	400050	CONTINUOUSLY REINFORCED CONCRETE PAVEMENT	CY	1,820
111	400063	CONTINUOUSLY REINFORCED CONCRETE PAVEMENT (TERMINAL JOINT, TYPE C)	LF	530
112	400065	CONTINUOUSLY REINFORCED CONCRETE PAVEMENT (TERMINAL JOINT, TYPE E)	LF	60
113	400075	CONTINUOUSLY REINFORCED CONCRETE PAVEMENT (PAVEMENT ANCHOR)	LF	240
114	017897	CONTINUOUSLY REINFORCED CONCRETE PAVEMENT (EXPANSION JOINT)	LF	180
115	401000	CONCRETE PAVEMENT	CY	930
116	420201	GRIND EXISTING CONCRETE PAVEMENT	SQYD	240
117	042344	18" DRILLED HOLE	LF	1,510
118	042345	24" DRILLED HOLE	LF	305
119	042346	30" DRILLED HOLE	LF	25,300
120	042347	STEEL SOLDIER PILE (2 - MC 18 X 42.7)	LF	1,060

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
121	042348	STEEL SOLDIER PILE (W 8 X 48)	LF	1,578
122	042349	STEEL SOLDIER PILE (W 14 X 99)	LF	876
123	042350	STEEL SOLDIER PILE (W 18 X 65)	LF	13,650
124	042351	STEEL SOLDIER PILE (W 18 X 86)	LF	232
125	042352	STEEL SOLDIER PILE (W 18 X 119)	LF	1,465
126	042353	STEEL SOLDIER PILE (W 21 X 201)	LF	10,900
127	490603	24" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	1,922
128	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	8,900
129	500050	TIEBACK ANCHOR	EA	340
130 (F)	510051	STRUCTURAL CONCRETE, BRIDGE FOOTING	CY	115
131 (F)	510053	STRUCTURAL CONCRETE, BRIDGE	CY	380
132 (F)	042354	STRUCTURAL CONCRETE (TUNNEL INVERT SLAB)	CY	12,670
133 (F)	042355	STRUCTURAL CONCRETE (TUNNEL WALL)	CY	3,850
134 (F)	510060	STRUCTURAL CONCRETE, RETAINING WALL	CY	3,855
135 (F)	042356	STRUCTURAL CONCRETE (TUNNEL ROOF SLAB)	CY	7,860
136 (F)	042357	STRUCTURAL CONCRETE (SLAB ON PILE)	CY	46
137	510502	MINOR CONCRETE (MINOR STRUCTURE)	CY	159
138 (F)	511047	ANTI-GRAFFITI COATING	SQFT	124,000
139 (F)	042358	ARCHITECTURAL TEXTURE (FLUTED FIN)	SQFT	25,000
140 (F)	042359	ARCHITECTURAL TEXTURE (LIGHT BOARD FINISH)	SQFT	2,200

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
141	511106	DRILL AND BOND DOWEL	LF	800
142	519081	JOINT SEAL (MR 1/2")	LF	60
143	519091	JOINT SEAL (MR 1 1/2")	LF	137
144	519102	JOINT SEAL (TYPE AL)	LF	3,900
145 (F)	520102	BAR REINFORCING STEEL (BRIDGE)	LB	165,000
146 (F)	520103	BAR REINFORCING STEEL (RETAINING WALL)	LB	826,800
147 (F)	042360	BAR REINFORCING STEEL (SLAB ON PILE)	LB	9,700
148 (F)	520109	BAR REINFORCING STEEL (TUNNEL)	LB	6,330,000
149 (F)	530100	SHOTCRETE	CY	2,100
150 (F)	540101	ASPHALT MEMBRANE WATERPROOFING	SQFT	7,800
151 (F)	042361	WATERPROOFING SYSTEM(TUNNEL INVERT SLAB)	SQFT	75,000
152 (F)	042362	WATERPROOFING SYSTEM (TUNNEL WALL)	SQFT	63,000
153 (F)	042363	WATERPROOFING SYSTEM (TUNNEL ROOF SLAB)	SQFT	65,000
154 (F)	042364	STRUCTURAL STEEL (RETAINING WALL)	LB	2,230,000
155	560248	FURNISH SINGLE SHEET ALUMINUM SIGN (0.063"-UNFRAMED)	SQFT	110
156	560249	FURNISH SINGLE SHEET ALUMINUM SIGN (0.080"-UNFRAMED)	SQFT	110
157	560251	FURNISH SINGLE SHEET ALUMINUM SIGN (0.063"-FRAMED)	SQFT	75
158	560252	FURNISH SINGLE SHEET ALUMINUM SIGN (0.080"-FRAMED)	SQFT	50
159	561016	60" CAST-IN-DRILLED-HOLE CONCRETE PILE (SIGN FOUNDATION)	LF	33
160	566011	ROADSIDE SIGN - ONE POST	EA	15

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
161	566012	ROADSIDE SIGN - TWO POST	EA	5
162	575004	TIMBER LAGGING	MFBM	200
163	620060	12" ALTERNATIVE PIPE CULVERT	LF	310
164	620100	18" ALTERNATIVE PIPE CULVERT	LF	3,960
165	620140	24" ALTERNATIVE PIPE CULVERT	LF	890
166	620220	36" ALTERNATIVE PIPE CULVERT	LF	96
167	017898	8" PLASTIC PIPE	LF	190
168	680225	3" SLOTTED PLASTIC PIPE	LF	700
169 (F)	042365	4" SLOTTED HDPE PIPE UNDERDRAIN	LF	3,520
170 (F)	042366	4" UNSLOTTED HDPE PIPE UNDERDRAIN	LF	1,310
171	680905	8" PERFORATED PLASTIC PIPE UNDERDRAIN	LF	1,710
172	017899	3" PERFORATED PLASTIC PIPE (EDGE DRAIN)	LF	650
173	681103	3" PLASTIC PIPE (EDGE DRAIN)	LF	10
174 (F)	681132	GEOCOMPOSITE DRAIN	SQFT	132,800
175	681990	FILTER FABRIC	SQYD	83,700
176	690104	8" CORRUGATED STEEL PIPE DOWNDRAIN	LF	200
177	690136	36" CORRUGATED STEEL PIPE DOWNDRAIN (.079" THICK)	LF	32
178	729010	ROCK SLOPE PROTECTION FABRIC	SQYD	5,630
179	731501	MINOR CONCRETE (CURB)	CY	52
180	731502	MINOR CONCRETE (MISCELLANEOUS CONSTRUCTION)	CY	78

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
181 (F)	731517	MINOR CONCRETE (GUTTER)	LF	946
182	731521	MINOR CONCRETE (SIDEWALK)	CY	17
183	731627	MINOR CONCRETE (CURB, SIDEWALK AND CURB RAMP)	CY	360
184 (F)	750001	MISCELLANEOUS IRON AND STEEL	LB	24,932
185 (F)	750505	BRIDGE DECK DRAINAGE SYSTEM	LB	340
186 (F)	042367	MISCELLANEOUS METAL (TUNNEL)	LB	120,700
187 (F)	800302	CHAIN LINK FENCE (TYPE CL-3, VINYL-CLAD)	LF	1,000
188	800360	CHAIN LINK FENCE (TYPE CL-6)	LF	70
189 (F)	800361	CHAIN LINK FENCE (TYPE CL-6, VINYL-CLAD)	LF	290
190 (F)	042368	ARCHITECTURAL FENCE	LF	1,194
191	802560	10' CHAIN LINK GATE (TYPE CL-6)	EA	2
192	833080	CONCRETE BARRIER (TYPE K)	LF	9,100
193	017900	QUICKCHANGE MOVEABLE BARRIER	LS	LUMP SUM
194	839541	TRANSITION RAILING (TYPE WB)	EA	2
195	839584	ALTERNATIVE IN-LINE TERMINAL SYSTEM	EA	2
196 (F)	042369	CALIFORNIA ST-10 BRIDGE RAIL (WALL MOUNTED)(MODIFIED)	LF	2,752
197 (F)	042370	CALIFORNIA ST-10 BRIDGE RAIL (MODIFIED) (TYPE B)	LF	371
198 (F)	042371	CALIFORNIA ST-10 BRIDGE RAIL (MODIFIED)	LF	985
199 (F)	042372	SAFETY RAILING (TYPE A)	LF	190
200 (F)	042373	SAFETY RAILING (TYPE B)	LF	170

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
201	840504	4" THERMOPLASTIC TRAFFIC STRIPE	LF	4,980
202	840505	6" THERMOPLASTIC TRAFFIC STRIPE	LF	1,100
203	840515	THERMOPLASTIC PAVEMENT MARKING	SQFT	570
204	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	63,500
205	840666	PAINT PAVEMENT MARKING (2-COAT)	SQFT	2,100
206	850111	PAVEMENT MARKER (RETROREFLECTIVE)	EA	1,000
207	860090	MAINTAINING EXISTING TRAFFIC MANAGEMENT SYSTEM ELEMENTS DURING CONSTRUCTION	LS	LUMP SUM
208	860150	SIGNAL AND LIGHTING (TEMPORARY)	LS	LUMP SUM
209	860402	LIGHTING (CITY STREET)	LS	LUMP SUM
210	860407	LIGHTING (PARKING LOT)	LS	LUMP SUM
211	860435	LIGHTING (DETOUR)	LS	LUMP SUM
212	860460	LIGHTING AND SIGN ILLUMINATION	LS	LUMP SUM
213	017901	HIGH VOLTAGE CONDUIT	LS	LUMP SUM
214	017902	MAINTENANCE CAMERA SYSTEM	LS	LUMP SUM
215	017903	TRAFFIC OPERATIONS SYSTEM	LS	LUMP SUM
216	017904	INTEGRATED CAMERA UNIT	EA	2
217	017905	CAMERA CONTROL UNIT	EA	2
218	017906	POWER STRIP	EA	2
219	017907	GENERAL PACKET RADIO SYSTEM (GPRS) WIRELESS MODEM	EA	2
220	017908	BATTERY SUBSTATION AND TUNNEL WORK	LS	LUMP SUM

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity
221	017909	RADIO REBOARDCAST SYSTEM	LS	LUMP SUM
222	017910	TUNNEL TRAFFIC OPERATIONS SYSTEM	LS	LUMP SUM
223	017911	TUNNEL LIGHTING	LS	LUMP SUM
224	017912	GROUNDING, CONDUITS EMBBED IN STRUCTURES	LS	LUMP SUM
225	042374	TUNNEL FIRE PROTECTION SYSTEM	LS	LUMP SUM
226	042375	ROADWAY DRAINAGE SYSTEM	LS	LUMP SUM
227	994650	BUILDING WORK	LS	LUMP SUM
228	999990	MOBILIZATION	LS	LUMP SUM

SPECIAL PROVISIONS

SECTION 1 (BLANK)

SECTION 2 BIDDING

2-1.01 MANDATORY PREBID MEETING

The Department will conduct a mandatory prebid meeting for this contract. The purpose of the meeting is to provide small businesses the opportunity to meet and interact with prospective bidders and increase participation in the performance of contracts.

Prospective bidders must attend the mandatory prebid meeting. The bidder's representative must be a company officer, project superintendent, or project estimator. For a joint venture, one of the parties must attend the mandatory prebid meeting. The Department will not accept bids from bidders who do not attend the mandatory prebid meeting.

A sign-up sheet will be used to identify all prospective bidders including name and title of the company representative attending the mandatory prebid meeting. The Department may hold a single prebid meeting for more than one contract. Make sure you sign the sign-up sheet for the contract you intend to bid on. If bidding multiple contracts, sign each sign-up sheet for each contract you intend to bid on.

The successful bidder will be required to report small businesses hired to work on this contract as a result of the mandatory prebid meeting.

The bidder's attention is directed to "Owner Controlled Insurance Program (OCIP)" of these special provisions for additional bidding requirements.

2-1.02 TIE BID RESOLUTION

After bid verification, if there is a tie between 2 or more bidders, the Department breaks the tie by tossing a coin.

2-1.03 DISADVANTAGED BUSINESS ENTERPRISES

Under 49 CFR 26.13(b):

> The contractor, sub recipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate.

Take necessary and reasonable steps to ensure that DBEs have opportunity to participate in the contract (49 CFR 26).

To ensure there is equal participation of the DBE groups specified in 49 CFR 26.5, the Department specifies a goal for Underutilized Disadvantaged Business Enterprises (UDBEs). UDBE is a firm that meets the definition of DBE and is a member of one of the following groups:

1. Black Americans
2. Native Americans
3. Asian-Pacific Americans
4. Women

References to DBEs include UDBEs, but references to UDBEs do not include all DBEs.

Make work available to UDBEs and select work parts consistent with available UDBE subcontractors and suppliers.

Meet the UDBE goal shown in the Notice to Bidders or demonstrate that you made adequate good faith efforts to meet this goal.

It is your responsibility to verify that the UDBE firm is certified as DBE at date of bid opening. For a list of DBEs certified by the California Unified Certification Program, go to:

http://www.dot.ca.gov/hq/bep/find_certified.htm

Only UDBE participation will count towards the UDBE goal. DBE participation will count towards the Department's federally mandated statewide overall DBE goal.

Credit for materials or supplies you purchase from UDBEs counts towards the goal in the following manner:

1. 100 percent counts if the materials or supplies are obtained from a UDBE manufacturer.
2. 60 percent counts if the materials or supplies are obtained from a UDBE regular dealer.
3. Only fees, commissions, and charges for assistance in the procurement and delivery of materials or supplies count if obtained from a UDBE that is neither a manufacturer or regular dealer. 49 CFR 26.55 defines "manufacturer" and "regular dealer."

You receive credit towards the goal if you employ a UDBE trucking company that performs a commercially useful function as defined in 49 CFR 26.55.

UDBE Commitment Submittal

Submit UDBE information on the Caltrans Bidder - UDBE - Commitment form included in the Bid book. If the form is not submitted with the bid, remove the form from the Bid book before submitting your bid.

If the UDBE Commitment form is not submitted with the bid, the apparent low bidder, the 2nd low bidder, and the 3rd low bidder must complete and submit the UDBE Commitment form to Office Engineer. UDBE Commitment form must be received by the Department no later than 4:00 p.m. on the 4th business day after bid opening.

Other bidders do not need to submit the UDBE Commitment form unless the Department requests it. If the Department requests you to submit a UDBE Commitment form, submit the completed form within 4 business days of the request.

Submit written confirmation from each UDBE stating that it is participating in the contract. Include confirmation with the UDBE Commitment form. A copy of a UDBE's quote will serve as written confirmation that the UDBE is participating in the contract.

If you do not submit the UDBE Commitment form within the specified time, the Department finds your bid nonresponsive.

Good Faith Efforts Submittal

If you have not met the UDBE goal, complete and submit the Good Faith Efforts Documentation form with the bid showing that you made adequate good faith efforts to meet the goal. Only good faith efforts directed towards obtaining participation by UDBEs will be considered. If good faith efforts documentation is not submitted with the bid, it must be received by the Department no later than 4:00 p.m. on the 4th business day after bid opening.

If your UDBE Commitment form shows that you have met the UDBE goal or if you are required to submit the UDBE Commitment form, you must also submit good faith efforts documentation within the specified time to protect your eligibility for award of the contract in the event the Department finds that the UDBE goal has not been met.

Good faith efforts documentation must include the following information and supporting documents, as necessary:

1. Items of work you have made available to UDBE firms. Identify those items of work you might otherwise perform with its own forces and those items that have been broken down into economically feasible units to facilitate UDBE participation. For each item listed, show the dollar value and percentage of the total contract. It is your responsibility to demonstrate that sufficient work to meet the goal was made available to UDBE firms.
2. Names of certified UDBEs and dates on which they were solicited to bid on the project. Include the items of work offered. Describe the methods used for following up initial solicitations to determine with certainty if the UDBEs were interested, and the dates of the follow-up. Attach supporting documents such as copies of letters, memos, facsimiles sent, telephone logs, telephone billing statements, and other evidence of solicitation. You are reminded to solicit certified UDBEs through all reasonable and available means and provide sufficient time to allow UDBEs to respond.
3. Name of selected firm and its status as a UDBE for each item of work made available. Include name, address, and telephone number of each UDBE that provided a quote and their price quote. If the firm selected for the item is not a UDBE, provide the reasons for the selection.
4. Name and date of each publication in which you requested UDBE participation for the project. Attach copies of the published advertisements.
5. Names of agencies and dates on which they were contacted to provide assistance in contacting, recruiting, and using UDBE firms. If the agencies were contacted in writing, provide copies of supporting documents.
6. List of efforts made to provide interested UDBEs with adequate information about the plans, specifications, and requirements of the contract to assist them in responding to a solicitation. If you have provided information, identify the name of the UDBE assisted, the nature of the information provided, and date of contact. Provide copies of supporting documents, as appropriate.
7. List of efforts made to assist interested UDBEs in obtaining bonding, lines of credit, insurance, necessary equipment, supplies, and materials, excluding supplies and equipment that the UDBE subcontractor purchases or leases from the prime contractor or its affiliate. If such assistance is provided by you, identify the name of the UDBE assisted, nature of the assistance offered, and date. Provide copies of supporting documents, as appropriate.
8. Any additional data to support demonstration of good faith efforts.

2-1.04 SSPC QP CERTIFICATION PREAWARD QUALIFICATION

Submit the SSPC QP certification required for cleaning and painting in these special provisions. Failure to submit the certification will result in a nonresponsive bid.

SECTION 3 CONTRACT AWARD AND EXECUTION

3-1.01 SMALL BUSINESS PARTICIPATION REPORT

The Department has established an overall 25 percent small business participation goal. To determine if the goal is achieved, the Department is tracking small business participation on all contracts.

Complete and sign the Small Business (SB) Participation Report form included in the contract documents even if no small business participation is reported. Submit it with the executed contract.

3-1.02 CALTRANS BIDDER - DBE INFORMATION FORM

Complete and sign the Caltrans Bidder - DBE Information form included in the contract documents even if no DBE participation is reported. Submit it with the executed contract.

Provide written confirmation from each DBE that the DBE is participating in the contract. A copy of a DBE's quote serves as written confirmation. If a DBE is participating as a joint venture partner, the Department encourages you to submit a copy of the joint venture agreement.

SECTION 4. BEGINNING OF WORK, TIME OF COMPLETION, AND LIQUIDATED DAMAGES

The 1st working day is the 10th day after contract approval.

The first paragraph and second paragraph, item number 2, of Section 8-1.03 "Beginning of Work" will not apply. Submit a written notice 24 hours before beginning work.

Do not start work at the job site, except for measuring controlling field dimensions and locating utilities, until the Engineer approves your submittal for:

1. Time-scaled logic diagram (Critical Path Method).
2. Traffic Management Plan (TMP).
3. Temporary Access Plans (TAP).

In addition to the above submittals, do not start work at the job site, except for measuring controlling field dimensions and locating utilities, until you submit:

1. Notice of Materials To Be Used.
2. Contingency plan for reopening closures to public traffic.
3. Written statement from the vendor that the order for electrical material has been received and accepted by the vendor. The statement must show the dates that the materials will be shipped.
4. Written statement from the vendor that the order for structural steel has been received and accepted by the vendor. The statement must show the dates that the materials will be shipped.

You may start work at the job site before the 10th day after contract approval if:

1. You obtain required approval for each submittal before the 10th day
2. The Engineer authorizes it in writing

The Department grants a time extension if a delay is beyond your control and prevents you from starting work at the job site on the 1st working day.

Complete the work within 605 working days.

The working day is defined as follows:

The working day: Time measure unit for work progress. A working day is any day except:

1. Special event days as listed in the Special Event Days table in this special provision.
2. A day when you cannot perform work on the controlling activity for at least 50 percent of the day with at least 50 percent of the normal labor and equipment due to any of the following:

2.1. The Engineer's direction to suspend the controlling activities for reasons unrelated to your performance
2.2. An unanticipated event not caused by either party such as:

2.2.1. Act of God (Pub Cont Code § 7105)
2.2.2 Act of a public enemy
2.2.3. Epidemic
2.2.4. Fire
2.2.5. Flood
2.2.6. Governor-declared state of emergency
2.2.7. Landslide
2.2.8. Quarantine restriction

2.3. An issue involving a third-party, including:

2.3.1. Industry or area-wide labor strike
2.3.2. Material shortage
2.3.3. Freight embargo
2.3.4. Jurisdictional requirement of a law enforcement agency
2.3.5. Workforce labor dispute of a utility or non-highway facility owner resulting in a utility or non-highway facility reconstruction not described and not solely for the Contractor's convenience

No work will performed in the Presidio (Rte SF-1 PM 5-90/7.1, SF-101 PM 8.05/9.85) on days listed in the Special Event Days table of this special provision:

Special Event Days

Presidio Event	Date of Event
Special Olympic Polar Bear Run	4th Thursday in February
Emerald Nuts Across the Bay 12k	2nd Sunday in March
US Half Marathon – Spring Half	2ndSaturday in April
Girl Scout Golden Gate Bridging Ceremony	2nd Saturday in May
Annual Memorial Day Observance	Memorial Day
Anchorman Escape from Alcatraz Triathlon	1st or 2nd Sunday in June
Golden Gate Triathlon	3rd or 4th Sunday in June
July 4th Observance	July 4
Avon 2 Day Walk	2nd Saturday and Sunday in July
San Francisco Marathon	Last Sunday in July
Aloha Festival Event	1st Saturday and Sunday in August
Film in the Fog	Last Saturday in September
Susan G. Komen 3-Day Breast Cancer Walk	1st Friday, Saturday and Sunday in October
Juvenile Diabetes Walk	1st Saturday in October
KNBR Bridge to Bridge Run	1st Sunday in October
Fleet Week/Blue Angels Performances	2nd or 3rd Saturday and Sunday in October
Seismic Challenge	3rd Saturday and Sunday in October
Nike Marathon	3rd Sunday in October
HDSA Walkathon	4th Saturday in October
Rival 10 Run	2nd Saturday and Sunday in November
US Half Marathon	2nd or 3rd Sunday of November

INCENTIVES AND DISINCENTIVES

Incentive payments and disincentive deductions apply to the completion of the work specified in the Incentive / Disincentive table.

Comply with "Maintaining Traffic" and "Closure Requirements and Conditions" of these special provisions.

Incentive payments and disincentive deductions are independent of liquidated damages and damages specified in "Closure Requirements and Conditions" of these special provisions.

Complete the work specified within the time specified in the Incentive / Disincentive table starting on the day specified. If you complete the work within the specified time, you will receive the incentive shown for each day less than the time specified. If you do not complete the work within the specified time, the Department will deduct the disincentive shown for each day needed to complete the work.

Incentive / Disincentive

Work	Start of Work	Time of Completion (Working Days)	Incentive Payment per Day	Disincentive Deduction per Day
Phase 1	1st working day	545	$50,000	$50,000

Phase 1 work is defined as the work necessary to complete the full width of all structures and roadways in their final configuration on Route 101 and Route 1 including all pavement delineation and traffic control devices as shown on the plans, final tunnel systems integration testing and all tunnel systems and equipment commissioning work as specified in the contract, and open all traffic lanes to public traffic.

Phase 2 work is defined as the remaining work to complete the contract.

Total incentive payment will not exceed $3,000,000.
Total disincentive deduction will not exceed $3,000,000.

It is anticipated that water will be available in sufficient quantities for the prosecution of the work. However, water shortages may occur during the life of the contract. Arrangements or commitments obtained by the Department are not a part of the contract. It is expressly understood and agreed that the Department assumes no responsibility to the bidder or Contractor whatsoever in respect to the arrangements made with the source. The Contractor shall assume all risks in connection with the use of the source and the terms upon which the use shall be made. There is no warranty or guaranty, either expressed or implied, to the quantity of water that can be obtained from the source. If the Department has compiled "Materials Information", as referred to in "Watering" of these special provisions, the bidder or Contractor is cautioned to make independent investigations and obtain the commitments or allocations as the bidder or Contractor deems necessary to verify the quantity of water available. The Contractor shall make arrangements or obtain commitments or allocations necessary to provide water for the project.

During the progress of the work, if water becomes unavailable or unavailable in the quantities needed for prosecution of the work, the unavailability of water will be considered a material shortage. The provisions in Section 5-1.116, "Differing Site Conditions (23 CFR 635.109)," of the Standard Specifications shall not apply to the unavailability of water.

SECTION 5 GENERAL

5-1.01 EMISSIONS REDUCTION

Contract execution constitutes submittal of the following certification:

> I am aware of the emissions reduction regulations being mandated by the California Air Resources Board. I will comply with such regulations before commencing the performance of the work and maintain compliance throughout the duration of this contract.

5-1.02 PERFORMANCE OF DBEs

Use each DBE subcontractor as listed on the Subcontractor List form unless you receive authorization for a substitution.
The Department requests the Contractor to:

1. Notify the Engineer of any changes to its anticipated DBE participation
2. Provide this notification before starting the affected work

Maintain records including:

1. Name and business address of each 1st-tier subcontractor
2. Name and business address of each DBE subcontractor, DBE vendor, and DBE trucking company, regardless of tier
3. Date of payment and total amount paid to each business

If you are a DBE contractor, include the date of work performed by your own forces and the corresponding value of the work.

Before the 15th of each month, submit a Monthly DBE Trucking Verification form.

For a DBE that leases trucks from a non-DBE, count only the fee or commission the DBE receives as a result of the lease arrangement.

If a DBE subcontractor is decertified before completing subcontracted work, the subcontractor must notify you in writing of the decertification date. If a subcontractor becomes a certified DBE before completing subcontracted work, the subcontractor must notify you in writing of the certification date. Submit the notifications. On contract work completion, complete a Disadvantaged Business Enterprises (DBE) Certification Status Change form. Submit the form within 90 days of contract acceptance.

Upon contract work completion, complete a Final Report – Utilization of Disadvantaged Business Enterprises (DBE), First-Tier Subcontractors form. Submit it within 90 days of contract acceptance. The Department withholds $10,000 until the form is submitted. The Department releases the withhold upon submission of the completed form.

5-1.03 PERFORMANCE OF UDBEs

UDBEs must perform work or supply materials as listed in the Caltrans Bidder - UDBE - Commitment form specified under Section 2, "Bidding," of these special provisions. Do not terminate a UDBE listed subcontractor for convenience and perform the work with your own forces or obtain materials from other sources without prior written authorization from the Department.

The Department grants authorization to use other forces or sources of materials for requests that show any of the following justifications:

1. Listed UDBE fails or refuses to execute a written contract based on plans and specifications for the project.
2. You stipulated that a bond is a condition of executing the subcontract and the listed UDBE fails to meet your bond requirements.
3. Work requires a contractors license and listed UDBE does not have a valid license under Contractors License Law.
4. Listed UDBE fails or refuses to perform the work or furnish the listed materials.
5. Listed UDBE's work is unsatisfactory and not in compliance with the contract.
6. Listed UDBE delays or disrupts the progress of the work.
7. Listed UDBE becomes bankrupt or insolvent.

If a listed UDBE subcontractor is terminated, you must make good faith efforts to find another UDBE subcontractor to substitute for the original UDBE. The substitute UDBE must perform at least the same amount of work as the original UDBE under the contract to the extent needed to meet the UDBE goal.

The substitute UDBE must be certified as a DBE at the time of request for substitution.

The Department does not pay for work or material unless it is performed or supplied by the listed UDBE or an authorized substitute.

5-1.04 PARTNERING DISPUTE RESOLUTION

The Department encourages the project team to exhaust the use of partnering in dispute resolution before engagement of an objective third party. Comply with Section 5-1.012, "Partnering," of the Standard Specifications.

For certain disputes, facilitated partnering session or facilitated dispute resolution session may be appropriate and effective in clarifying issues and resolving all or part of a dispute.

To afford the project team enough time to plan and hold the session, a maximum of 20 days may be added to the dispute review board (DRB) referral time following the Engineer's written response to a supplemental potential claim record as specified in Section 5-1.15, "Dispute Resolution," of the Standard Specifications.

To allow this additional referral time, the project team must document its agreement and intention in the dispute resolution plan of the partnering charter. The team may further document agreement of any associated criteria to be met for use of the additional referral time.

If the session is not held, the DRB referral time remains in effect as specified in Section 5-1.15, "Dispute Resolution," of the Standard Specifications.

5-1.05 FEDERAL REQUIREMENTS (AMERICAN RECOVERY AND REINVESTMENT ACT)

Under the American Recovery and Reinvestment Act (ARRA) of 2009, 9 USC § 902:

SEC. 902. ACCESS OF GOVERNMENT ACCOUNTABILITY OFFICE.

(a) ACCESS.—Each contract awarded using funds made available in this Act shall provide that the Comptroller General and his representatives are authorized—

(1) to examine any records of the contractor or any of its subcontractors, or any State or local agency administering such contract, that directly pertain to, and involve transactions relating to, the contract or subcontract; and

(2) to interview any officer or employee of the contractor or any of its subcontractors, or of any State or local government agency administering the contract, regarding such transactions.

(b) RELATIONSHIP TO EXISTING AUTHORITY.—Nothing in this section shall be interpreted to limit or restrict in any way any existing authority of the Comptroller General.

Under ARRA of 2009, 9 USC § 1515(a):

SEC. 1515. ACCESS OF OFFICES OF INSPECTOR GENERAL TO CERTAIN RECORDS AND EMPLOYEES.

(a) ACCESS.—With respect to each contract or grant awarded using covered funds, any representative of an appropriate inspector general appointed under section 3 or 8G of the Inspector General Act of 1978 (5 U.S.C. App.), is authorized—

(1) to examine any records of the contractor or grantee, any of its subcontractors or subgrantees, or any State or local agency administering such contract, that pertain to, and involve transactions relating to, the contract, subcontract, grant, or subgrant; and

(2) to interview any officer or employee of the contractor, grantee, subgrantee, or agency regarding such transactions.

(b) RELATIONSHIP TO EXISTING AUTHORITY.—Nothing in this section shall be interpreted to limit or restrict in any way any existing authority of an inspector general.

Immediately notify the Engineer if you have been contacted by the U.S. Comptroller, Inspector General, or their representatives.

5-1.06 MONTHLY EMPLOYMENT REPORT (AMERICAN RECOVERY AND REINVESTMENT ACT)

For the purpose of complying with the American Recovery and Reinvestment Act of 2009, submit a completed Monthly Employment Report form by the 5th of each month for the previous month. For the form, go to:

http://www.dot.ca.gov/hq/construc/forms.htm

If you fail to submit a complete and accurate report, the Department withholds 2 percent of the monthly progress estimate. The Department does not withhold more than $10,000 or less than $1,000. The Department releases the withhold upon submission of the completed form.

5-1.07 SURFACE MINING AND RECLAMATION ACT

Imported borrow or aggregate material must come from a surface mine permitted under the Surface Mining and Reclamation Act of 1975 (SMARA), Pub Res Code § 2710, et seq., or from an exempt site.

The Department of Conservation, Office of Mine Reclamation maintains a list of permitted mine sites. For the list of permitted sites, go to:

http://www.conservation.ca.gov/omr/ab_3098_list

If you import borrow or aggregate material from a surface mine not on this list, submit proof the mine is exempt from SMARA.

5-1.08 ELECTRONIC SUBMISSION OF PAYROLL RECORDS

In lieu of submitting weekly payroll records to the Engineer as specified in Section 7-1.01A(3), "Payroll Records," of the Standard Specifications, you may submit weekly payroll records electronically.

Before submitting payroll records electronically, you must complete and sign the Contractor's Acknowledgement and submit it to the District where your project is located. Submit your signed acknowledgement to the corresponding District electronic mailbox shown in the following table:

Electronic Mailboxes

District	Address
1	district1.payrolls@dot.ca.gov
2	district2.payrolls@dot.ca.gov
3	district3.payrolls@dot.ca.gov
4	district4.payrolls@dot.ca.gov
5	district5.payrolls@dot.ca.gov
6	district6.payrolls@dot.ca.gov
7	district7.payrolls@dot.ca.gov
8	district8.payrolls@dot.ca.gov
9	district9.payrolls@dot.ca.gov
10	district10.payrolls@dot.ca.gov
11	district11.payrolls@dot.ca.gov
12	district12.payrolls@dot.ca.gov

The Department responds with an e-mail containing a Caltrans Internet Certificate to be used for the electronic submission of payroll records. You must agree to accept this certificate and reply to the e-mail. After you accept the certificate and reply to the e-mail, the Department is ready to accept your electronic submissions.

Each electronic submission must:

1. Include payroll records in a nonmodifiable PDF image format. No spreadsheets, word documents, or password protected documents are accepted.
2. Include payroll records with all data elements required by the Labor Code § 1776.
3. Include a signed Statement of Compliance form with each weekly record.
4. Be received by the Department by close of business on the 15th day of the month for the prior month's work.
5. Be encrypted before submission.
6. Contain the following information in the subject line:

    6.1. Contract number
    6.2. Week ending date as W/E mm/dd/yy

7. Contain 1 contract number and week ending date per submission.

For additional information on electronic submission of payroll records, go to:

http://www.dot.ca.gov/hq/construc/LaborCompliance/index.htm

5-1.09 TRAINING

For the Federal training program, the number of trainees or apprentices is 23.

5-1.10 FORCE ACCOUNT PAYMENT

Payment for extra work at force account will be determined by either non-subcontracted or subcontracted force account payment unless otherwise specified.

Non-Subcontracted Force Account Payment

When extra work to be paid for on a force account basis is performed by the Contractor, compensation will be determined in accordance with Section 9-1.03, "Force Account Payment," of the Standard Specifications and these special provisions.

The second, third and fourth paragraphs of Section 9-1.03A, "Work Performed by Contractor," of the Standard Specifications shall not apply.

Attention is directed to "Time-Related Overhead" of these special provisions.

To the total of the direct costs for work performed on a force account basis, computed as provided in Section 9-1.03A(1), "Labor," Section 9-1.03A(2), "Materials," and Section 9-1.03A(3), "Equipment Rental," of the Standard Specifications, there will be added the following markups:

Cost	Percent Markup
Labor	30
Materials	10
Equipment Rental	10

The above markups shall be applied to work performed on a force account basis, regardless of whether the work revises the current contract completion date.

The above markups, together with payments made for time-related overhead pursuant to "Time-Related Overhead" of these special provisions, shall constitute full compensation for all overhead costs for work performed on a force account basis. These overhead costs shall be deemed to include all items of expense not specifically designated as cost or equipment rental in conformance with the provisions in Section 9-1.03A(1), "Labor," Section 9-1.03A(2), "Materials," and Section 9-1.03A(3), "Equipment Rental," of the Standard Specifications. The total payment made as provided above and in the first paragraph of Section 9-1.03A, "Work Performed by Contractor," of the Standard Specifications shall be deemed to be the actual cost of the work performed on a force account basis, and shall constitute full compensation therefor.

Full compensation for overhead costs for work performed on a force account basis, and for which no adjustment is made to the quantity for time-related overhead conforming to the provisions in "Time-Related Overhead" of these special provisions, shall be considered as included in the markups specified above, and no additional compensation will be allowed therefor.

Subcontracted Force Account Payment

When extra work to be paid for on a force account basis is performed by a subcontractor approved in conformance with the provisions in Section 5-1.055, "Subcontracting," of the Standard Specifications, compensation will be determined in accordance with the provisions in Section 9-1.03, "Force Account Payment," of the Standard Specifications.

5-1.11 RESPONSIBILITY TO OTHER ENTITIES

The Contractor shall be responsible for any liability imposed by law and for injuries to or death of any person including, but not limited to, workers and the public or damage to property, and shall indemnify and save harmless, the State of California and the Department, the United States, the Presidio Trust, the Golden Gate Bridge, Highway and Transportation District, the City and County of San Francisco, the San Francisco County Transportation Authority, the National Park Service, the Federal Highway Administration, and their officers, directors, agents, subsidiaries, parents, and employees connected with the work, within the limits of which county, city or district the work is being performed, all in the same manner and to the same extent conforming to the provisions in Section 7-1.12, "Indemnification and Insurance," of the Standard Specifications, for the protection of the State of California and all officers and employees thereof connected with the work.

5-1.12 COMPENSATION ADJUSTMENTS FOR PRICE INDEX FLUCTUATIONS

The provisions of this section shall apply only to the following contract items:

ITEM CODE	ITEM
390131	HOT MIX ASPHALT (TYPE A)
397005	TACK COAT

The compensation payable for asphalt binder used in hot mix asphalt and tack coat will be increased or decreased in conformance with the provisions of this section for paving asphalt price fluctuations exceeding 5 percent (Iu/Ib is greater than 1.05 or less than 0.95) which occur during performance of the work.

The quantity of asphalt binder used in tack coat will be determined by multiplying the item quantity for tack coat included in a monthly estimate by the minimum percent residue specified in Section 94, "Asphaltic Emulsions," of the Standard Specifications. The asphaltic emulsion minimum percent residue will be based on the type of emulsion used by the Contractor.

At the Contractor's option, the Contractor may provide actual daily test results for asphalt binder residue for the tack coat used. Test results provided by the Contractor shall be from an independent testing laboratory that participates in the AASHTO Proficiency Sample Program. The Contractor shall take samples of asphaltic emulsion from the distributor truck at mid-load from a sampling tap or thief. Two separate 1/2 gallon samples shall be taken in the presence of the Engineer. The Contractor shall provide one sample to the Contractor's independent testing laboratory within 24 hours of sampling. The second sample shall be given to the Engineer. The test results from the Contractor's independent testing laboratory shall be delivered to the Engineer within 10 days from sample date.

The adjustment in compensation will be determined in conformance with the following formulae when the item of hot mix asphalt or tack coat or both are included in a monthly estimate:

A. Total monthly adjustment = AQ
B. For an increase in paving asphalt price index exceeding 5 percent:

$$A = 0.90\ (Iu/Ib - 1.05)\ Ib$$

C. For a decrease in paving asphalt price index exceeding 5 percent:

$$A = 0.90\ (Iu/Ib - 0.95)\ Ib$$

D. Where:

A = Adjustment in dollars per ton of paving asphalt used to produce hot mix asphalt and asphaltic emulsion residue used as tack coat rounded to the nearest $0.01.
Iu = The California Statewide Paving Asphalt Price Index which is in effect on the first business day of the month within the pay period in which the quantity subject to adjustment was included in the estimate.
Ib = The California Statewide Paving Asphalt Price Index for the month in which the bid opening for the project occurred.
Q = Quantity in tons of asphalt binder that was used in producing the quantity of hot mix asphalt shown under "This Estimate" on the monthly estimate using the amount of asphalt binder determined by the Engineer plus the quantity in tons of asphalt binder that would have been used as residue in the tack coat shown under "This Estimate" on the monthly estimate.

The adjustment in compensation will also be subject to the following:

A. The compensation adjustments provided herein will be shown separately on payment estimates. The Contractor shall be liable to the State for decreased compensation adjustments and the Department may deduct the amount thereof from moneys due or that may become due the Contractor.
B. Compensation adjustments made under this section will be taken into account in making adjustments in conformance with the provisions in Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications.
C. In the event of an overrun of contract time, adjustment in compensation for asphalt binder included in estimates during the overrun period will be determined using the California Statewide Paving Asphalt Price Index in effect on the first business day of the month within the pay period in which the overrun began.

The California Statewide Paving Asphalt Price Index is determined each month on the first business day of the month by the Department using the median of posted prices in effect as posted by Chevron, ExxonMobil, and Union 76 for the Buena Vista, Huntington Beach, and Midway Sunset fields.

In the event that the companies discontinue posting their prices for a field, the Department will determine an index from the remaining posted prices. The Department reserves the right to include in the index determination the posted prices of additional fields.

The California Statewide Paving Asphalt Price Index is available on the Division of Engineering Services website at:

http://www.dot.ca.gov/hq/esc/oe/asphalt_index/astable.html

5-1.13 AREAS FOR CONTRACTOR'S USE

Attention is directed to the provisions in Section 7-1.19, "Rights in Land and Improvements," of the Standard Specifications and these special provisions.

The highway right of way shall be used only for purposes that are necessary to perform the required work. The Contractor shall not occupy the right of way, or allow others to occupy the right of way, for purposes which are not necessary to perform the required work.

Areas available for the use of the Contractor are designated on the plans. Use of the Contractor's work areas and other State-owned property shall be at the Contractor's own risk, and the State shall not be held liable for damage to or loss of materials or equipment located within these areas.

Areas available for the use of the Contractor as designated on the plans shall be enclosed with temporary fence and a chain link access gate. The Contractor shall allow access to any Presidio emergency vehicle. The access gate shall be locked with a padlock chain. A Presidio owned and Department owned padlock shall be in series with the padlock chain to allow emergency access at any time.

Area A: Available to the Contractor on August 1, 2010 or 150 working days after contract approval whichever occurs first.
Area B: Available to the Contractor at the beginning of Stage 2, 3-day weekend closure to open the detour, the Contractor to provide 14 days advance notice
Area C: Available to the Contractor after June 1, 2010
Area D: Available to the Contractor on the 1st working day of the Contract
Area E: Available to the Contractor after September 1, 2010
Area F: Available to the Contractor after September 1, 2010
Area G: Available to the Contractor on the 1st working day of the Contract
Area H: Available to the Contractor on the 1st working day of the Contract
Area I: Available to the Contractor on the 1st working day of the Contract
Area J: Available to the Contractor on the 1st working day of the Contract (requires 14 days notice prior to closure on Lincoln Blvd., refer to "Maintaining Traffic" requirements provided elsewhere on this Special Provisions
Area K: Available to the Contractor on the 1st working day of the Contract
Area L: Available to the Contractor beginning September 1, 2010, Contractor to provide 10 days advance notice
Area M: Available to the Contractor beginning September 1, 2010
Area N: Available to the Contractor after Jan 15, 2011
Area O: Available to the Contractor after Jan 15, 2011
Area P: Available to the Contractor at the beginning of Stage 2, 3-day weekend closure to open the detour, Contractor to provide 14 days advance notice

The Contractor shall not occupy any roadway that is in use by the public unless allowed by lane closure charts included in the Contract. Areas under existing structures may be used only for storage of equipment or materials used for the Construction of this contract.

The Contractor shall relinquish Area C and Area D to the Department for its exclusive use within 10 days after completion of Stage 2 work to open the detour and completion of all bridge removal on B Line as shown on Stage 2 and 3 on the contract plans. The detour is defined as all roadway and structure work on the MS, MN, DN, D and SD lines as shown on the plans.

The Contractor shall obtain encroachment permits prior to occupying State-owned parcels outside the contract limits. The required encroachment permits may be obtained from the Department of Transportation, Permit Engineer, 111 Grand Ave, Oakland, CA, 6th Floor.

Residence trailers will not be allowed within the highway right of way, except that one trailer will be allowed for yard security purposes.

Construction job site trailers will not be allowed within limits of the Presidio, the highway right of way and areas available for use to the Contractor.

Personal vehicles of the Contractor's employees and Contractor's work vehicles shall not be parked within the Presidio right of way except in the areas available for use as shown on the plans. The Contractor’s delivery and hauling equipment, materials and equipment used in the performance of the work may not be stage or placed in areas outside the areas for Contractor’s use.

The Contractor shall not obstruct any emergency vehicle and shall not obstruct access to any fire hydrant, utilities and utility access points within the Presidio.

The Contractor shall remove equipment, materials, and rubbish from the work areas and other State--owned property which the Contractor occupies. The Contractor shall leave the areas in a presentable condition in conformance with the provisions in Section 4-1.02, "Final Cleaning Up," of the Standard Specifications.

The Contractor shall secure, at the Contractor's own expense, areas required for plant sites, storage of equipment or materials or for other purposes, if sufficient area is not available to the Contractor within the contract limits, or at the sites designated on the plans outside the contract limits.

5-1.14 PAYMENTS

In determining the partial payments to be made to the Contractor, only the following listed materials will be considered for inclusion in the payment as materials furnished but not incorporated in the work:

A. Alternative culvert pipe
B. Miscellaneous iron and steel
C. ABSORB 350 crash cushion module
D. Light Standards
E. Luminaires
F. Sign Lighting Fixtures
G. CCTV Camera Poles
H. HAR Pole
I. Communication Conduit
J. Steel Piling
K. Tieback Anchors
L. Bar Reinforcing Steel
M. Structural Steel
N. Underdrain Pipe
O. Miscellaneous Metal
P. Bridge Deck Drainage System
Q. Fences and Gates
R. Timber
S. Railings

5-1.15 SUPPLEMENTAL PROJECT INFORMATION

The Department makes the following supplemental project information available:

Means	Description
Included in the Information Handout	California Regional Water Quality Control Board Certification United States Army Corps of Engineers Nationwide permit Bay Conservation and Development Commission Consistency Determination A Conceptual Storm Water Pollution Prevention Plan Department of Industrial Relations Underground Classification Owner Controlled Insurance Program (OCIP) Manual – Prebid Version 2009 Built Environment Plans Transportation Management Plan Guidelines Manual Development of Presidio-Wide Cleanup Levels for Soil, Sediment, Groundwater, and Surface Water," dated October 30, 2002 and Table 7-6 revised May 2006. Department of Toxic Substances Control (DTSC) Information Advisory for Clean Imported Fill Material (dated October 2001). Doyle Drive Replacement Project - Environmental Soil Investigation, Dated August 2009 Asbestos and Lead-Containing Paint Survey - Doyle Drive ACM and LCM Project - Dated August 2009 Quickchange Movable Barrier Lease Quote dated 10/22/09 VMS Handouts Foundation Report for Southbound Battery Tunnel with Appendices dated August 2009 (Bridge No. 34-0161L) Foundation Review for Southbound Battery Tunnel dated September 1, 2009 (Bridge No. 34-0161L Foundation Report Retaining Wall No. 6 dated July 14, 2009 Foundation Report for Retaining Wall No. 8 dated July 15, 2009 Foundation Review for Retaining Wall No. 8 dated August 24, 2009 Foundation Recommendations for Presidio Viaduct Substation (Bridge No. 34-0157W) dated July 13, 2009 - Note: Structure name changed to Battery Tunnel Substation (Bridge) Foundation Review for Presidio Viaduct Substation (Bridge No. 34-0157W) dated August 5, 2009 - Note: Structure name changed to Battery Tunnel Substation (Bridge)
Available for inspection at the District Office	A Conceptual Storm Water Pollution Prevention Plan has been prepared for this Contract and is available for inspection at the Department of Transportation, Duty Senior's Desk, 111 Grand Avenue, Oakland, California Non-Stormwater Information Package
Available for inspection at the Transportation Laboratory	
Available as specified in the Standard Specifications	Bridge as-built drawings

5-1.16 SPECIES PROTECTION

GENERAL

Summary

This work includes protecting regulated species or their habitat.

This project is within or near habitat for regulated species:

Wrentit (non-migratory, non-game, nesting bird)
Roosting Bats

CONSTRUCTION

Protective Radius

Upon discovery of a regulated species, stop construction activities within a 100 ft. radius of the discovery. Immediately notify the Engineer. Do not resume activities until receiving written notification from the Engineer.

MEASUREMENT AND PAYMENT

Full compensation for Species Protection is included in the various contract items of work and no additional compensation will be allowed.

5-1.17 BIRD PROTECTION

The Department anticipates nesting or attempted nesting by migratory and nongame birds from January 1 to July 31.

Stop all work within a 100-foot radius of the discovery except as specified in the following table:

Radii Exceptions

Species	Work stoppage radii (feet)
Nesting Raptors	300 feet
Wrentit (non-migratory, passerine bird)	100 feet

5-1.18 RELATIONS WITH CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

This project lies within the boundaries of the San Francisco Bay Regional Water Quality Control Board (RWQCB).

The State Water Resources Control Board (SWRCB) has issued to the Department a permit that governs storm water and non-storm water discharges from the Department's properties, facilities, and activities. The Department's permit is entitled "Order No. 99 - 06 - DWQ, NPDES No. CAS000003, National Pollutant Discharge Elimination System (NPDES) Permit, Statewide Storm Water Permit and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans)." Copies of the Department's permit are available for review from the SWRCB, Storm Water Permit Unit, 1001 "I" Street, P.O. Box 1977, Sacramento, California 95812-1977, Telephone: (916) 341-5254, and may also be obtained at:

http://www.waterboards.ca.gov/water_issues/programs/stormwater/

The Department's permit references and incorporates by reference the current statewide general permit issued by the SWRCB entitled "Order No. 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002, Waste Discharge Requirements (WDRs) for Discharges of Storm Water Runoff Associated with Construction Activity" that regulates discharges of storm water and non-storm water from construction activities disturbing one acre or more of soil in a common plan of development. Sampling and analysis requirements as specified in SWRCB Resolution No. 2001-46 are added to the statewide general permit. Copies of the statewide permit and modifications thereto are available for review from the SWRCB, Storm Water Permit Unit, 1001 "I" Street, P.O. Box 1977, Sacramento, California 95812-1977, Telephone: (916) 341-5254 and may also be obtained at:

http://www.waterboards.ca.gov/water_issues/programs/stormwater/

The NPDES permits that regulate this project, as referenced above, are collectively referred to in this section as the "permits."

This project shall conform to the permits and modifications thereto. The Contractor shall maintain copies of the permits at the project site and shall make them available during construction.

The Contractor shall know and comply with provisions of Federal, State, and local regulations and requirements that govern the Contractor's operations and storm water and non-storm water discharges from the project site and areas of disturbance outside the project limits during construction. Attention is directed to Sections 7-1.01, "Laws to be Observed," 7-1.11, "Preservation of Property," 7-1.12, "Indemnification and Insurance," and 9-1.055, "Penalty Withholds," of the Standard Specifications.

The Contractor shall notify the Engineer immediately upon request from the regulatory agencies to enter, inspect, sample, monitor, or otherwise access the project site or the Contractor's records pertaining to water pollution control work. The Contractor and the Department shall provide copies of correspondence, notices of violation, enforcement actions, or proposed fines by regulatory agencies to the requesting regulatory agency.

5-1.19 RELATIONS WITH UNITED STATES ARMY CORP OF ENGINEERS

A portion of this project is located within the jurisdiction of the United States Army Corp of Engineers. An agreement regarding waters of the United States, including wetlands, has been entered into by the Department of Transportation and the United States Army Corp of Engineers. These areas are identified as environmentally sensitive areas (ESA). The Contractor shall be fully informed of the requirements of this agreement as well as rules, regulations, and conditions that may govern the Contractor's operations in these areas and shall conduct the work accordingly.

Copies of the agreement are available for inspection at the Department of Transportation, District 04, Construction Office Duty Senior, 111 Grand Avenue, Oakland, CA 94612, telephone number (510) 286-5209.

Attention is directed to Sections 7-1.01, "Laws to be Observed," 7-1.01G, "Water Pollution," and 7-1.12, "Indemnification and Insurance," of the Standard Specifications.

Modifications to the agreement between the Department of Transportation and the United States Army Corp of Engineers, which are proposed by the Contractor, shall be submitted in writing to the Engineer for transmittal to the United States Army Corp of Engineers for their consideration.

When the Contractor is notified by the Engineer that a modification to the agreement is under consideration, no work shall be performed which is inconsistent with the original agreement until the Departments take action on the proposed modifications..

The provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

Modifications to any agreement between the Department of Transportation and the United States Army Corp of Engineers will be fully binding on the Contractor. The provisions of this section shall be made a part of every subcontract executed pursuant to this contract.

5-1.20 NATIONAL PARK REGULATIONS

This project is located within the limits of Presidio Trust National Park. The work shall be performed in conformance with State laws and with the regulations of the Department of Interior governing preservation of historical and natural features of parks and improvements therein.

Historical features, trees and other natural features within the park area shall be protected and safeguarded.

The Presidio is a converted national park. The prior use of the Presidio was a military base. The Presidio has two site clean up documents.

These two documents are available as specified in "Supplemental Project Information" of these special provisions:

A. Department of Toxic Substances Control (DTSC) Information Advisory for Clean Imported Fill Material (dated October 2001).
B. Development of Presidio-Wide Cleanup Levels for Soil, Sediment, Groundwater, and Surface Water," dated October 30, 2002 and Table 7-6 revised May 2006.

Imported embankment will comply with the two Presidio site cleanup documents, listed above in this special provision and these special provisions.

Imported embankment is material, including but not limited to, imported topsoil, imported borrow and imported borrow (lightweight aggregate), used for embankment construction.

Imported embankment shall not contain any elements or compounds that could result in the imported embankment being characterized as a hazardous waste as defined in Title 22 Division 4.5 Chapter 11 of the California Code of Regulation and Title 40 Part 261 of the Code of Federal Regulations.

The evaluation of imported embankment shall be in compliance with the Department of Toxic Substances Control (DTSC) Information Advisory for Clean Imported Fill Material (Dated October 2001). The imported embankment shall meet the requirements of Presidio Trust Cleanup Levels as stated in Chapter 7 of the following document: "Development of Presidio-Wide Cleanup Levels for Soil, Sediment, Groundwater, and Surface Water," dated October 30, 2002 and Table 7-6 revised May 2006. The evaluation shall be performed by or under the direction of an engineer registered as a civil engineer in California or a geologist registered as a geologist in California.

The Contractor shall provide the Engineer a "Notice of Materials to be used" (CEM-3101) describing the location and historic land use of the proposed source of imported embankment.

The Contractor shall submit the imported embankment compliance data ("Notice of Materials to be used") to the Engineer for acceptance 30 days prior to the placement of any imported embankment. The Contractor shall be responsible for the removal of any imported embankment that does not comply with these special provisions and has not been approved by the Engineer. The Engineer shall have 15 days to review the compliance data and provide a written determination.

Full compensation for conforming to the provisions, including providing compliance data, collecting and analyzing samples of imported embankment in this section shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefor.

5-1.21 NATURALLY OCCURRING ASBESTOS

Naturally occurring asbestos (NOA) is present within the project limits. Material containing NOA is material that has an asbestos content of 0.25 percent or greater as defined in California Code of Regulations, Title 17, Section 93105 "Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations." These provisions are also applicable when work is located in serpentine and ultramafic rock.

Handling, stockpiling, transporting, and disposing of material containing NOA must comply with "Material Containing Naturally Occurring Asbestos" of these special provisions.

Notify the Engineer and the Air Pollution Control District (APCD) at least 15 days before starting work that disturbs material containing NOA. Maintain and make available at the job site a copy of the APCD notification and exemption, if appropriate. Provide the Engineer a copy of the APCD notification and exemption, if approved.

The site investigation report is available as specified in "Supplemental Project Information" of these special provisions.

After you have completed the handling and placement of material containing NOA in accordance with these special provisions, as certified by the Engineer, you will have no further responsibility for the NOA material in place within the right-of-way. You will not be considered a generator of the hazardous material, and the Department requires no further cleanup, removal, or remedial actions for the material containing NOA will be required within the right-of-way.

Excavate, stockpile, reuse, and dispose of material containing hazardous levels of NOA under the rules and regulations of the following agencies:

1. United States Environmental Protection Agency
2. Department of Toxic Substances Control, Region 2
3. California Integrated Waste Management Board
4. California Department of Health Services
5. California Division of Occupational Safety and Health Administration
6. California Air Resources Board
7. Bay Area Air Pollution Control District
8. California Department of Motor Vehicles

Handle and transport material containing hazardous levels of NOA to comply under Federal and State laws and regulations and county and municipal ordinances and regulations. Laws and regulations that govern this work include:

1. California Code of Regulations, Title 8, Section 1529 (Asbestos) and Section 5192 (Hazardous Waste Operations and Emergency Response)
2. California Code of Regulations, Title 17, Section 93105 (Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations) and Section 93106 (Asbestos Airborne Toxic Control Measure for Surfacing Applications)
3. California Code of Regulations, Title 22, Division 4.5, Chapter 10 (Environmental Health Standards for the Management of Hazardous Waste)
4. Health and Safety Code, Division 20, Chapter 6.5 (Hazardous Waste Control)
5. Code of Federal Regulations, Part 1926, Section 1101, (Asbestos)

5-1.22 ENVIRONMENTALLY SENSITIVE AREA

An ESA exists on this project.

Take the management measures shown in the following table for the corresponding ESA shown. Any access to an ESA other than that shown is prohibited.

ESA Management

Identification	Location	Management measures
Environmentally Sensitive Areas	Various locations as shown on the plans	Before start of work, protect the ESA by installing temporary fence (Type ESA)
Stone walls, steps, channels and curbs	Various locations (see plans)	Before start of work, protect the ESA by installing various protective barriers (see Layout and Detour Layout plans)
Battery Sherwood, and Battery Slaughter	Northwest of VA Cemetery, north side of Doyle Drive (see plans)	Before start of work, protect the ESA by installing temporary fence (Type CL-6, Slatted)
Specified trees at the drip line	Behind building 106	Before start of work, protect the ESA by installing temporary fence (Type CL-6, Slatted)
Battery Baldwin	West of Battery Sherwood, north of Doyle Drive	No excavations may be performed within the footprint of this underground structure.
Drain	Between the contractor yard and archaeological site CA-SFr-6/26, near Station 92	A temporary reinforced silt fence will exist at this location. Maintain this fence.
Buildings 1152, 1160, 1170, 1169, 1167, 1188, 1184, 229, 228, 227, 603, 106, 105, 107, 122, 129, 669		Before start of work, protect the ESA by installing temporary fence (Type ESA)
CA-SFr-6/26	Area west of Building 610 (see plans)	A temporary fence (Type CL-6, Slatted) will exist at this location. Maintain this fence.
Wrought iron fence	Between the south side of Lincoln Blvd., and the north side of the VA Cemetery.	Before start of work, protect the ESA by installing a temporary fence (Type ESA)
Shooting range structure	In contractor yard, near Station 92 (see plans)	A temporary reinforced silt fence will exist at this location. Maintain this fence.
Row of cypress trees	Between Buildings 670 and 669 and between Lincoln Blvd and the VA Cemetery (see plans)	A temporary reinforced silt fence will exist at this location. Maintain this fence.
Battery Blaney	East of Battery Slaughter, north of Doyle Drive	Before start of work, protect the ESA by installing a temporary fence (Type ESA)

5-1.23 ARCHAEOLOGICAL MONITORING AREA

AMAs

AMA Designation and Description	PM Limits
The Presidio	SF 101, PM 8.2/9.2

5-1.24 ARCHITECTURAL MONITORING AREA

Architectural monitoring area within, near, or straddling the project limits are shown on the plans.

Architectural Monitoring Area: Architectural Resource Designation and Description
Battery Sherwood
Battery Slaughter
Battery Blaney
Battery Baldwin (Underground)
National Cemetery to First Road
Building 150 – Mortuary Chapel
Building 151 – House
Building 152 – Restroom
Building 153 – Garage
Building 154 – Maintenance Garage
Building 603, Commissary
Building 631, Ammunition
Building 632, Ammunition
Building 105, Barracks
Building 106, Band Barracks
Building 107, Switching Station
Building 108, Electric Shop
Building 122, Gymnasium
Building 123, Garage
Building 128, Enlisted Family Quarters
Building 129, Enlisted Family Quarters
Building 1182, Warehouse
Building 1183, Warehouse
Building 1184, Warehouse
Building 1185, Warehouse
Building 1186, Warehouse
Building 1187, Warehouse
Building 1188, Warehouse
Building 1151, Pool
Building 1152, Gym
Building 1160, Warehouse
Building 1170, Warehouse

ARCHITECTURAL RESOURCES

Architectural resources are above-ground historical properties and above-ground historical resources.
Do not disturb the architectural resources.

ARCHITECTURAL MONITOR

The Department assigns an architectural monitor to monitor job site activities within the architectural monitoring area.
The architectural monitoring area is defined as the area within 200 feet of the architectural resources in the above table.
Do not work within the architectural monitoring area unless the architectural monitor is present.

The Engineer and the Department architectural monitor conduct an architectural monitoring area field review with you at least 5 business days before start of work.

Install management measures in areas listed in "Environmentally Sensitive Area," elsewhere in these special provisions, for architectural monitoring areas during the architectural monitoring field review and before the start of any work within these areas.

At least 5 business days before starting work within the architectural monitoring area, submit a schedule of days and hours to be worked for the Engineer's approval. If you require changes in the schedule, submit an update for the Engineer's approval at least 5 business days before any changed work day.

5-1.25 NONHIGHWAY FACILITIES (INCLUDING UTILITIES)

The utility owner will relocate a utility shown in the following table before the corresponding date shown:

Utility Relocation and Date of the Relocation

Utility	Location	Date
Sanitary Sewer	SB 71+80	02/20/2010
	SB 73+50 to 75+30	02/20/2010
	SB81+50 to 82+60	02/20/2010
	DN48+50	02/20/2010
	DN71.20	02/20/2010
	DN73+00 to 75+00	02/20/2010
	DN78+30 to 81+10	02/20/2010
	DN80+20	02/20/2010
	MN51+50	02/20/2010

Utility Relocation and Date of the Relocation

Utility	Location	Date
Presidio Trust Electrical	SB 68+00	02/20/2010
	DN64+90	02/20/2010
	DN72+50 to 75+00	02/20/2010
	DN82+50 to 84+50	02/20/2010
	MN52+50 to 56+00	02/20/2010

Utility Relocation and Date of the Relocation

Utility	Location	Date
PG&E Electrical	SB 76+70 to 84+50	02/20/2010
	DN62+00 to 64+00	02/20/2010

Utility Relocation and Date of the Relocation

Utility	Location	Date
Telecommunications	SB76+70 to 84+50	02/20/2010
	DN64+90 to 66.20	02/20/2010
	DN66+70	02/20/2010
	DN67+10	02/20/2010
	DN70+80	02/20/2010
	DN78+10	02/20/2010
	MN52+70 to 57+10	02/20/2010
	MN53.70 to 55+00	02/20/2010
	MN57+00 to MN57+90	02/20/2010

Utility Relocation and Date of the Relocation

Utility	Location	Date
Potable Water	SB72+10	02/20/2010
	DN84+20 to 85+20	02/20/2010
	DN77+50	02/20/2010
	DN60+00 to 61+00	02/20/2010
		02/20/2010

Utility Relocation and Date of the Relocation

Utility	Location	Date
Gas	SB 72+50	02/20/2010
	DN70+50 to 75.50	02/20/2010
	DN71+50	02/20/2010
	DN79+00	02/20/2010
	DN49+00	02/20/2010

5-1.26 AIR QUALITY – DEMOLITION NOTIFICATION

In compliance with Standard Specifications Section 7-1.01F, "Air Pollution Control," the Contractor shall notify the air pollution control district or air quality management district identified below as required by the National Emission Standards for Hazardous Air Pollutants (NESHAP) under 40 CFR Part 61, Subpart M, and California Health and Safety Code section 39658(b)(1). A copy of the notification form and attachments shall be provided to the Engineer prior to submittal. Notification shall take place a minimum of 10 business days prior to starting demolition or renovation activities as defined in the NESHAP regulations. Notification forms may be obtained at:

http://www.baaqmd.gov/Forms.aspx

The Contractor shall mail or otherwise deliver the original notification form with any necessary attachments to:

Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109-7799

APCO -
(415) 749-5052

The Contractor shall also notify other local permit agencies and utility companies prior to starting any demolition activities.

Full compensation for complying with requirements of this section shall be considered as included in the contract price paid for the items involved, and no additional compensation will be allowed therefor.

5-1.27 UNEXPLODED ORDNANCE (UXO)

The limits of this project fall within the boundary of the Presidio of San Francisco. Unexploded ordnance (UXO) has been found by the United States Army Corps of Engineers adjacent to the work area. Any worker performing soil disturbance activities, from clearing and grubbing to excavating and landscaping, must be informed of the potential for encountering UXO, including bullet cartridges, grenades and cannon balls. Before work at the job site begins, including mobilization, the Presidio Trust Safety and Occupational Health Manager will be providing Environmental and Safety/UXO Awareness Training. The training will be held at San Francisco Presidio and will take one hour to complete. All workers must attend a UXO training session. The Contractor is responsible for training any additional workers employed during the contract.

If unexpected UXO is discovered, the Contractor shall immediately stop work, move a safe distance away from the UXO and control access to that location. The Engineer shall be informed of the potential UXO as soon as possible. The Contractor shall contact the Presidio Trust Safety and Occupational Health Manager, at 415-748-0059 or Presidio Trust Environmental Program Manager, at 415-561-4259. UXO will be managed in accordance with the Golden Gate National Recreation Area Standard Operating Procedure, #814, (October 2004), as amended. The Contractor may continue work in unaffected areas.

Full compensation for wages and expenses associated with training, including travel cost, is considered included in the contract items of work involved and no additional compensation will be allowed therefor.

5-1.28 TUNNEL SAFETY ORDERS

The work to be performed at the following locations: sign foundation piles and Southbound Battery Tunnel, has been classified "Potentially Gassy" by the State Division of Occupational Safety and Health under Section 8422 of the Tunnel Safety Orders of the California Code of Regulations.

The Contractor's attention is directed to Section 7-1.06, "Safety and Health Provisions," of the Standard Specifications. A change to the work as a direct result of the Contractor's planned operations that would cause work activities to fall under the requirements of the Tunnel Safety Orders, and that has not been shown on the plans or specified in these special provisions shall be reason for suspension of the work. The Contractor shall notify the Engineer not less than 20 days prior to worker exposure to a facility meeting the definition of a tunnel or shaft as described in Sections 8403 or 8405 of the Tunnel Safety Orders. The Department will obtain additional location classifications as may be necessary to allow the work to proceed.

The Contractor shall prominently post a notice of the classification and any special orders, rules, special conditions, or regulations at the tunnel work site, and all personnel shall be informed of the classification.

At least 7 days prior to beginning work covered by these provisions, the Contractor shall submit the name of the person designated as the on-site Safety Representative to the Engineer along with proof of certification by the Division of Occupational Safety and Health as having met the requirements of Section 8406 of the Tunnel Safety Orders of the California Code of Regulations.

5-1.29 OWNER CONTROLLED INSURANCE PROGRAM (OCIP)

GENERAL

Section 7-1.12B, "Insurance," of the Standard Specifications does not apply except as otherwise stated in these special provisions. References to the insurance requirements in Section 7-1.12, "Indemnification and Insurance," of the Standard Specifications shall be interpreted as references to "Owner Controlled Insurance Program (OCIP)" of these special provisions.

The Department has elected to implement an Owner Controlled Insurance Program (OCIP). The Department will administer the OCIP with the assistance of an OCIP Administrator.

OCIP is a series of insurance polices issued by one or more insurance companies to provide certain types of coverages for the Contractor and eligible subcontractors of all tiers. These coverages include workers' compensation, general liability, and excess liability. For this OCIP, coverages shall also include contractor's pollution liability.

OCIP will include completed operations coverage. OCIP does not prohibit participants from purchasing any additional liability insurance. OCIP does not include surety insurance.

The "Owner Controlled Insurance Program (OCIP) Manual," describes the program and provides guidelines for participation in OCIP. This manual is referred to in these special provisions as the OCIP Manual and is incorporated by reference into the contract. The OCIP Manual is available for inspection at the District Office as specified in "Supplemental Project Information" of these special provisions. In the event of any conflict or discrepancy between any of the documents, these special provisions supersede the OCIP Manual or other program documents other than the OCIP insurance policies issued in accordance with these special provisions.

Nothing in the contract is intended to establish a standard of care owed to any member of the public or to extend to the public the status of a third-party beneficiary for any of the insurance described in these specifications. OCIP requirements contained in this section "Owner Controlled Insurance Program (OCIP)," do not create any contractual relationship between the subcontractors and the Department. The Contractor shall be responsible for compliance with requirements of this section including compliance by its enrolled subcontractors and by its excluded subcontractors of all tiers.

Changes to any OCIP requirement or procedure shall be approved by the Department. No Contractor or subcontractor has the authority to change any OCIP requirements or procedures.

ELIGIBILITY AND ENROLLMENT IN OCIP

The Contractor and each eligible subcontractor shall be enrolled in OCIP before starting work on the job site by submitting CT OCIP Form 1, "OCIP Enrollment Form."

The OCIP covers construction activities at the job site. Eligible Contractors and subcontractors are contractors who provide direct labor at the job site. Temporary labor services and employee leasing companies are to be treated as eligible contractors if the services provided are construction activities at the job site. The Contractor and each eligible subcontractor shall follow the enrollment procedures shown in the OCIP Manual.

Enrolled contractors are contractors who have completed the enrollment procedures and received evidence of OCIP insurance.

Excluded subcontractors include:

1. Architects, engineers, surveyors, soil testing companies, and their consultants
2. Hazardous waste transport companies
3. Suppliers, vendors, and material dealers that do not perform construction activities at the job site or subcontract installation
4. Guard services and non-construction janitorial services
5. Truckers including trucking to the project where delivery is the only scope of work performed, haulers, drivers, and others who merely transport, pick up, deliver or carry materials, personnel, parts, and equipment to or from the job site
6. Any other parties the Department elects to exclude from OCIP even if otherwise eligible

If an excluded subcontractor performs direct labor at the job site, it shall participate in the project safety program and comply with the requirements in "Project Safety" of these special provisions.

Excluded subcontractors are required to provide their own insurance according to requirements specified in "Contractor-Furnished Insurance," of these special provisions. OCIP insurance policies and OCIP coverages will not apply to excluded parties, even if such parties are erroneously enrolled in OCIP. The Department may exclude any subcontractor from enrollment in OCIP, even if it meets the requirements for eligibility as defined above.

The Contractor shall maintain its own insurance for coverages not provided under OCIP until contract acceptance. Subcontractors shall maintain their own insurance for coverages not provided under OCIP policies until completion of their work. Required coverage types and limits are specified in "Contractor-Furnished Insurance" of these special provisions. These are minimum requirements and are not intended to limit either the amount of insurance available to the Department as an additional insured nor to limit the obligations of the Contractor and subcontractors under the indemnity provisions of Section 7-1.12, "Indemnification and Insurance," of the Standard Specifications. Before beginning work, the Contractor shall furnish the Engineer documents showing that all required insurance is in full force.

The OCIP insurance company reserves the right to reject late OCIP enrollments. If there have been losses in a period during which a subcontractor delayed its enrollment, OCIP will not furnish coverage to the subcontractor for such losses.

INSURANCE PROVIDED UNDER OCIP

Under OCIP, the Department provides general liability, including 10-years of completed operations coverage, excess liability, and workers' compensation, and contractor pollution liability insurance covering work performed by enrolled contractors.

The Department's election to use OCIP does not constitute any representation by the Department with respect to the adequacy of the insurance to protect the Contractor or its subcontractors against all obligations imposed by law or by this contract. The coverage, as with all insurance, is limited in scope and may not include every form of insurance protection the Contractor or its subcontractors may deem necessary. The Contractor agrees that the Department and the OCIP Administrator are not agents, partners, or guarantors of the OCIP insurer and that the Department is not responsible for any claims or disputes between or among the Contractor, the subcontractors, and any OCIP insurer.

In addition to any insurance provided under OCIP, all contractors are responsible for providing certain insurance as specified in "Contractor-Furnished Insurance" of these special provisions. It is the responsibility of the Contractor and each subcontractor to discuss OCIP with their insurance agents, brokers, or consultants, and verify if any changes or additional coverages are required.

Coverage under OCIP applies to construction activities under this contract performed at the job site. For purposes of OCIP, job site is defined as the areas within the boundaries of the project. Areas adjacent to or nearby where incidental operations are performed may be covered, but only if they are solely dedicated to contract work and reported to the OCIP Administrator and the OCIP Administrator has confirmed that they are covered.

Unless approved by the Engineer and accepted and endorsed on the policy by the insurer, off-site locations are not covered under OCIP even if the site is utilized as a batch plant dedicated to the project or operations are for fabrication of materials to be used at the job site or training of apprentices. Off-site locations include the regularly established workplace, plant, factory, office, shop, warehouse, yard or other property of Contractor or any subcontractor.

Off-site operations of an enrolled contractor or subcontractor, including product manufacturing or product assembling, may be covered if the Contractor requests coverage for specified operations and the operations are:

1. Solely dedicated to the performance of the contracted work
2. Approved in writing by Department
3. Approved by the OCIP insurer and endorsed onto the general liability and workers' compensation insurance policies
4. Acknowledged in writing by the OCIP Administrator

The Department assumes no obligation to provide insurance coverages other than those summarized above and set forth in the actual OCIP policies. The insurance provided under OCIP does not extend coverage for product liability to other parties such as vendors and suppliers, for any product manufactured, assembled, or worked on away from the job site.

The Contractor and all eligible subcontractors of any tier will be enrolled in OCIP upon completion and acceptance of the forms included in the OCIP Enrollment Package.

OCIP Insurance Coverage

OCIP provides the following insurance coverages for the enrolled contractor and subcontractors of all tiers as follows:

1. Workers Compensation Insurance is provided on a statutory basis. If there is an exposure of injury to the Contractor's employees under the U.S. Longshore and Harbor Workers' Compensation Act, the Jones Act, or under laws, regulations or statutes applicable to maritime employees, coverage is included for such injuries or claims. Employer's liability insurance is provided in amounts not less than:

   1.1 $1,000,000 for each accident for bodily injury by accident
   1.2 $1,000,000 policy limit for bodily injury by disease
   1.3 $1,000,000 for each employee for bodily injury by disease

2. General liability insurance: The general annual aggregate limit is annually reinstated each policy year. Defense coverage is in addition to the policy limits. Completed-operations coverage will be extended for 10 years beyond the earlier of final acceptance of the work or expiration of the final policies. A single limit applies for the 10-year period. Limits for bodily injury, including death arising from the bodily injury, and property damage are:

   2.1 $2,000,000 for each occurrence
   2.2 $4,000,000 aggregate for completed operations
   2.3 $4,000,000 general annual aggregate

3. Umbrella or Excess Liability Insurance limits are not less than $200,000,000 per occurrence and in the aggregate. Coverage is excess and following form to the commercial general liability and employer's liability policies. General aggregate limits are annually reinstated.
4. Contractor Pollution Liability with a limit of $25,000,000 per occurrence and aggregate. Coverage extends to hazardous materials transport and treatment / disposal facilities.

The Contractor and subcontractors shall consult the actual policies for coverage details. The enrolled Contractor and subcontractors will receive a separate workers' compensation policy. A copy of the primary general liability policy and the excess liability policy will be available from the OCIP administrator.

The insurance company policy limits of liability, coverage terms, and conditions will determine the scope of coverage provided by OCIP. The policies may be amended from time to time. The Contractor and enrolled subcontractors of all tiers are bound by the terms of coverage as contained in the insurance policies.

OCIP does not provide builder's risk, professional liability, or any other type of insurance or surety not specifically described in these special provisions.

OCIP Coverage Termination and Modifications

Except for completed operations coverage, OCIP insurance coverage for enrolled Contractor will terminate upon contract acceptance and OCIP insurance coverage for its enrolled subcontractors will terminate upon completion of work at the job site.

The Department reserves the right to terminate or modify all or part of the Department's OCIP with 30 days prior written notice. In the event of termination or modification, the Contractor and its subcontractors of all tiers shall procure and maintain insurance required by the Department. The Department will reimburse to the Contractor the cost of insurance replacement, including associated project costs that may arise due to such insurance replacement. The form, coverage, limits, cost, and insurer rating for the replacement insurance shall be subject to Department approval.

Coverage after Completion of the Work

Insurance coverage under OCIP ends at contract acceptance. If a contractor returns to the job site to perform warranty work, it must perform warranty work under its own insurance coverage. Warranty work is not covered under the insurance provided by OCIP.

Assignment of Return Premiums

The Department will pay all OCIP premiums. The Department will be the sole beneficiary of any dividends or return premiums generated by OCIP.

In consideration of the Department providing an OCIP, the Contractor and subcontractors waive any right to and shall irrevocably assign to and for the benefit of the Department, all return premiums, premium refunds, premium discounts, dividends, retentions, credits, and any other moneys due the Department in connection with the insurance that the Department will provide. The Contractor shall, if requested, promptly execute an assignment form prepared by the Department. The Contractor shall require all tiers of enrolled subcontractors to execute a similar assignment for the benefit of the Department if such form is required of Contractor.

CONTRACTOR DEDUCTIBLE ASSESSMENT

The enrolled Contractor or subcontractor primarily responsible for causing any bodily injury or property damage liability loss shall be responsible for payment of a deductible assessment. The assessment will equal the deductible under the Contractor's or subcontractor's regular (non-OCIP) commercial general liability policy up to a maximum assessment of $25,000. The minimum assessment shall be the actual loss or $5,000, whichever is less. The assessment shall be applied on the same basis as applied under the Contractor's or subcontractor's regular (non-OCIP) general liability insurance policy. The enrolled Contractor and subcontractors shall submit to the Department a copy of their commercial general liability insurance certificate for the purpose of determining the deductible assessment.

If the loss exceeds $5,000 and information necessary to determine the Contractor's deductible as stated on its commercial general insurance certificate is not available to the Department, the Department will charge the Contractor the actual loss up to a $25,000 maximum per occurrence until receipt of documentation from the Contractor's commercial general insurance policy evidencing the contractor's actual deductible. If the loss is less than $5,000, the Department will charge the actual loss. The Department will charge the Contractor deductible assessment by processing administrative deductions on the Contractor's progress payments. At the option of the Department, the contractor deductible assessment may also be processed by direct billing, construction change orders, or any other method deemed appropriate by the Department.

The deductible assessment will apply to contractor pollution liability losses using the same terms and conditions described above except that the assessment for such losses shall be determined by the deductible on the Contractor or subcontractor's pollution liability policy subject to the minimum assessment of $5,000 or actual loss, whichever is less. In the event that the Contractor or subcontractor does not have a contractor's pollution liability policy, the Contractor's or subcontractor's general liability policy deductible will be used to determine the assessment subject to the minimums described above.

The deductible assessment does not apply to workers' compensation claims for Contractor's own employee.

CONTRACTOR-FURNISHED INSURANCE

Before starting work, the Contractor shall furnish certificates of insurance to the Engineer for itself and subcontractors of all tiers evidencing that coverages are in force on a primary basis for losses not covered under OCIP insurance policies.

Required Contractor-Furnished Insurance Policies

For excluded contractors, contractor-furnished insurance shall apply to all losses. For eligible, enrolled contractors, contractor-furnished insurance shall comply with the following:

1. Automobile liability insurance for on-site and off-site.
2. Workers' compensation and employer's liability insurance applies for any work performed off-site.
3. Commercial general liability insurance for any operation not covered under OCIP.
4. Umbrella or excess liability applies on the same basis as the above underlying commercial general liability, employer's liability and automobile liability policies.
5. Professional liability insurance for on-site and off-site as applicable.
6. Tools and equipment floater insurance for on-site and off-site.

The Contractor-furnished insurance shall provide that there will be no cancellations, lapse, or reduction of coverage without 30 days' prior written notice to the Department, except for 10 days' prior written notice to the Department for non-payment of premium. Certificates of contractor-furnished insurance shall set forth deductible amounts or self-insured retentions applicable to each policy.

Self-insurance programs and self-insured retentions in insurance policies must be declared and are subject to separate annual review and approval by the Department. If the Contractor uses a self-insurance program or self-insured retention, then in the event of loss covered by the Contractor's insurance or not covered by OCIP, the Contractor shall provide the Department with the same protection from liability and defense of suits as would be afforded by first-dollar insurance. Execution of the contract is the Contractor's acknowledgement that the Contractor will be bound by all laws and court decisions as if the Contractor were an insurer subject to such applicable laws and court decisions specifically as if the Contractor were an insurer as defined under Ins Code § 23, and that the self-insurance program or self-insured retention shall operate as insurance as defined under Ins Code § 22.

Self-insurance programs and self-insured retentions in insurance policies are subject to separate annual review and approval by the Department.

Required Contractor-Furnished Insurance Limits

The documents required as evidence of contractor-furnished insurance shall show minimum coverage as follows:

1. Automobile liability insurance, including owned, non-owned and hired autos with limits no less than $1,000,000 combined single limit per accident
2. Workers' compensation (statutory) and employer's liability insurance:

    2.1. $1,000,000 for bodily injury for each accident
    2.2. $1,000,000 policy limit for bodily injury by disease
    2.3. $1,000,000 for each employee for bodily injury by disease

3. Commercial general liability insurance with coverage at least as broad as Insurance Services Office form CG 00 01 with limits no less than:

   3.1. $1,000,000 per occurrence
   3.2. $2,000,000 products and completed operations aggregate
   3.3. $2,000,000 general aggregate

4. Umbrella or excess liability insurance containing a clause stating that it takes effect (drops down) in the event the primary limits are impaired or exhausted. Coverage shall apply and follow form over primary coverages shown above. A $2,000,000 minimum limit requirement shall apply annually on a per occurrence and aggregate basis. No umbrella or excess liability insurance is required of an eligible and enrolled subcontractor who performs less than $100,000 of the work.
5. Professional liability insurance: If the Contractor's work requires design or other professional services, the Contractor shall obtain and maintain, or require its subcontractors responsible for performing such design services to obtain and maintain, at all times during the term of this contract, professional liability (errors and omissions) insurance for all professional services provided. This professional liability insurance shall include full prior acts coverage sufficient to cover the services under this contract, the limits of which shall be not less than $2,000,000 per claim and aggregate, with a maximum of $100,000 self insured retention. Professional liability insurance shall be maintained during the term of the contract and it must include a 5 year minimum extended reporting period.
6. Contractor's tools and equipment insurance: The Contractor shall be responsible for any insurance it may deem necessary for protection against loss of owned, rented, or borrowed equipment and tools, including any tools owned by mechanics, and any tools, equipment, scaffolding, staging, trailers, cranes, towers, and forms owned, rented, or borrowed by the Contractor or its subcontractors. The Department will have no liability with respect to such equipment and tools and does not provide builder's risk or any other type of property insurance. Any policies maintained by the Contractor on their owned or rented equipment and materials shall not prohibit the insureds from waiving their rights of recovery against the Department. The Contractor hereby waives any rights of recovery against Department for damage to or loss of such equipment or tools. The Contractor shall obtain similar waivers in favor of the Department and its agents and employees from each subcontractor with whom it contracts to work on this project or any other project with the Department. Department, its agents, and employees are not liable for any losses on owned, rented, or borrowed equipment due to the Contractor's failure to secure such insurance or to maintain adequate levels of coverage.
7. Protection & Indemnity (P&I) : If the Contractor's work requires the use of watercraft on coastal waters, the Contractor shall obtain and maintain, or require its subcontractors responsible for performing such design services to obtain and maintain, at all times during the term of this contract, protection and indemnity insurance with limits to be approved by the Department.
8. Aircraft Liability: If the Contractor's work requires the use of aircraft of any kind the Contractor shall obtain and maintain, or require its subcontractors responsible for performing such aviation services to obtain and maintain, at all times during the term of this contract, aircraft liability insurance with limits to be approved by the Department.

The State and Department, the United States, the Presidio Trust, the National Park Service, the Golden Gate Bridge Highway & Transportation District, the City of San Francisco, and the San Francisco County Transportation Authority and their officers, directors, agents, subsidiaries, parents, and employees shall be added as additional insureds for automobile liability, general liability, and umbrella or excess liability arising out of or connected with work performed by or on behalf of the Contractor. Additional insured coverage shall be as broad as form CG 2010 for general liability and umbrella or excess liability. The endorsement must be separately attached to the certificate of insurance and must list the project number and the entities listed above as additional insureds.

These minimum requirements do not limit in any way the Contractor's or subcontractor's obligation under any Indemnification Agreement. The Contractor shall agree that it is the intent of the parties to this contract that all available limits of contractor insurance shall apply to any loss off-site or otherwise not covered by OCIP and that these minimum requirements do not limit the coverage of umbrella or excess policies for any loss to which such insurance would otherwise apply, including coverage for additional insureds.

Maintenance of Contractor-Furnished Insurance

All required insurance shall be maintained without interruption from the start of work until contract acceptance. The insurance required shall be written on forms that conform to the requirements under OCIP Manual and are acceptable to Department. The Contractor shall provide to the Department within 3 business days of any renewal, change, or replacement of coverage, certificates of insurance and endorsements evidencing coverage required.

If an eligible, enrolled Contractor or subcontractor chooses to have any of its own insurance policies include the job site during the construction period, coverage shall be in excess of or applicable to difference in conditions of the insurance provided under OCIP. The Department will not pay for this additional cost. Inclusion of the job site on such insurance policies does not replace OCIP coverage or otherwise affect the cost identification requirements in section "Contractor's Insurance Cost Identification and Deduction," of these special provisions.

Any type of insurance or any increase of limits of liability not described in this section, "Contractor-Furnished Insurance," that the Contractor requires for the Contractor's own protection or on account of any statute shall be the Contractor's responsibility.

Failure to Maintain Insurance

In the event the Contractor or any subcontractor fails to furnish and maintain required insurance or to furnish satisfactory evidence of the required insurance, the Department may procure and maintain the coverages for the Contractor or subcontractor. The Department will furnish all necessary information to the Contractor and deduct the cost from any monies due or to become due the Contractor. Failure to provide evidence of such insurance may result in the Contractor or subcontractor being excluded from the job site until proper coverage is verified. The cost of any resulting delay shall be borne by the Contractor.

CONTRACTOR'S INSURANCE COST IDENTIFICATION AND DEDUCTION

The Contractor shall identify the costs of its workers' compensation, general liability, and excess liability insurance. The cost of insurance includes the insurance premiums, the applicable taxes and assessments, any mark-up on the insurance premiums, any retained loss programs, self-insured programs, self-insured retentions, any deductible program, and any other cost that duplicates insurance provided by the Department.

The Contractor and each eligible subcontractor shall use CT OCIP Form 1, "OCIP Enrollment Form" to identify their workers' compensation insurance, general liability insurance, and excess liability insurance costs, along with all insurance costs which duplicate insurance provided under OCIP. This form and supporting documents shall be completed and returned to the Engineer as part of OCIP enrollment.

The Contractor and each eligible subcontractor must submit documentation that supports the deducted cost for insurance from the bid for the work. Supporting documentation may include the following pages from their workers' compensation, general liability, and excess liability policies:

1. Declarations or information page
2. Rate page
3. Deductible endorsement
4. Verification of experience modification factor for workers compensation insurance
5. 5 years of loss history for entities that retain losses
6. For contractors that self-insure workers' compensation, a copy of the Annual Report submitted to the state regulatory agency for the last 3 years or a detailed accounting of the total cost of the self-insured program for the last 3 years
7. Explanation of the method of determining the mark-up on their insurance costs
8. Explanation of the basis of the mark-up on their subcontractors' insurance costs

The Contractor shall be solely responsible for ensuring that eligible subcontractors of all tiers identify and deduct the cost of the insurance already provided under OCIP.

The Contractor's insurance cost deduction from its bid shall be based on the following insurance coverages and limits:

1. Workers' compensation insurance statutory benefits and employer's liability limits of:

    1.1. $1,000,000 for bodily injury for each accident
    1.2. $1,000,000 policy limit for bodily injury by disease
    1.3. $1,000,000 for each employee for bodily injury by disease

2. Commercial general liability insurance with coverage no less broad than that provided by Insurance Services Office form CG 00 01 10 01 with limits of:

    2.1. $2,000,000 per occurrence
    2.2. $2,000,000 completed operations aggregate
    2.3. $4,000,000 general aggregate

3. Umbrella or excess liability insurance (for Contractor only) providing total limits of $25,000,000 per occurrence and aggregate. There are no excess liability insurance requirements for subcontractors.

If the Contractor's current insurance program does not conform to these requirements because of lower total limits or a different structure for primary insurance, the Contractor may use the following factors to account for the difference in cost between the Contractor's existing program and the program described above:

1. Cost to increase primary general liability limits from $1,000,000/$2,000,000/$2,000,000 to $2,000,000/$2,000,000/$4,000,000, add 18 percent of the cost of primary general liability premium attributable to this project.
2. Cost for $25,000,000 umbrella or excess liability coverage, add 40 percent of the cost of primary general liability premium attributable to this project including any adjustment required by the calculation in a. immediately above.

As an alternative to using the factors described in items 1 and 2 above, the Contractor may obtain actual quotations from its insurers or insurance brokers for coverage as described applicable only to this project. However the Contractor shall not be required to purchase such coverage and shall not, in any case, charge the Department for such coverage.

Deduction Guidelines

The Contractor and eligible subcontractors of all tiers shall use the following guidelines to identify all costs for insurance as described in this section:

1. If a contractor's regular general liability insurance program includes a deductible or self-insured retention greater than $25,000, the contractor must provide evidence of the corresponding premium credits granted by the contractor's insurer. These credits will not be allowed as an offset to the amount to be deducted. The value of these credits will be included in the amount to be deducted for OCIP. As an alternative to providing premium credit information, the contractor may submit an insurer-provided or actuarially developed rate for the difference in cost between contractor's actual deductible (or self-insured retention) and the $25,000 deductible provided by OCIP.
2. If neither deductible credits nor an insurer or actuary-determined rate is available, the cost deduction calculation must include a rate determined by the Department. The Department has determined that the rate for the portion of coverage between the $25,000 deductible assessment and a deductible of $250,000 is one and one half percent (1.5%) of contract value. This rate will be applied proportionately to the contractor's actual deductible between $25,000 and $250,000 (by interpolation). For example, if the contractor's deductible is $100,000, the rate credit will be 0.83% (225,000-100,000/225,000 x 1.5%). This amount will be added to the contractor-identified insurance costs using the CT OCIP Form 1 and supporting documents, and will be part of the deduction.
3. Corporate allocations must include the insurance company's actual calculation of premium. Contractor must provide additional documentation for any such credits claimed.
4. Upon request, a contractor shall provide a copy of the most recently issued WCIRB or NCCI worksheet showing payroll and losses for the workers' compensation Experience Modification rating period. Workers' compensation self-insured contractors shall use a unity (1.0) modifier for purposes of calculating workers' compensation deduction credits. Self-insured contractors should use rates provided by their insurer for the cost of first-dollar workers' compensation coverage or may use WCIRB pure premium rates increased by 15 percent.

By completing and submitting CT OCIP Form 1, "OCIP Enrollment Form," and supporting documents, the Contractor and subcontractors of all tiers certify that all costs for insurance as described in this section have been correctly identified and have been deducted from the Contractor's bid for the work.

The Contractor shall ensure subcontractors of all tiers follow the requirements in this section "Contractor Insurance Cost Identification and Deduction Guidelines."

Required Recordkeeping for Cost Identification

In addition to the provisions of Section 7.1.01A(3), "Payroll Records," of the Standard Specifications, the Contractor and eligible subcontractors shall:

1. Keep and maintain accurate and properly classified records of payroll and other data necessary for the proper computation of workers' compensation premiums with respect to the insurance provided under OCIP. The Contractor's and its subcontractors' records shall be maintained to show separately by employee and class of work, or comparable information acceptable to the Department, all necessary pertinent payroll data excluding the premium portion of overtime for the purpose of developing and determining premiums and shall keep their records relating to the work performed under this contract in such a manner that the records can readily be separated from other work of the Contractor or subcontractors of all tiers.

2. Submit to the Department or to the OCIP Administrator monthly records of workers' compensation payroll and other data for itself and its subcontractors to the Department by the 15th day of the subsequent month using forms provided by the Department. Upon completion of a subcontractor's work under this contract, the Contractor shall submit to the Department or its representative all necessary data to permit complete insurance premium determination for each of its subcontractors. Certified payroll is not an acceptable substitution. The Contractor and subcontractors of all tiers shall keep and maintain accurate records by workers' compensation classifications of their payroll for work insured by OCIP.

AUDIT AND RECOVERY OF CONTRACTOR INSURANCE COST

The Contractor and subcontractors agree that, upon enrollment, the Department, the OCIP Administrator, and any OCIP insurer may inspect, copy, and audit the Contractor's and the subcontractors' payroll records, books and records, insurance policies, insurance cost data, bid documents, estimates, or any other information to confirm the accuracy of any information provided to the Department or OCIP Administrator, to verify compliance with the contract documents or to confirm that costs of general liability insurance, excess liability insurance and workers' compensation insurance are not included in the original bid. The Contractor agrees to maintain and have available the records identified above for a period of up to three years after completion of the project.

Upon contract acceptance, the Contractor shall submit to the Department all necessary data to permit complete insurance premium determination for itself and its subcontractors of all tiers. At the end of the contract and each subcontract, and at any other time as determined by the Engineer, the OCIP Administrator or the insurance company, an audit will be performed using the reported payroll and receipts furnished during the OCIP policy term.

CONTRACTOR RESPONSIBILITIES

The Contractor shall be responsible for and require its subcontractors of all tiers to be responsible for:

1. Complying with all rules and regulations of the California Workers' Compensation Insurance Rating Bureau (CWCIRB).
2. Complying with applicable claims handling responsibilities and project safety administration as specified in sections "Claim Reporting and Participation Responsibilities" and "Project Safety" of these special provisions.
3. Complying with necessary contract, operations, and insurance information including but not limited to declarations pages, underwriting and rating information, certificates, loss histories, Cal OSHA citations, and, if requested, complete, certified copies of insurance polices.
4. Cooperating with the Department and its representatives as regards the administration and operation of OCIP.
5. Assuring that all subcontractors receive copies of the OCIP Manual. Failure of the Contractor to provide an OCIP Manual to subcontractors shall not relieve the Contractor or any subcontractor from the requirements of these special provisions.
6. Assuring that the terms of this section, "Owner Controlled Insurance Program (OCIP)," are included in all subcontracts of every tier, purchase orders, and agreements entered into for performance of any portion of the work.
7. Not violating or knowingly permit violation of any conditions of the policies of insurance provided under OCIP.
8. Cooperating with OCIP insurance policy requirements, including but not limited to physical audit of payroll records by the insurance company or its representatives.

Without limitation upon any of the Department's other rights or remedies, any failure by the Contractor or any subcontractor to comply with this section, "Owner Controlled Insurance Program," shall entitle the Department, at its option, upon notice to the Contractor to either:

1. Suspend performance by the Contractor, without any compensation, until there is full compliance
2. Terminate this contract for cause

The Contractor shall not violate or knowingly permit to be violated any conditions of the OCIP Policies or other policies of insurance required by "Owner Controlled Insurance Program (OCIP)," or by the OCIP Manual. The Contractor shall ensure that all requirements imposed by such policies, the terms of this section, "Owner Controlled Insurance Program (OCIP)," and the OCIP Manual shall likewise be imposed on, and assumed and performed by, each subcontractor of every tier.

SUBMITTAL OF FORMS AND DOCUMENTS

The Contractor shall submit the following forms as specified:

1. **CT OCIP Form 1, "OCIP Enrollment Form."** The Contractor and eligible subcontractors of all tiers, before starting work, shall complete and submit the form to the Engineer along with copies of the Contractor's insurance policy pages that display applicable rates and premium calculations for workers' compensation, general liability, and excess or umbrella liability insurance, if applicable.
2. **CT OCIP Form 2, "Monthly Payroll Reporting Form."** The enrolled Contractor and subcontractors of all tiers shall complete and submit the form to the Engineer for the prior month's work by the 15th day of the following month. This form must be submitted showing "0" payroll even if the enrolled Contractor or subcontractor was not on site that month. This form shall be submitted monthly until a CT OCIP Form 3, "Contractor's Notice of Work Termination Form," is submitted, even if there was no on-site work performed. This form shall be submitted in addition to any payroll records required by Section 7-1.01A(3), "Payroll Records," of the Standard Specifications.
3. **CT OCIP Form 3, "Contractor's Notice of Work Termination."** The Contractor and enrolled subcontractors of all tiers shall, upon completion of its work, complete and submit this form to the Engineer by the 5th business day after the last day of the month during which work was completed, including punch list items under the contract. The Contractor shall ensure enrolled subcontractors of all tiers complete this form.

Failure of the Contractor to submit complete OCIP documents to the Engineer will result in a withhold in the amount of $500 for each day any of the required forms are not submitted within the above time frames. The Department will not compensate the Contractor for any delays or costs resulting from failure to comply with these requirements.

WAIVER OF RIGHT OF RECOVERY

Contractor hereby waives all rights of recovery against the Department, consultants, OCIP Administrator, and any other Contractor, subcontractor and consultant performing OCIP work or rendering OCIP services in connection with the project, including without limitation, the officers, directors, agents, shareholders and employees of each of them. The waivers provided for in this paragraph shall be deemed effective as to any individual or entity even if such individual or entity:

1. Would otherwise have a duty of indemnification, contractual or otherwise
2. Did not pay the insurance premium directly or indirectly

CLAIM REPORTING AND PARTICIPATION RESPONSIBILITIES

The Contractor shall adhere to and perform all reporting requirements as set forth in the Claims Procedures part of the OCIP Manual. The Contractor has a right to participate and provide input in all workers' compensation claim review meetings involving claims made by that contractor's employees including the annual review prior to any unit statistical filings.

PROJECT SAFETY

The Contractor shall ensure that its employees and the general public will be provided a clean, safe environment free of hazards during construction activities. The ultimate responsibility for providing a safe place to work rests with the Contractor. The Contractor shall develop its own written Site-Specific Safety Program (SSSP). At minimum, the SSSP shall conform to the requirements addressed in the CA Code of Regs if applicable, and any other pertinent safety regulations. This includes, but is not limited to, all applicable local, state, and federal Safety Standards and Codes.

The Contractor shall allocate a full-time, 100% project dedicated, on-site Safety Quality Control Manager (SQCM) for the duration of this contract. This SQCM must be a competent and qualified person, as defined by Cal OSHA, shall provide oversight on the project. SQCM shall have knowledge in the area of safety procedures for all types of work being performed on this contract. SQCM shall be up to date on Caltrans, Cal OSHA, OSHA and other safety agency requirements. SQCM shall continuously review the construction work plan and actual work, and submit daily status reports to the Engineer through the contractor’s onsite construction manager on all activities underway to document safety conditions, and if necessary measures being taken to improve safety. This provision does not relieve the Contractor of his responsibility to comply with all safety requirements of the contract.

At a minimum, daily status reports shall include:

1. Documentation of daily work activity.
2. Documentation of safety related field activities.
3. Documentation of safety deficiencies and corrective actions taken.
4. Documentation of meetings, conversations, and other communications related to safety issues.

All reports shall include name of individual preparing report, date, and weather conditions.

The Contractor shall provide resumes/qualifications for SQCM for review and approval by the Engineer. Contractor shall terminate and/or replace the SQCM upon 2 weeks written notice from the Engineer. The Contractor may terminate and/or replace the SQCM upon 2 weeks written notice to the Engineer.

Without diminishing the Contractor's responsibility for safety, the Department through OCIP may provide technical safety services to assist the Engineer in monitoring the safety, health, and environmental performance of the Contractor and its subcontractors of all tiers. The Contractor and its subcontractors of all tiers shall be monitored for effectiveness and application of their respective safety programs at the job site.

The Contractor and its subcontractors of all tiers shall adhere to a 100 percent drug and alcohol-free program. At a minimum pre-employment, probable cause, and post-accident testing is required.

Contractor employees must wear approved Class B hard hats on the job site.

Fall protection is required for work at or above six feet.

The Contractor or subcontractors shall ensure that employees of the Contractor and subcontractors of all tiers attend a safety orientation program and that new hires and personnel transferred to the project receive this orientation prior to starting work. This orientation shall be designed to communicate all project-specific safety policies, procedures, and expectations of the Department in regard to the construction of the project.

The Contractor shall perform a daily self-inspection of the site and shall document such inspections at least weekly.

The Contractor or subcontractors shall hold weekly crew-level toolbox safety meetings. These meetings shall be documented as to content and attendance.

The Contractor shall hold weekly subcontractor safety coordination meetings documented as to content and attendance.

The Contractor and subcontractors are responsible to assure that any accident receives prompt response including investigation, analysis and reporting, and that any injuries receive prompt care and treatment.

SECTION 6. (BLANK)

SECTION 7. (BLANK)

SECTION 8. MATERIALS

SECTION 8-1. MISCELLANEOUS

8-1.01 PREQUALIFIED AND TESTED SIGNING AND DELINEATION MATERIALS

The Department maintains the following list of Prequalified and Tested Signing and Delineation Materials. The Engineer shall not be precluded from sampling and testing products on the list of Prequalified and Tested Signing and Delineation Materials.

The manufacturer of products on the list of Prequalified and Tested Signing and Delineation Materials shall furnish the Engineer a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each type of traffic product supplied.

For those categories of materials included on the list of Prequalified and Tested Signing and Delineation Materials, only those products shown within the listing may be used in the work. Other categories of products, not included on the list of Prequalified and Tested Signing and Delineation Materials, may be used in the work provided they conform to the requirements of the Standard Specifications.

Materials and products may be added to the list of Prequalified and Tested Signing and Delineation Materials if the manufacturer submits a New Product Information Form to the New Product Coordinator at the Transportation Laboratory. Upon a Departmental request for samples, sufficient samples shall be submitted to permit performance of required tests. Approval of materials or products will depend upon compliance with the specifications and tests the Department may elect to perform.

PAVEMENT MARKERS, PERMANENT TYPE

Retroreflective With Abrasion Resistant Surface (ARS)

1. Apex, Model 921AR (4" x 4")
2. Ennis Paint, Models C88 (4" x 4"), 911 (4" x 4") and C80FH
3. Ray-O-Lite, Models "AA" ARC II (4" x 4") and ARC Round Shoulder (4" x 4")
4. 3M Series 290 (3.5" x 4")
5. 3M Series 290 PSA
6. Glowlite, Inc Model 988AR (4" x 4")

Retroreflective With Abrasion Resistant Surface (ARS)

(for recessed applications only)

1. Ennis Paint, Model 948 (2.3" x 4.7")
2. Ennis Paint, Model 944SB (2" x 4")*
3. Ray-O-Lite, Model 2002 (2" x 4.6")
4. Ray-O-Lite, Model 2004 (2" x 4")*

*For use only in 4.5 inch wide (older) recessed slots

Non-Reflective, 4-inch Round

1. Apex Universal (Ceramic)
2. Apex Universal, Models 929 (ABS) and 929PP (Polypropylene)
3. Glowlite, Inc. (Ceramic) and PP (Polypropylene)
4. Hi-Way Safety, Inc., Models P20-2000W and 2001Y (ABS)
5. Interstate Sales, "Diamond Back" (Polypropylene)
6. Novabrite Models Cdot (White) Cdot-y (Yellow), Ceramic
7. Novabrite Models Pdot-w (White) Pdot-y (Yellow), Polypropylene
8. Three D Traffic Works TD10000 (ABS), TD10500 (Polypropylene)

PAVEMENT MARKERS, TEMPORARY TYPE

Temporary Markers For Long Term Day/Night Use (180 days or less)

1. Vega Molded Products "Temporary Road Marker" (3" x 4")
2. Filtrona Extrusion, Halftrack model 25, 26 and RPM 35

Temporary Markers For Short Term Day/Night Use (14 days or less)

(For seal coat or chip seal applications, clear protective covers are required)

1. Apex Universal, Model 932
2. Filtrona Extrusion, Models T.O.M., T.R.P.M., and "HH" (High Heat)
3. Hi-Way Safety, Inc., Model 1280/1281
4. Glowlite, Inc., Model 932

STRIPING AND PAVEMENT MARKING MATERIAL

Permanent Traffic Striping and Pavement Marking Tape

1. Advanced Traffic Marking, Series 300 and 400
2. Brite-Line, Series 1000
3. Brite-Line, "DeltaLine XRP"
4. Swarco Industries, "Director 35" (For transverse application only)
5. Swarco Industries, "Director 60"
6. 3M, "Stamark" Series 380 and 5730
7. 3M, "Stamark" Series 420 (For transverse application only)

Temporary (Removable) Striping and Pavement Marking Tape (180 days or less)

1. Advanced Traffic Marking, Series 200
2. Brite-Line, Series 100
3. Garlock Rubber Technologies, Series 2000
4. P.B. Laminations, Aztec, Grade 102
5. Swarco Industries, "Director-2"
6. Trelleborg Industries, R140 Series
7. 3M Series 620 "CR", and Series A750
8. 3M Series A145, Removable Black Line Mask
   (Black Tape: for use only on Hot mix asphalt surfaces)
9. Advanced Traffic Marking Black "Hide-A-Line"
   (Black Tape: for use only on Hot mix asphalt surfaces)
10. Brite-Line "BTR" Black Removable Tape
    (Black Tape: for use only on Hot mix asphalt surfaces)
11. Trelleborg Industries, RB-140
    (Black Tape: for use only on Hot mix asphalt surfaces)

Preformed Thermoplastic (Heated in place)

1. Flint Trading Inc., "Hot Tape"
2. Flint Trading Inc., "Premark Plus"
3. Ennis Paint Inc., "Flametape"

Ceramic Surfacing Laminate, 6" x 6"

1. Highway Ceramics, Inc.

CLASS 1 DELINEATORS

One Piece Driveable Flexible Type, 66-inch

1. Filtrona Extrusion, "Flexi-Guide Models 400 and 566"
2. Carsonite, Curve-Flex CFRM-400
3. Carsonite, Roadmarker CRM-375
4. FlexStake, Model 654 TM
5. GreenLine Model CGD1-66

Special Use Type, 66-inch

1. Filtrona Extrusion, Model FG 560 (with 18-inch U-Channel base)
2. Carsonite, "Survivor" (with 18-inch U-Channel base)
3. Carsonite, Roadmarker CRM-375 (with 18-inch U-Channel base)
4. FlexStake, Model 604
5. GreenLine Model CGD (with 18-inch U-Channel base)
6. Impact Recovery Model D36, with #105 Driveable Base
7. Safe-Hit with 8-inch pavement anchor (SH248-GP1)
8. Safe-Hit with 15-inch soil anchor (SH248-GP2) and with 18-inch soil anchor (SH248-GP3)

Surface Mount Type, 48-inch

1. Bent Manufacturing Company, Masterflex Model MFEX 180-48
2. Carsonite, "Channelizer"
3. FlexStake, Models 704, 754 TM, and EB4
4. Impact Recovery Model D48, with #101 Fixed (Surface-Mount) Base
5. Three D Traffic Works "Channelflex" ID No. 522248W

CHANNELIZERS

Surface Mount Type, 36-inch

1. Bent Manufacturing Company, Masterflex Models MF-360-36 (Round) MF-180-36 (Flat) and MFEX 180—36
2. Filtrona Extrusion, Flexi-Guide Models FG300PE, FG300UR, and FG300EFX
3. Carsonite, "Super Duck" (Round SDR-336)
4. Carsonite, Model SDCF03601MB "Channelizer"
5. FlexStake, Models 703, 753 TM, and EB3
6. GreenLine, Model SMD-36
7. Hi-way Safety, Inc. "Channel Guide Channelizer" Model CGC36
8. Impact Recovery Model D36, with #101 Fixed (Surface-Mount) Base
9. Safe-Hit, Guide Post, Model SH236SMA and Dura-Post, Model SHL36SMA
10. Three D Traffic Works "Boomerang" 5200 Series

Lane Separation System

1. Filtrona Extrusion, "Flexi-Guide (FG) 300 Curb System"
2. Qwick Kurb, "Klemmfix Guide System"
3. Dura-Curb System
4. Tuff Curb

CONICAL DELINEATORS, 42-inch

(For 28-inch Traffic Cones, see Standard Specifications)

1. Bent Manufacturing Company "T-Top"
2. Plastic Safety Systems "Navigator-42"

3. TrafFix Devices "Grabber"
4. Three D Traffic Works "Ringtop" TD7000, ID No. 742143
5. Three D Traffic Works, TD7500
6. Work Area Protection Corp. C-42

OBJECT MARKERS

Type "K", 18-inch

1. Filtrona Extrusion, Model FG318PE
2. Carsonite, Model SMD 615
3. FlexStake, Model 701 KM
4. Safe-Hit, Model SH718SMA

Type "Q" Object Markers, 24-inch

1. Bent Manufacturing "Masterflex" Model MF-360-24
2. Filtrona Extrusion, Model FG324PE
3. Carsonite, "Channelizer"
4. FlexStake, Model 701KM
5. Safe-Hit, Models SH824SMA_WA and SH824GP3_WA
6. Three D Traffic Works ID No. 531702W and TD 5200
7. Three D Traffic Works ID No. 520896W

CONCRETE BARRIER MARKERS AND
TEMPORARY RAILING (TYPE K) REFLECTORS

Impactable Type

1. ARTUK, "FB"
2. Filtrona Extrusion, Models PCBM-12 and PCBM-T12
3. Duraflex Corp., "Flexx 2020" and "Electriflexx"
4. Hi-Way Safety, Inc., Model GMKRM100
5. Plastic Safety Systems "BAM" Models OM-BARR and OM-BWAR
6. Three D Traffic Works "Roadguide" Model TD 9300

Non-Impactable Type

1. ARTUK, JD Series
2. Plastic Safety Systems "BAM" Models OM-BITARW and OM-BITARA
3. Vega Molded Products, Models GBM and JD
4. Plastic Vacuum Forming, "Cap-It C400"

METAL BEAM GUARD RAIL POST MARKERS

(For use to the left of traffic)

1. Filtrona Extrusion, "Mini" (3" x 10")
2. Creative Building Products, "Dura-Bull, Model 11201"
3. Duraflex Corp., "Railrider"
4. Plastic Vacuum Forming, "Cap-It C300"

CONCRETE BARRIER DELINEATORS, 16-inch

(For use to the right of traffic)

1. Filtrona Extrusion, Model PCBM T-16
2. Safe-Hit, Model SH216RBM
3. Three D Traffic Works "Roadguide" Model 9400

CONCRETE BARRIER-MOUNTED MINI-DRUM (10" x 14" x 22")

1. Stinson Equipment Company "SaddleMarker"

GUARD RAILING DELINEATOR

(Place top of reflective element at 48 inches above plane of roadway)

Wood Post Type, 27-inch

1. Filtrona Extrusion, FG 427 and FG 527
2. Carsonite, Model 427
3. FlexStake, Model 102 GR
4. GreenLine GRD 27
5. Safe-Hit, Model SH227GRD
6. Three D Traffic Works "Guardflex" TD9100
7. New Directions Mfg, NDM27

Steel Post Type

1. Carsonite, Model CFGR-327

RETROREFLECTIVE SHEETING

Channelizers, Barrier Markers, and Delineators

1. Avery Dennison T-6500 Series (For rigid substrate devices only)
2. Avery Dennison WR-7100 Series
3. Nippon Carbide Industries, Flexible Ultralite Grade (ULG) II
4. Reflexite, PC-1000 Metalized Polycarbonate
5. Reflexite, AC-1000 Acrylic
6. Reflexite, AP-1000 Metalized Polyester
7. Reflexite, Conformalight, AR-1000 Abrasion Resistant Coating
8. 3M, High Intensity

Traffic Cones, 4-inch and 6-inch Sleeves

1. Nippon Carbide Industries, Flexible Ultralite Grade (ULG) II
2. Reflexite, Vinyl, "TR" (Semi-transparent) or "Conformalight"
3. 3M Series 3840
4. Avery Dennison S-9000C

Drums

1. Avery Dennison WR-6100
2. Nippon Carbide Industries, Flexible Ultralite Grade (ULG) II
3. Reflexite, "Conformalight", "Super High Intensity" or "High Impact Drum Sheeting"
4. 3M Series 3810

Barricades: Type I, Medium-Intensity (Typically Enclosed Lens, Glass-Bead Element)

1. Nippon Carbide Industries, CN8117
2. Avery Dennison, W 1100 series
3. 3M Series CW 44

Barricades: Type II, Medium-High-Intensity (Typically Enclosed Lens, Glass-Bead Element)

1. Avery Dennison, W-2100 Series

Vertical Clearance Signs: Structure Mounted

1. 3M Model 4061, Diamond Grade DG3, Fluorescent Yellow

Signs: Type II, Medium-High-Intensity (Typically Enclosed Lens, Glass-Bead Element)

1. Avery Dennison, T-2500 Series
2. Nippon Carbide Industries, Nikkalite 18000

Signs: Type III, High-Intensity (Typically Encapsulated Glass-Bead Element)

1. Avery Dennison, T-5500A and T-6500 Series
2. Nippon Carbide Industries, Nikkalite Brand Ultralite Grade II
3. 3M 3870 and 3930 Series

Signs: Type IV, High-Intensity (Typically Unmetallized Microprismatic Element)

1. Avery Dennison, T-6500 Series
2. Nippon Carbide Industries, Crystal Grade, 94000 Series
3. Nippon Carbide Industries, Model No. 94847 Fluorescent Orange
4. 3M Series 3930 and Series 3924S

Signs: Type VI, Elastomeric (Roll-Up) High-Intensity, without Adhesive

1. Avery Dennison, WU-6014
2. Novabrite LLC, "Econobrite"
3. Reflexite "Vinyl"
4. Reflexite "SuperBright"
5. Reflexite "Marathon"
6. 3M Series RS20

Signs: Type VII, Super-High-Intensity (Typically Unmetallized Microprismatic Element)

1. 3M Series 3924S, Fluorescent Orange
2. 3M LDP Series 3970

Signs: Type VIII, Super-High-Intensity (Typically Unmetallized Microprismatic Element)

1. Avery Dennison, T-7500 Series
2. Avery Dennison, T-7511 Fluorescent Yellow
3. Avery Dennison, T-7513 Fluorescent Yellow Green
4. Avery Dennison, W-7514 Fluorescent Orange
5. Nippon Carbide Industries, Nikkalite Crystal Grade Series 92800
6. Nippon Carbide Industries, Nikkalite Crystal Grade Model 92847 Fluorescent Orange

Signs: Type IX, Very-High-Intensity (Typically Unmetallized Microprismatic Element)

1. 3M VIP Series 3981 Diamond Grade Fluorescent Yellow
2. 3M VIP Series 3983 Diamond Grade Fluorescent Yellow/Green
3. 3M VIP Series 3990 Diamond Grade
4. Avery Dennison T-9500 Series
5. Avery Dennison, T9513, Fluorescent Yellow Green
6. Avery Dennison, W9514, Fluorescent Orange
7. Avery Dennison, T-9511 Fluorescent Yellow

SPECIALTY SIGNS

1. Reflexite "Endurance" Work Zone Sign (with Semi-Rigid Plastic Substrate)

ALTERNATIVE SIGN SUBSTRATES

Fiberglass Reinforced Plastic (FRP) and Expanded Foam PVC

1. Fiber-Brite (FRP)
2. Sequentia, "Polyplate" (FRP)
3. Inteplast Group "InteCel" (0.5 inch for Post-Mounted CZ Signs, 48-inch or less)(PVC)

Aluminum Composite, Temporary Construction Signs and Permanent Signs up to 4 foot, 7 Inches

1. Alcan Composites "Dibond Material, 80 mils"
2. Mitsubishi Chemical America, Alpolic 350
3. Bone Safety Signs, Bone Light ACM

8-1.02 STATE-FURNISHED MATERIALS

The State furnishes you with:

- Callbox mounting brackets.
- Callboxes
- Loop detector sensor units
- Model 170 controller assembly, including controller unit, completely wired controller cabinet, and inductive loop detector sensor units.
- Variable Message Sign (VMS) panels including controller assembly.

The State furnishes you with completely wired controller cabinets with auxiliary equipment but without controller unit at Caltrans Maintenance Station, 30 Rickard Street, San Francisco, CA 94134. Callboxes and mounting brackets will be furnished to the Contractor at District Recycling Yard at 210 Burma Road, Oakland. At least 48 hours before you pick up the materials, inform the Engineer what you will pick up and when you will pick it up.

SECTION 8-2. CONCRETE

8-2.01 PORTLAND CEMENT CONCRETE

Portland cement concrete shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and these special provisions.

SUPPLEMENTARY CEMENTITIOUS MATERIALS

The Contractor may use rice hull ash as a supplementary cementitious material (SCM) to make minor concrete. Rice hull ash shall conform to the requirements in AASHTO Designation: M 321 and the following chemical and physical requirements:

Chemical Requirements	Percent
Silicon Dioxide (SiO_2) [a]	90 min.
Loss on ignition	5.0 max.
Total Alkalies (as Na_2O) equivalent	3.0 max.

Physical Requirements	Percent
Particle size distribution Less than 45 microns Less than 10 microns	 95 50
Strength Activity Index with portland cement [b] 7 days 28 days	 95 (minimum % of control) 110 (minimum % of control)
Expansion at 16 days when testing job materials in conformance with ASTM C 1567 [c]	0.10 max.
Surface Area when testing by nitrogen adsorption in conformance with ASTM D 5604	40.0 m^2/g min.

Notes:
[a] A maximum of 1.0% of the SiO_2 may exist in crystalline form.
[b] When tested in conformance with the requirements for strength activity testing of silica fume in AASHTO Designation: M 307
[c] In the test mix, Type II or Type V portland cement shall be replaced with at least 12% RHA by weight.

Rice hull ash will be considered as a Type UF SCM for the purposes of calculating cementitious material requirements in Section 90-2.01C, "Required Use of Supplementary Cementitious Materials," of the Standard Specifications and these special provisions.

8-2.02 CONTRACTOR QUALITY CONTROL (CONCRETE PAVEMENT)

GENERAL

Summary

This work includes controlling concrete pavement quality.
Comply with Section 40-1.03, "Quality Control and Assurance," of the Standard Specifications.

Submittals

Before starting paving activities, submit:

1. Quality control plan (QCP). The Engineer has 15 days to review and accept.
2. Plan showing the beam curing area and water service. The Engineer has 5 business days to review and accept.

QCP must include the following additional requirements:

1. Name and qualifications of a Quality Control Manager (QCM). The QCM administers the QCP. Give the QCM authority to make decisions concerning work and product quality. The QCM must be available at the job site during paving. The QCM may not delegate authority except in emergencies and with the Engineer's approval. The QCM must not be a foreman or a production or paving crew member.
2. Organization chart showing quality control lines of authority.
3. List of names and phone numbers of individuals and alternates responsible for quality control including:

    3.1. Administration
    3.2. Sampling
    3.3. Testing
    3.4. Inspection

4. List of inspection, sampling, and testing personnel with their:

    4.1. Names
    4.2. Duties
    4.3. Qualifications
    4.4. Experience

5. For each laboratory used:

    5.1. Laboratory name and location
    5.2. Name and qualifications of a Laboratory Quality Control Manager
    5.3. Names of testers

6. Approved:

    6.1. Test result forms
    6.2. Roadway and plant inspection forms
    6.3. Daily Quality Control Summary form
    6.4. Compliance charts

7. Random sampling methods
8. List of testing and sampling equipment to be used
9. Current calibration dates and charts

If there are changes to quality control procedures or personnel, modify the QCP with a supplement. Until the Engineer accepts the changes, do not produce or place concrete pavement.

Documentation forms include:

1. Data sheets for test results and calculations
2. Daily Quality Control Summary Sheet that facilitates the Engineer's computation of moving test averages and describes quality control actions to be taken, including adjustments to:

    2.1. Aggregate proportions
    2.2. Admixture proportions
    2.3. Moisture

Submit documents for testing and inspection. Documents must indicate:

1. Nature and number of observations
2. Number and type of deficiencies
3. Quantities accepted and rejected
4. Corrective action taken

Submit construction activity documents before contract acceptance.

Quality Control and Assurance

Provide quality control inspectors and testers for concrete pavement production and placement.

Inspectors must inspect concrete pavement construction equipment for proper operation periodically as specified in the QCP.

Calibrate testing equipment under the equipment manufacturer's instructions.

Provide a testing facility at the plant site or job site.

Allow the Engineer use of the testing facility including the facility's:

1. Telephone
2. Copying machine
3. Facsimile machine

Provide a safe and secure area for the Engineer to cure beam specimens. The curing area must include access to potable water through a pressurized water line with a hose bib.

Develop and maintain a filing system for construction activity documents including:

1. Reports
2. Charts
3. Records
4. Diaries

For the early age concrete pavement stress/strength system, use the latest version of HiperPav computer program or an equal prediction model.

PAYMENT

The Department does not adjust payment or contract time for repair work required when the QCM or quality control inspectors identify a deficiency.

Full compensation for Contractor quality control is included in the contract price paid per cubic yard for concrete pavement as designated in the Engineer's Estimate and no separate payment will be made therefor.

SECTION 8-3. WELDING

8-3.01 WELDING

GENERAL

Unless otherwise noted in these special provisions, Section 8-3, Welding, applies to all welded materials associated with this project.

Flux cored welding electrodes conforming to the requirements of AWS A5.20 E6XT-4 or E7XT-4 shall not be used to perform welding for this project.

Wherever reference is made to the following AWS welding codes in the Standard Specifications, on the plans, or in these special provisions, the year of adoption for these codes shall be as listed:

AWS Code	Year of Adoption
D1.1	2008
D1.3	2008
D1.4	2005
D1.5	2008
D1.6	2007
D1.8	2009

Requirements of the AWS welding codes shall apply unless otherwise specified in the Standard Specifications, on the plans, or in these special provisions. Wherever the abbreviation AWS is used, it shall be equivalent to the abbreviations ANSI/AWS or AASHTO/AWS.

Inspection and approval of all joint preparations, assembly practices, joint fit-ups, welding techniques, and the performance of each welder, welding operator, and tack welder shall be documented by the QC Inspector on a daily basis for each day welding is performed. For each inspection, including fit-up, Welding Procedure Specification (WPS) verification, and final weld inspection, the QC Inspector shall confirm and document compliance with the requirements of the AWS or other specified code criteria and the requirements of these special provisions on all welded joints before welding, during welding, and after the completion of each weld.

The Engineer shall have the authority to verify the qualifications or certifications of any welder, QC Inspector, or NDT personnel to specified levels by retests or other means approved by the Engineer.

When joint weld details that are not prequalified to the details of Clause 3 of AWS D1.1 or to the details of Figure 2.4 or 2.5 of AWS D1.5 are proposed for use in the work, the joint details, their intended locations, and the proposed welding parameters and essential variables, shall be approved by the Engineer. The Contractor shall allow the Engineer 15 days to complete the review of the proposed joint detail locations. In the event the Engineer fails to complete the review within the time allowed, and if, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

In addition to the requirements of AWS D1.1, welding procedure qualifications for work welded in conformance with the code shall conform to the following:

When a nonstandard weld joint is to be made using a combination of WPSs, a single test may be conducted combining the WPSs to be used in production, provided the essential variables, including weld bead placement, of each process are limited to those established in Table 4.5.

Upon approval of the proposed joint detail locations and qualification of the proposed joint details, welders and welding operators using these details shall perform a qualification test plate using the WPS variables and the joint detail to be used in production. The test plate shall have the maximum thickness to be used in production and a minimum length of 18 inches. The test plate shall be mechanically and radiographically tested. Mechanical and radiographic testing and acceptance criteria shall be as specified in the applicable AWS codes.

The Engineer will witness all qualification tests for WPSs that were not previously approved by the Department. Unless otherwise specified, an approved independent third party will witness the qualification tests for welders or welding operators. The independent third party shall be a current CWI and shall not be an employee of the contractor performing the welding.

In addition to the requirements specified in the applicable code, the period of effectiveness for a welder's or welding operator's qualification shall be a maximum of 3 years for the same weld process, welding position, and weld type. If welding will be performed without gas shielding, then qualification shall also be without gas shielding. Excluding welding of fracture critical members, a valid qualification at the beginning of work on a contract will be acceptable for the entire period of the contract, as long as the welder's or welding operator's work remains satisfactory. The Contractor shall allow the Engineer 15 days to review the qualifications and copy of the current certification of the independent third party. In the event the Engineer fails to complete the review within the time allowed, and if, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

The Contractor shall notify the Engineer 7 days prior to performing any procedure qualification tests. Witnessing of qualification tests by the Engineer shall not constitute approval of the intended joint locations, welding parameters, or essential variables. The Contractor shall notify the Engineer using the "Standard TL-38 Inspection Form" located at:

http://www.dot.ca.gov/hq/esc/Translab/OSM/smbforms.htm

Clause 6.14.6, "Personnel Qualification," of AWS D1.1, Section 7.8, "Personnel Qualification," of AWS D1.4, and Clause 6.1.3.4, "Personnel Qualification," of AWS D1.5 are replaced with the following:

Personnel performing nondestructive testing (NDT) shall be qualified and certified in conformance with the requirements of the American Society for Nondestructive Testing (ASNT) Recommended Practice No. SNT-TC-1A and the Written Practice of the NDT firm. The Written Practice of the NDT firm shall meet or exceed the guidelines of the ASNT Recommended Practice No. SNT-TC-1A. Individuals who perform NDT, review the results, and prepare the written reports shall be either:

A. Certified NDT Level II technicians, or;
B. Level III technicians who hold a current ASNT Level III certificate in that discipline and are authorized and certified to perform the work of Level II technicians.

Clause 6.6.5, "Nonspecified NDT Other than Visual," of AWS D1.1, Section 7.6.5 of AWS D1.4 and Clause 6.6.5 of AWS D1.5 shall not apply.

For any welding, the Engineer may direct the Contractor to perform NDT that is in addition to the visual inspection or NDT specified in the AWS or other specified welding codes, in the Standard Specifications, or in these special provisions. Except as provided for in these special provisions, additional NDT required by the Engineer, and associated repair work, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications. Prior to release of welded material by the Engineer, if testing by NDT methods other than those originally specified discloses an attempt to defraud or reveals a gross nonconformance, all costs associated with the repair of the deficient area, including NDT of the weld and of the repair, and any delays caused by the repair, shall be at the Contractor's expense. A gross nonconformance is defined as the sum of planar type rejectable indications in more than 20 percent of the tested length.

When less than 100 percent of NDT is specified for any weld, it is expected that the entire length of weld meet the specified acceptance-rejection criteria. Should any welding deficiencies be discovered by additional NDT directed or performed by the Engineer that utilizes the same NDT method as that originally specified, all costs associated with the repair of the deficient area, including NDT of the weld and of the weld repair, and any delays caused by the repair, shall be at the Contractor's expense.

Repair work to correct welding deficiencies discovered by visual inspection directed or performed by the Engineer, and any associated delays or expenses caused to the Contractor by performing these repairs, shall be at the Contractor's expense.

WELDING QUALITY CONTROL

Welding quality control shall conform to the requirements in the AWS or other specified welding codes, the Standard Specifications, and these special provisions.

Unless otherwise specified, welding quality control shall apply when any work is welded in conformance with the provisions in Section 49, "Piling," Section 52, "Reinforcement," Section 55, "Steel Structures," or Section 75-1.035, "Bridge Joint Restrainer Units," of the Standard Specifications or structural steel for building work.

The Contractor shall designate in writing a welding Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for the quality of welding, including materials and workmanship, performed by the Contractor and subcontractors.

The QCM shall be the sole individual responsible to the Contractor for submitting, receiving, reviewing, and approving all correspondence, required submittals, and reports to and from the Engineer. The QCM shall be a registered professional engineer or shall be currently certified as a CWI.

Unless the QCM is hired by a subcontractor providing only QC services, the QCM shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project. The QCM may be an employee of the Contractor.

The QCM shall sign and furnish to the Engineer, a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each item of work for which welding was performed. The certificate shall state that all of the materials and workmanship incorporated in the work, and all required tests and inspections of this work, have been performed in conformance with the details shown on the plans, the Standard Specifications, and these special provisions.

Welding inspection personnel or NDT firms to be used in the work shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project, except for the following condition:

A. The work is welded in conformance with AWS D1.5 and is performed at a permanent fabrication or manufacturing facility that is certified under the AISC Quality Certification Program, Category CBR, Major Steel Bridges and Fracture Critical endorsement F, when applicable.

For welding performed at such facilities, the inspection personnel or NDT firms may be employed or compensated by the facility performing the welding provided the facility maintains a QC program that is independent from production.

Prior to submitting the Welding Quality Control Plan (WQCP) required herein, a prewelding meeting between the Engineer, the Contractor's QCM, and a representative from each entity performing welding or inspection for this project, shall be held to discuss the requirements for the WQCP.

Information regarding the contents, format, and organization of a WQCP, is available at the Transportation Laboratory and at:

http://www.dot.ca.gov/hq/esc/Translab/OSM/smbresources.htm

The Contractor shall submit to the Engineer, in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, 2 copies of a separate WQCP for each subcontractor or supplier for each item of work for which welding is to be performed.

The Contractor shall allow the Engineer 15 days to review the WQCP submittal after a complete plan has been received. No welding shall be performed until the WQCP is approved in writing by the Engineer. In the event the Engineer fails to complete the review within the time allowed, and if, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

An amended WQCP or any addendum to the approved WQCP shall be submitted to, and approved in writing by the Engineer, for proposed revisions to the approved WQCP. An amended WQCP or addendum will be required for revisions to the WQCP, including but not limited to a revised WPS; additional welders; changes in NDT firms, QC, or NDT personnel or procedures; or updated systems for tracking and identifying welds. The Engineer shall have 7 days to complete the review of the amended WQCP or addendum. Work affected by the proposed revisions shall not be performed until the amended WQCP or addendum has been approved. In the event the Engineer fails to complete the review within the time allowed, and if, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

After final approval of the WQCP, amended WQCP, or addendum, the Contractor shall submit 7 copies to the Engineer of the approved documents. A copy of the Engineer approved document shall be available at each location where welding is to be performed.

All welding will require inspection by the Engineer. The Contractor shall request inspection at least 3 business days prior to the beginning of welding for locations within California and 5 business days for locations outside of California. The Contractor shall request inspection at:

http://www.dot.ca.gov/hq/esc/Translab/OSM/smbforms.htm

Continuous inspection shall be provided when any welding is being performed. Continuous inspection, as a minimum, shall include having a QC Inspector within such close proximity of all welders or welding operators so that inspections by the QC Inspector of each welding operation at each welding location does not lapse for a period exceeding 30 minutes.

A daily production log for welding shall be kept for each day that welding is performed. The log shall clearly indicate the locations of all welding. The log shall include the welders' names, amount of welding performed, any problems or deficiencies discovered, and any testing or repair work performed, at each location. The daily report from each QC Inspector shall also be included in the log.

The following items shall be included in a Welding Report that is to be submitted to the Engineer within 15 days following the performance of any welding:

A. A daily production log.
B. Reports of all visual weld inspections and NDT.
C. Radiographs and radiographic reports, and other required NDT reports.
D. A summary of welding and NDT activities that occurred during the reporting period.
E. Reports of each application of heat straightening.
F. A summarized log listing the rejected lengths of weld by welder, position, process, joint configuration, and piece number.
G. Documentation that the Contractor has evaluated all radiographs and other nondestructive tests and corrected all rejectable deficiencies, and that all repaired welds have been reexamined using the required NDT and found acceptable.

The following information shall be clearly written on the outside of radiographic envelopes: name of the QCM, name of the nondestructive testing firm, name of the radiographer, date, contract number, complete part description, and all included weld numbers, report numbers, and station markers or views, as detailed in the WQCP. In addition, all interleaves shall have clearly written on them the part description and all included weld numbers and station markers or views, as detailed in the WQCP. A maximum of 2 pieces of film shall be used for each interleave.

Reports of all visual inspections and NDT shall be signed by the inspector or technician and submitted daily to the QCM for review and signature prior to submittal to the Engineer. Corresponding names shall be clearly printed or typewritten next to all signatures. Reports of all NDT, whether specified, additional, or informational, performed by the Contractor shall be submitted to the Engineer.

The Engineer will review the Welding Report to determine if the Contractor is in conformance with the WQCP. Except for field welded steel pipe piling, the Engineer shall be allowed 15 days to review the report and respond in writing after the complete Welding Report has been received. Prior to receiving notification from the Engineer of the Contractor's conformance with the WQCP, the Contractor may encase in concrete or cover welds for which the Welding Report has been submitted. However, should the Contractor elect to encase or cover those welds prior to receiving notification from the Engineer, it is expressly understood that the Contractor shall not be relieved of the responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection. Should the Contractor elect to wait to encase or cover welds pending notification by the Engineer, and in the event the Engineer fails to complete the review within the time allowed, and if, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

For field welded steel pipe piling, including bar reinforcement in the piling, the Contractor shall allow the Engineer 2 business days to review the Welding Report and respond in writing after the required items have been received. No field welded steel pipe piling shall be installed, and no reinforcement in the piling shall be encased in concrete until the Engineer has approved the above requirements in writing.

In addition to the requirements in AWS D1.1 and AWS D1.5, third-time excavations of welds or base metal to repair unacceptable discontinuities, regardless of NDT method, and all repairs of cracks require prior approval of the Engineer.

The Engineer shall be notified immediately in writing when welding problems, deficiencies, base metal repairs, or any other type of repairs not submitted in the WQCP are discovered, and also of the proposed repair procedures to correct them. For requests to perform third-time repairs or repairs of cracks, the Contractor shall include an engineering evaluation of the proposed repair. The engineering evaluation, at a minimum, shall address the following:

A. What is causing each defect?
B. Why the repair will not degrade the material properties?
C. What steps are being taken to prevent similar defects from happening again?

The Contractor shall allow the Engineer 7 days to review these procedures. No remedial work shall begin until the repair procedures are approved in writing by the Engineer. In the event the Engineer fails to complete the review within the time allowed, and if, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

Unless otherwise specified, Clauses 6.1.3 through 6.1.4.3 of AWS D1.1, Section 7.1.2 of AWS D1.4, and Clauses 6.1.1.2 through 6.1.3.3 of AWS D1.5 are replaced with the following:

The QC Inspector shall be the duly designated person who acts for and on behalf of the Contractor for inspection, testing, and quality related matters for all welding.

Quality Assurance (QA) is the prerogative of the Engineer. The QA Inspector is the duly designated person who acts for and on behalf of the Engineer.

The QC Inspector shall be responsible for quality control acceptance or rejection of materials and workmanship, and shall be currently certified as an AWS Certified Welding Inspector (CWI) in conformance with the requirements in AWS QC1, "Standard for AWS Certification of Welding Inspectors."

The QC Inspector may be assisted by an Assistant QC Inspector provided that this individual is currently certified as an AWS Certified Associate Welding Inspector (CAWI) in conformance with the requirements in AWS QC1, "Standard for AWS Certification of Welding Inspectors." The Assistant QC Inspector may perform inspection under the direct supervision of the QC Inspector provided the assistant is always within visible and audible range of the QC Inspector. The QC Inspector shall be responsible for signing all reports and for determining if welded materials conform to workmanship and acceptance criteria. The ratio of QC Assistants to QC Inspectors shall not exceed 5 to 1.

When the term "Inspector" is used without further qualification, it shall refer to the QC Inspector.

Clause 6.5.4 of AWS D1.5 is replaced with the following:

The QC Inspector shall inspect and approve each joint preparation, assembly practice, welding technique, joint fit-up, and the performance of each welder, welding operator, and tack welder to make certain that the applicable requirements of this code and the approved Welding Procedure Specification (WPS) are met. The QC Inspector shall examine the work to make certain that it meets the requirements of Clauses 3 and 6.26. The size and contour of all welds shall be measured using suitable gages. Visual inspection for cracks in welds and base metal, and for other discontinuities shall be aided by strong light, magnifiers, or such other devices as may be helpful. Acceptance criteria different from those specified in this code may be used when approved by the Engineer.

In addition to the requirements of AWS D1.5, Clause 5.12 or 5.13, welding procedures qualification for work welded in conformance with that code shall conform to the following requirements:

A. Unless considered prequalified, fillet welds shall be qualified in each position. The fillet weld soundness test shall be conducted using the essential variables of the WPS as established by the Procedure Qualification Record (PQR).
B. For qualification of joints that do not conform to Figures 2.4 and 2.5 of AWS D1.5, a minimum of two WPS qualification tests are required. The tests shall be conducted using both Figure 5.1 and Figure 5.3. The test conforming to Figure 5.1 shall be conducted in conformance with AWS D1.5, Clause 5.12 or 5.13. The test conforming to Figure 5.3 shall be conducted using the welding electrical parameters that were established for the test conducted conforming to Figure 5.1. The ranges of welding electrical parameters established during welding per Figure 5.1 in conformance with AWS D1.5, Clause 5.12, shall be further restricted according to the limits in Table 5.3 during welding per Figure 5.3.
C. Multiple zones within a weld joint may be qualified. The travel speed, amperage, and voltage values that are used for tests conducted per AWS D1.5 Clause 5.13 shall be consistent for each pass in a weld joint, and shall in no case vary by more than ±10 percent for travel speed, ±10 percent for amperage, and ±7 percent for voltage as measured from a predetermined target value or average within each weld pass or zone. The travel speed shall in no case vary by more than ±15 percent when using submerged arc welding.
D. For a WPS qualified in conformance with AWS D1.5 Clause 5.13, the values to be used for calculating ranges for current and voltage shall be based on the average of all weld passes made in the test. Heat input shall be calculated using the average of current and voltage of all weld passes made in the test for a WPS qualified in conformance with Clause 5.12 or 5.13.
E. Macroetch tests are required for WPS qualification tests, and acceptance shall be per AWS D1.5 Clause 5.19.3.
F. When a nonstandard weld joint is to be made using a combination of WPSs, a test conforming to Figure 5.3 may be conducted combining the WPSs to be used in production, provided the essential variables, including weld bead placement, of each process are limited to those established in Table 5.3.
G. Prior to preparing mechanical test specimens, the PQR welds shall be inspected by visual and radiographic tests. Backing bar shall be 3 inches in width and shall remain in place during NDT testing. Results of the visual and radiographic tests shall comply with AWS D1.5 Clause 6.26.2, excluding Clause 6.26.2.2. Test plates that do not comply with both tests shall not be used.

PAYMENT

Full compensation for conforming to the requirements of "Welding" shall be considered as included in the contract prices paid for the various items of work involved and no additional compensation will be allowed therefor.

SECTION 9. DESCRIPTION OF STRUCTURAL WORK

The work to be done consists, in general, of constructing the following structures as shown on the plans:

SOUTHBOUND BATTERY TUNNEL AND RETAINING WALLS A AND B
(Bridge No. 34-0161L)

A. Tunnel: A cut-and-cover, cast-in-place reinforced concrete tunnel approximately 1036 feet in length, 66 feet to 72 feet in width and 30 feet in height, including Retaining Wall C.
B. Retaining Walls A and B: Temporary steel soldier pile shoring walls with lagging, tiebacks, walers, and struts approximately 954 feet in length for Retaining Wall A and 1017 feet in length for Retaining Wall B.

RETAINING WALL NO. 8
(Bridge No. 34E0014)

A permanent retaining wall including sections of conventional retaining wall and footing with Cast-In-Drilled Hole (CIDH) concrete piles, sections of cantilevered steel soldier piles set in tangent-drilled holes with cast-in-place concrete facing, and sections of tangent CIDH concrete pile wall with combination of permanent tiebacks, soldier piles, and cast-in-place concrete facing, approximately 1174 feet in length.

BATTERY SUBSTATION (BRIDGE)
(Bridge No. 34-0157W)

A 3-span reinforced concrete slab bridge supported on CIDH concrete piles approximately 64 feet in length and 62 feet in width with Type 1 reinforced concrete closure walls. The substation building is housed in the space underneath the bridge structure.

BATTERY SUBSTATION
(Bridge No. 34-0157W)

The substation building in the space underneath the bridge structure will house substation equipment room, traffic operations room and tunnel control room.

MARINA VIADUCT (BRIDGE REMOVAL)
(Bridge No. 34-0014)

Stage removal of a multi-span viaduct structure with ramps approximately 3308 feet in length measured along Route 101 with varying widths.

SECTION 10. CONSTRUCTION DETAILS

SECTION 10-1. GENERAL

10-1.00 CONSTRUCTION PROJECT INFORMATION SIGNS

Before any major physical construction work readily visible to highway users is started on this contract, the Contractor shall furnish and erect 1 Type 1 Construction Project Information signs at the locations designated by the Engineer.

The signs and overlays shall be of a type and material consistent with the estimated time of completion of the project and shall conform to the details shown on the plans.

The sign letters, the border and the Department's construction logos shall conform to the colors (non-reflective) and details shown on the plans, and shall be on a white background (non-reflective). The colors blue and orange shall conform to PR Color Number 3 and Number 6, respectively, as specified in the Federal Highway Administration's Color Tolerance Chart.

The sign message to be used for fund types shall consist of the following, in the order shown:

FEDERAL HIGHWAY TRUST FUNDS
STATE HIGHWAY FUNDS
AB 1171 TOLL REVENUES
SAN FRANCISCO COUNTY TRANSPORTATION FUNDS

The sign message to be used for type of work shall consist of the following:

HIGHWAY CONSTRUCTION
BRIDGE CONSTRUCTION

The sign message to be used for the Year of Completion of Project Construction will be furnished by the Engineer. The Contractor shall furnish and install the "Year" sign overlay within 10 working days of notification of the year date to be used.

The letter sizes to be used shall be as shown on the plans. The information shown on the signs shall be limited to that shown on the plans.

The signs shall be kept clean and in good repair by the Contractor.

Upon completion of the work, the signs shall be removed and disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13 of the Standard Specifications.

Full compensation for furnishing, erecting, maintaining, and removing and disposing of the construction project information signs shall be considered as included in the contract lump sum price paid for construction area signs and no additional compensation will be allowed therefor.

10-1.01 ORDER OF WORK

Order of work shall conform to the provisions in Section 5-1.05, "Order of Work," of the Standard Specifications and these special provisions.

Attention is directed to "Rock Excavation (Controlled Blasting)," "Vibration Monitoring" and "Survey of Existing Non-Highway Facilities," of these special provisions and Section 5-1.18, "Property and Facility Preservation" and Section 7-1.01, "Laws to be Observed," of the Standard Specifications, regarding the damage and repair to historical resources. Repair of damage to historical resources must comply with the U.S. Secretary of the Interior's Standards for the Treatment of Historic Properties and can be found at the following web site:

http://www.nps.gov/history/hps/tps/standards/index.htm

Attention is directed to "Archaeological Monitoring Area" of these special provisions and Section 14-2.02, "Archaeological Resources" of the Standard Specifications. Boulders and cobblestones, as determined by the Engineer or archaeological monitor, are considered as an archaeological resource and must be documented in situ and salvaged when discovered during any earth moving operation. The materials to be salvaged, as determined by the Engineer or the archaeological monitor, shall remain the property of the Presidio Trust, and shall be hauled to Building 666, within the Presidio.

Prior to the start of the operation for cold plane asphalt concrete pavement, the Contractor shall have a certified hot mix asphalt plant and an approved mix design for the initial hot mix asphalt paving layer.

Attention is directed to "Environmentally Sensitive Area," "Temporary Fence (Type CL-6, Slatted)" and "Temporary Fence (Type ESA)," of these special provisions. Existing temporary fence (Type CL-6, slatted), temporary reinforced silt fence or temporary fence (Type ESA) may be present in the work area. The Contractor must maintain and remove existing temporary fence (Type CL-6, slatted), temporary reinforced silt fence or temporary fence (Type ESA), as shown on the plans or as directed by the Engineer. Maintaining and removal of existing temporary fence (Type CL-6, slatted), and temporary fence (Type ESA) will be measured and paid for as temporary fence (Type CL-6, slatted), and temporary fence (Type ESA). Maintaining and removal of existing temporary reinforced silt fence-will be measured and paid for as temporary fence (Type ESA).

The areas for Contractor's use shall be vacated and restored to original conditions, as a condition for contract acceptance.

A first order of work shall be ordering structural steel members, steel piling, and treated timber lagging.

Shotcrete test panels shall be constructed and tested before any shotcrete work is performed.

A Conceptual Storm Water Pollution Prevention Plan (SWPPP) has been prepared for this Contract as described in "Supplemental Project Information," of these special provisions. The Contractor shall adhere to the Conceptual SWPPP for all construction activities planned for the first 60 days after contract approval, or until the Contractor's SWPPP as required in "Water Pollution Control," of these special provisions is approved by the Engineer. The Contractor shall sign the "Initial SWPPP Certification," included within the Conceptual SWPPP and submit it to the Engineer. The Contractor's SWPPP shall supersede the Conceptual SWPPP upon Engineer's approval.

Attention is directed to "Environmentally Sensitive Area" and "Temporary Fence (Type ESA)" of these special provisions. Prior to beginning work, the boundaries of the Environmentally Sensitive Areas (ESA) shall be clearly delineated in the field. The boundaries shall be delineated by the installation of temporary fence (Type ESA).

The order of work for the Battery Substation shall be as follows:

A. Perform part of the short circuit, protection, and coordination study on the Power Distribution System shown on the plans for Doyle Drive in order to determine the initial parameters of the Secondary Unit Substation and Utility Service. Order the Utility service on both the Battery Tunnel side and the Main Post Tunnel side of Doyle Drive. Order the Secondary Unit Substation, Motor Control Centers, and the Switchboard for the Battery Substation of Doyle Drive.
B. Install the underground conduits, conductors, and cables; and the Grounding Electrode System of the Battery Substation. Order all other equipment for the Battery Substation and Southbound Tunnel.
C. Perform the "Arc flash Hazard study" part of the "Power System Testing" specifications for the Battery Substation. Install all the equipment of the Battery Substation in the substation.

D. Install the underground conduits, conductors, and cables; and the Grounding Electrode System of the Southbound Tunnel. Install all the equipment of the Southbound Tunnel in the tunnel
E. Close the Incoming Medium Voltage Circuit Breaker of the Battery Substation and open the Tie Medium Voltage Circuit Breaker (Commission the System and test the power distribution system).
F. Commission the Battery Southbound Tunnel System.
G. Install channelised AM and FM rebroadcast systems in the Battery Substation.
H. Install AM and FM rebroadcast antenna in the Battery Tunnel.

A first order of work shall be to place the order for the electrical equipment. The Engineer shall be furnished a statement from the vendor that the order for the electrical equipment has been received and accepted by the vendor.

The uppermost layer of new pavement shall not be placed until all underlying conduits and loop detectors have been installed.

Prior to commencement of the traffic signal functional test at any location, all items of work related to signal control shall be completed and all roadside signs, pavement delineation, and pavement markings shall be in place at that location.

Attention is directed to "Maintaining Traffic" of these special provisions and to the stage construction sheets of the plans.

Attention is directed to "Progress Schedule (Critical Path Method)" of these special provisions regarding the submittal of a general time-scaled logic diagram within 10 days after approval of the contract. The diagram shall be submitted prior to performing any work that may be affected by any proposed deviations to the construction staging of the project.

The work shall be performed in conformance with the stages of construction shown on the plans. Nonconflicting work in subsequent stages may proceed concurrently with work in preceding stages, provided satisfactory progress is maintained in the preceding stages of construction.

In each stage, after completion of the preceding stage, the first order of work shall be the removal of existing pavement delineation as directed by the Engineer. Pavement delineation removal shall be coordinated with new delineation so that lane lines are provided at all times on traveled ways open to public traffic.

Before obliterating any pavement delineation (traffic stripes, pavement markings, and pavement markers) that is to be replaced on the same alignment and location, as determined by the Engineer, the pavement delineation shall be referenced by the Contractor, with a sufficient number of control points to reestablish the alignment and location of the new pavement delineation. The references shall include the limits or changes in striping pattern, including one- and 2-way barrier lines, limit lines, crosswalks and other pavement markings. Full compensation for referencing existing pavement delineation shall be considered as included in the contract prices paid for new pavement delineation and no additional compensation will be allowed therefor.

Prior to applying HMA (Type A), the Contractor shall cover all manholes, valve and monument covers, grates, or other exposed facilities located within the area of application, using a plastic or oil resistant construction paper secured to the facility being covered by tape or adhesive. The covered facilities shall be referenced by the Contractor, with a sufficient number of control points to relocate the facilities after the HMA (Type A) has been placed. After completion of the HMA (Type A) operation, all covers shall be removed and disposed of in a manner satisfactory to the Engineer. Full compensation for covering manholes, valve and monument covers, grates, or other exposed facilities, referencing, and removing temporary cover shall be considered as included in the contract price paid per ton for HMA (Type A), and no additional compensation will be allowed therefor.

At the end of each working day if a difference in excess of 0.15 foot exists between the elevation of the existing pavement and the elevation of excavations within 8 feet of the traveled way, material shall be placed and compacted against the vertical cuts adjacent to the traveled way. During excavation operations, native material may be used for this purpose; however, once placing of the structural section commences, structural material shall be used. The material shall be placed to the level of the elevation of the top of existing pavement and tapered at a slope of 4:1 (horizontal:vertical) or flatter to the bottom of the excavation. Treated base shall not be used for the taper. Full compensation for placing the material on a 4:1 slope, regardless of the number of times the material is required, and subsequent removing or reshaping of the material to the lines and grades shown on the plans shall be considered as included in the contract price paid for the materials involved and no additional compensation will be allowed therefor. No payment will be made for material placed in excess of that required for the structural section.

At those locations exposed to public traffic where guard railings or barriers are to be constructed, reconstructed, or removed and replaced, the Contractor shall schedule operations so that at the end of each working day there shall be no post holes open nor shall there be any railing or barrier posts installed without the blocks and rail elements assembled and mounted thereon.

At least 60 days before applying seeds, furnish the Engineer a statement from the vendor that the order for the seed required for this contract has been received and accepted by the vendor. The statement from the vendor must include the names and quantity of seed ordered and the anticipated date of delivery.

10-1.02 WATER POLLUTION CONTROL

GENERAL

Water pollution control work shall conform to the provisions in Section 7-1.01G, "Water Pollution," of the Standard Specifications, section of these special provisions entitled "Relations With California Regional Water Quality Control Board," and these special provisions.

A Conceptual Storm Water Pollution Prevention Plan (CSWPPP) has been prepared for this contract and is available as described in "Project Information" of these special provisions.

The Contractor may obtain other National Pollutant Discharge Elimination System (NPDES) permits that apply to activities and mobile operations within or outside of the project limits including hot mix asphalt batch plants, material borrow areas, concrete plants, staging areas, storage yards, or access roads.

The Contractor shall perform water pollution control work in conformance with the requirements in the "Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual" and its addenda in effect on the day the Notice to Contractors is dated. This manual is referred to as the "Preparation Manual." Copies of the Preparation Manual may be obtained from:

State of California
Department of Transportation
Publication Distribution Unit
1900 Royal Oaks Drive
Sacramento, California 95815
Telephone: (916) 445-3520

The Preparation Manual and other references for performing water pollution control work are available from the Department's Construction Storm Water and Water Pollution Control web site at:

http://www.dot.ca.gov/hq/construc/stormwater/stormwater1.htm

Before the start of job site activities, the Contractor shall provide training for project managers, supervisory personnel, and employees involved with water pollution control work. The training shall include:

A. Rules and regulations
B. Implementation and maintenance for:

    1. Temporary Soil Stabilization
    2. Temporary Sediment Control
    3. Tracking Control
    4. Wind Erosion Control

The Contractor shall designate in writing a Water Pollution Control Manager (WPCM). The Contractor shall submit a statement of qualifications describing the training, work history, and expertise of the proposed WPCM. The qualifications shall include either:

A. A minimum of 24 hours of Department approved storm water management training described at Department's Construction Storm Water and Water Pollution Control web site.
B. Certification as a Certified Professional in Erosion and Sediment Control (CPESC).

The WPCM shall be:

A. Responsible for water pollution control work.
B. The primary contact for water pollution control work.
C. Have authority to mobilize crews to make immediate repairs to water pollution control practices.

The Contractor may designate one manager to prepare the SWPPP and a different manager to implement the plan. The WPCP preparer shall meet the training requirements for the WPCM.

STORM WATER POLLUTION PREVENTION PLAN

The Contractor shall submit a Storm Water Pollution Prevention Plan (SWPPP) to the Engineer for approval. The SWPPP shall conform to the requirements in the Preparation Manual, the NPDES permit, and these special provisions. The SWPPP shall be submitted in place of the water pollution control program required by the provisions in Section 7-1.01G, "Water Pollution," of the Standard Specifications.

The SWPPP shall include water pollution control practices:

A. For storm water and non-storm water from areas outside of the job site related to construction activities for this contract such as:

   1. Staging areas.
   2. Storage yards.
   3. Access roads.

B. Appropriate for each season as described in "Implementation Requirements" of these special provisions.
C. For activities or mobile operations related to all NPDES permits.

The SWPPP shall include a schedule that:

A. Describes when work activities that could cause water pollution will be performed.
B. Identifies soil stabilization and sediment control practices for disturbed soil area.
C. Includes dates when these practices will be 25, 50, and 100 percent complete.
D. Shows 100 percent completion of these practices before the rainy season.

The SWPPP shall include the following temporary water pollution control practices and their associated contract items of work as shown on the plans or specified in these special provisions:

A. Temporary Soil Stabilization

   1. Temporary Hydraulic Mulch (Bonded Fiber Matrix)
   2. Temporary Cover
   3. Move-In/Move-Out (Temporary Erosion Control)
   4. Temporary Fence (Type ESA)
   5. Temporary Erosion Control Blanket

B. Temporary Sediment Control

   1. Temporary Drainage Inlet Protection
   2. Temporary Silt Fence
   3. Temporary Gravel Bag Berm
   4. Temporary Fiber Roll
   5. Temporary Check Dam

C. Tracking Control

   1. Street Sweeping
   2. Temporary Construction Entrance
   3. Temporary Tire Wash System

D. Wind Erosion Control

   1. Temporary Cover

E. Non-Storm Water Management

   1. Construction Site Management

F. Waste Management and Materials Pollution Control

1. Construction Site Management
2. Temporary Concrete Washout (Portable)
3. Temporary Storm Water Run-On Bypass and Excavation Dewatering

The SWPPP shall include the following contract items of work for permanent water pollution control as shown on the plans or as specified in these special provisions:

A. Erosion Control (Hydroseed)
B. Fiber Rolls
C. Erosion Control Product (Netting)
D. Erosion Control (Compost Blanket)
E. Move-In/Move-Out (Erosion Control)

Within 5 days after contract approval, follow this process for SWPPP approval:

1. Submit 3 copies of the SWPPP and allow 15 days for the Engineer's review. If revisions are required, the Engineer provides comments and specifies the date that the review stopped
2. Change and resubmit the SWPPP within 5 days of receipt of the Engineer's comments. The Engineer's review resumes when the complete SWPPP is resubmitted. Allow 5 days for the Engineer's second review
3. When the Engineer approves the SWPPP, submit 4 copies of the approved SWPPP. After approval, the Engineer submits one copy of the approved SWPPP to the San Francisco Bay RWQCB for their review and comment
4. If the San Francisco Bay RWQCB provides comments to the SWPPP, amend the SWPPP within 5 days

If the Engineer fails to complete the review within the time allowed and if, in the opinion of the Engineer, completion of the work is delayed or interfered with because of the Engineer's or the RWQCB's review, the Department pays you for resulting losses, and grants an extension of time.

The SWPPP shall include a copy of the US Army Corps of Engineers Permit, Clean Water Act Section 401 Water Quality Certification from the San Francisco Bay RWQCB.

The Contractor shall not perform work that may cause water pollution until the SWPPP has been approved by the Engineer. The Engineer's review and approval shall not waive any contract requirements and shall not relieve the Contractor from complying with Federal, State and local laws, regulations, and requirements.

The Contractor shall amend the SWPPP annually and shall resubmit it to the Engineer 25 days before the defined rainy season.

If there is a change in construction schedule or activities, the Contractor shall prepare an amendment to the SWPPP to identify additional or revised water pollution control practices. The Contractor shall submit the amendment to the Engineer for review within a time agreed to by the Engineer not to exceed the number of days specified for the initial submittal of the SWPPP. The Engineer will review the amendment within the same time allotted for the review of the initial submittal of the SWPPP.

If directed by the Engineer or requested in writing by the Contractor and approved by the Engineer, changes to the water pollution control work specified in these special provisions will be allowed. Changes may include addition of new water pollution control practices. The Contractor shall incorporate these changes in the SWPPP. Additional water pollution control work will be paid for as extra work in accordance with Section 4-1.03D, "Extra Work," of the Standard Specifications.

The Contractor shall keep a copy of the approved SWPPP at the job site. The SWPPP shall be made available when requested by a representative of the Regional Water Quality Control Board, State Water Resources Control Board, United States Environmental Protection Agency, or the local storm water management agency. Requests from the public shall be directed to the Engineer.

SAMPLING AND ANALYSIS

The Contractor shall include a Sampling and Analysis Plan (SAP) in the SWPPP to monitor the effectiveness of the water pollution control practices. The Contractor shall prepare the SAP in conformance with the Preparation Manual.

The Contractor shall designate trained personnel to collect water quality samples. The personnel and training shall be documented in the SAP. Training shall consist of the following elements:

A. SAP review,
B. Health and safety review, and
C. Sampling simulations.

In the SAP the Contractor shall describe the following water quality sampling procedures:

A. Sampling preparation,
B. Collection,
C. Quality assurance and quality control,
D. Sample labeling,
E. Collection documentation,
F. Sample shipping,
G. Chain of custody,
H. Sample numbering, and
I. Precautions from the construction site health and safety plan.

The Contractor shall document sample collection during precipitation.

Samples to be analyzed in the field shall be taken by the Contractor's designated sampling personnel using collection and analysis methods, and equipment calibration specified by the manufacturer of the sampling equipment. Samples to be analyzed by a laboratory, shall be sampled, preserved, and analyzed by a State-certified laboratory in conformance with the requirements in 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants." The Contractor shall identify the State-certified laboratory, sample containers, preservation requirements, holding times, and analysis method in the SAP. A list of State-certified laboratories that are approved by the Department is available at:

http://www.dhs.ca.gov/ps/ls/ELAP/html/lablist.htm

Non-Visible Pollutants

This project has the potential to discharge non-visible pollutants in storm water from the construction site. The Contractor shall include in the SAP a description of the sampling and analysis strategy to be implemented on the project for monitoring non-visible pollutants.

In the SAP the Contractor shall identify potential non-visible pollutants that will be present on the construction site associated with the following:

A. Construction materials and wastes;
B. Existing contamination due to historical site usage; or
C. Application of soil amendments, including soil stabilization products, with the potential to alter pH or contribute toxic pollutants to storm water.

The Contractor shall show the locations planned for storage and use of the potential non-visible pollutants on the SWPPP Water Pollution Control Drawings.

The Contractor shall include in the SAP the following list of conditions that require sampling when observed during a storm water inspection:

A. Materials or wastes containing potential non-visible pollutants are not stored under watertight conditions.
B. Materials or wastes containing potential non-visible pollutants are stored under watertight conditions, but:

    1. A breach, leakage, malfunction, or spill is observed;
    2. The leak or spill has not been cleaned up before precipitation; and
    3. There is the potential for discharge of non-visible pollutants to surface waters or drainage system.

C. Construction activities; such as application of fertilizer, pesticide, herbicide, methyl methacrylate concrete sealant, or non-pigmented curing compound; have occurred during precipitation or within 24 hours preceding precipitation, and have the potential to discharge pollutants to surface waters or drainage system.
D. Soil amendments, including soil stabilization products, with the potential to alter pH levels or contribute toxic pollutants to storm water runoff have been applied, and have the potential to discharge pollutants to surface waters or drainage system (unless independent test data are available that demonstrate acceptable concentrations of non-visible pollutants in the soil amendment).
E. Storm water runoff from an area contaminated by historical usage of the site has the potential to discharge pollutants to surface waters or drainage system.

The Contractor shall describe in the SAP the schedule for collecting a sample downhill from each non-visible pollutant source and an uncontaminated control sample, during the first 2 hours of discharge from precipitation during daylight hours that result in enough discharge for sample collection. If discharge flows to the non-visible pollutant source, a sample shall be collected immediately downhill from where the discharge enters the Department's right of way. If precipitation occurs again after at least 72 hours of dry weather the Contractor shall take new samples.

In the SAP the Contractor shall identify sampling locations for collecting downstream and control samples, and the reason for their selection. The control sampling location shall be selected so the sample does not come into contact with materials, wastes or areas associated with potential non-visible pollutants or disturbed soil areas. The Contractor shall show non-visible pollutant sampling locations on the SWPPP Water Pollution Control Drawings.

The Contractor shall identify in the SAP the analytical method to be used for downhill and control samples for potential non-visible pollutants on the project.

Analytical Results and Evaluation

The Contractor shall submit a hard copy and electronic copy of water quality analytical results, and quality assurance and quality control data to the Engineer within 5 days of sampling for field analyses, and within 30 days for laboratory analyses. The Contractor shall also provide an evaluation of whether the downhill samples show levels of the tested parameter higher than in the control sample. If downhill or downstream samples show increased levels, the Contractor will assess the water pollution control measures, site conditions, and surrounding influences to determine the probable cause for the increase. As determined by the assessment, the Contractor will repair or modify water pollution control measures to address increases and amend the SWPPP as necessary. Electronic results (in one of the following file formats: .xls, .txt, .csv, .dbs, or .mdb) shall have the following information:

A. Sample identification number.
B. Contract number.
C. Constituent.
D. Reported value.
E. Analytical method.
F. Method detection limit.
G. Reported limit.

The Contractor shall maintain the water quality sampling documentation and analytical results with the SWPPP on the project site.

If construction activities or knowledge of site conditions change such that discharges or sampling locations change, the Contractor shall amend the SAP in conformance with this section, "Water Pollution Control."

IMPLEMENTATION REQUIREMENTS

The Contractor's responsibility for SWPPP implementation shall continue throughout any temporary suspension of work ordered in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications.

If the Contractor or the Engineer identifies a deficiency in the implementation of the approved SWPPP, the deficiency shall be corrected immediately, unless an agreed date for correction is approved in writing by the Engineer. The deficiency shall be corrected before the onset of precipitation. If the Contractor fails to correct the deficiency by the agreed date or before the onset of precipitation, the Department may correct the deficiency and deduct the cost of correcting deficiencies from payments.

If the Contractor fails to conform to the provisions of this section, "Water Pollution Control," the Engineer may order the suspension of work until the project complies with the requirements of this section.

Year-Round

The Contractor shall monitor the National Weather Service weather forecast on a daily basis during the contract. The Contractor may use an alternative weather forecasting service if approved by the Engineer. Appropriate water pollution control practices shall be in place before precipitation.

The Contractor may discontinue earthwork operations for a disturbed area for up to 21 days and the disturbed soil area will still be considered active. When earthwork operations in the disturbed area have been completed, the Contractor shall implement appropriate water pollution control practices within 15 days, or before predicted precipitation, whichever occurs first.

Rainy Season

The Contractor shall provide soil stabilization and sediment control practices during the rainy season between October 15 and April 15.

The Contractor shall implement soil stabilization and sediment control practices a minimum of 10 days before the start of the rainy season.

During the defined rainy season, the active disturbed soil area of the project site shall be not more than 5 acres. The Engineer may approve expansions of the active disturbed soil area limit if requested in writing. The Contractor shall maintain soil stabilization and sediment control materials on site to protect disturbed soil areas.

Rain Event Action Plan

The Contractor shall prepare a written Rain Event Action Plan (REAP) as part of the SWPPP. The REAP must describe work to be done to protect exposed areas of the jobsite before predicted storms.

The REAP must include:

1. Title sheet
2. Table of contents
3. Description of the storm event requiring the mobilization of crews and protection of exposed areas:

    3.1. Precipitation predicted by the National Weather Service to occur within 72 hours and have one of the following:

        3.1.1. Probability of at least 40 percent
        3.1.2. Quantity of at least 0.25 inches

4. Pre-storm activities including:

    4.1. Responsibilities of the WPC manager
    4.2. Responsibilities of the crew and crew size
    4.3. Stabilization for active and inactive disturbed soil areas
    4.4. Stockpile management

5. Activities to be done during storm events including:

    5.1. Responsibilities of the WPC manager
    5.2. Responsibilities of the crew and crew size
    5.3. Stabilization for active and inactive disturbed soil areas
    5.4. Stockpile management
    5.5. BMP maintenance

6. Diagram showing drainage patterns including:

    6.1. Surface flow and subsurface drainage systems
    6.2. Run-on flows to the jobsite
    6.3. Flows to drainage inlets and other drainage facilities
    6.4. Modifications to existing surface and subsurface drainage systems
    6.5. Impacts of current work and construction phase

7. Coordination with subcontractors
8. Description of flood contingency measures

The REAP must be revised whenever the SWPPP is amended:

1. At the start of the rainy season
2. When there is a change in the construction schedule or activities

The WPC manager must implement the REAP including mobilizing crews to complete activities before precipitation occurs.

INSPECTION AND MAINTENANCE

The WPCM shall inspect the water pollution control practices identified in the SWPPP as follows:

A. Before a forecasted storm,
B. After precipitation that causes site runoff,
C. At 24-hour intervals during extended precipitation,
D. On a predetermined schedule, a minimum of once every 2 weeks outside of the defined rainy season, and
E. On a predetermined schedule, a minimum of once a week during the defined rainy season.

The WPCM shall oversee the maintenance of the water pollution control practices.

The WPCM shall use the Storm Water Quality Construction Site Inspection Checklist provided in the Preparation Manual or an alternative inspection checklist provided by the Engineer. A copy of the completed site inspection checklist shall be submitted to the Engineer within 24 hours of finishing the inspection.

REPORTING REQUIREMENTS

If the Contractor identifies discharges into surface waters or drainage systems causing or potentially causing pollution, or if the project receives a written notice or order from a regulatory agency, the Contractor shall immediately inform the Engineer. The Contractor shall submit a written report to the Engineer within 7 days of the discharge, notice or order. The report shall include the following information:

A. The date, time, location, and nature of the operation, type of discharge and quantity, and the cause of the notice or order.
B. The water pollution control practices used before the discharge, or before receiving the notice or order.
C. The date of placement and type of additional or altered water pollution control practices placed after the discharge, or after receiving the notice or order.
D. A maintenance schedule for affected water pollution control practices.

Annual Certifications

By June 15 of each year, the Contractor shall complete and submit to the Engineer an Annual Certification of Compliance, as contained in the Preparation Manual.

PAYMENT

During each estimate period the Contractor fails to conform to the provisions in this section, "Water Pollution Control," or fails to implement the water pollution control practices shown on the plans or specified elsewhere in these special provisions as items of work, the Department will withhold 25 percent of the progress payment.

Withholds for failure to perform water pollution control work will be in addition to all other withholds provided for in the contract. The Department will return performance-failure withholds in the progress payment following the correction of noncompliance.

The contract lump sum price paid for prepare storm water pollution prevention plan shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in preparing, obtaining approval of, and amending the SWPPP and inspecting water pollution control practices as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Payments for prepare storm water pollution prevention plan will be made as follows:

A. After the SWPPP has been approved by the Engineer, 50 percent of the contract item price for prepare storm water pollution prevention plan will be included in the monthly progress estimate.
B. Forty percent of the contract item price for prepare storm water pollution prevention plan will be paid over the life of the contract.
C. After acceptance of the contract in conformance with the provisions in Section 7-1.17, "Acceptance of Contract," of the Standard Specifications, payment for the remaining 10 percent of the contract item price for prepare storm water pollution prevention plan will be made in conformance with the provisions in Section 9-1.07A, "Payment Prior to Proposed Final Estimate."

Storm water sampling and analysis will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications. No payment will be made for the preparation, collection, analysis, and reporting of storm water samples where appropriate water pollution control practices are not implemented before precipitation or if a failure of a water pollution control practice is not corrected before precipitation.

Implementation of water pollution control practices in areas outside the highway right of way not specifically provided for in the SWPPP or in these special provisions will not be paid for.

Water pollution control practices for which there are separate contract items of work will be measured and paid for as those contract items of work.

10-1.03 CONSTRUCTION SITE MANAGEMENT

GENERAL

Summary

This work includes controlling potential sources of water pollution before they come in contact with storm water systems or watercourses.

Control material pollution and manage waste and non-storm water at the job site by implementing effective handling, storage, use, and disposal practices.

For information on documents under these special provisions, refer to the Department's Preparation Manual, Dewatering Guide, and BMP Manual.

Preparation Manual, Dewatering Guide, and BMP Manual are available from the Department's Construction Storm Water and Water Pollution Control web site at:

http://www.dot.ca.gov/hq/construc/stormwater/stormwater1.htm

Definitions

BMP Manual: The Department's Construction Site Best Management Practices (BMP) Manual.

Dewatering Guide: The Department's Field Guide to Construction Site Dewatering.

Minor spills: Small quantities of oil, gasoline, paint, or other material that are small enough to be controlled by a first responder upon discovery of the spill.

Preparation Manual: The Department's Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual.

Semi-significant spills: Spills that can be controlled by a first responder with help from other personnel.

Significant or hazardous spills: Spills that cannot be controlled by construction personnel.

Submittals

Submit the following:

1. Material Safety Data Sheet (MSDS) at least 5 days before material is used or stored
2. Monthly inventory records for material used or stored
3. Stormwater training:

    3.1. Include training dates and subject for employees and subcontractors with SWPPP or WPCP. Include dates and subject for ongoing training, including tailgate meetings.

    3.2. Employee training records:

        3.2.1. Within 5 days of SWPPP or WPCP approval for existing employees

        3.2.2. Within 5 days of training for new employees

        3.2.3. At least 5 days before subcontractors begin work for subcontractor's employees

4. Manifest forms for hazardous waste disposal within 5 days of transport and disposal
5. Copy of written approval to discharge into a sanitary sewer system at least 5 days before beginning discharge activities

Quality Control and Assurance

Train all employees and subcontractors in these subjects:

1. Material pollution prevention and control
2. Waste management
3. Non-storm water management

4. Identifying and handling hazardous substances
5. Potential dangers to humans and the environment from spills and leaks or exposure to toxic or hazardous substances

Training must take place before starting work on this job. New employees must receive the complete training before starting work on this job. Conduct weekly meetings to discuss and reinforce spill prevention and control; material delivery, storage, use, and disposal; waste management; and non-storm water management procedures.

MATERIALS

Not used.

CONSTRUCTION

Spill Prevention and Control

Implement spill and leak prevention procedures for chemicals and hazardous substances stored on the job site.

As soon as it is safe, contain and clean up spills of petroleum products, sanitary and septic waste substances listed under CFR Title 40, Parts 110, 117, and 302.

Minor Spills: Clean up minor spills using these procedures:

1. Contain spread of the spill
2. Recover spilled material using absorption
3. Clean contaminated area
4. Dispose of contaminated material promptly and properly

Semi-significant Spills: Clean up semi-significant spills immediately using these procedures:

1. Contain spread of the spill
2. Recover spilled material using absorption where the spill occurs on paved or an impermeable surface
3. Contain the spill with an earthen dike and dig up contaminated soil for disposal where the spill occurs on soil
4. When the spill occurs during precipitation, cover the spill with plastic or other material to prevent contaminated runoff
5. Dispose of contaminated material promptly and properly

Significant or Hazardous Spills: Immediately notify qualified personnel of significant or hazardous spills. Take these steps:

1. Construction personnel must not attempt to cleanup the spill until qualified staff have arrived
2. Notify the Engineer and follow up with a written report
3. Obtain the services of a spills contractor or hazardous material team immediately
4. Notify the local emergency response team by dialing 911 and county officials at the emergency phone numbers kept on the job site
5. Notify the Governor's Office of Emergency Services Warning Center at (805) 852-7550
6. Notify the National Response Center at (800) 424-8802 regarding spills of Federal reportable quantities under CFR Title 40, Parts 110, 119, and 302
7. Notify other agencies as appropriate, including:

    7.1. Fire Department
    7.2. Public Works Department
    7.3. Coast Guard
    7.4. Highway Patrol
    7.5. City Police or County Sheriff Department
    7.6. Department of Toxic Substances
    7.7. California Division of Oil and Gas
    7.8. Cal OSHA
    7.9. Regional Water Resources Control Board

Report minor, semi-significant, and significant spills to the WPC (Water Pollution Control) manager. WPC manager must notify the Engineer immediately. WPC manger must oversee and enforce proper spill prevention and control measures.

Prevent spills from entering storm water runoff before and during cleanup. Spills must not be buried or washed with water.

Keep material or waste storage areas clean, well organized, and equipped with enough cleanup supplies for the material being stored.

Material Management

General

Material must be delivered, used, and stored for this job in a way that minimizes or eliminates discharge of material into the air, storm drain systems, or watercourses.

Implement the practices described in this section while taking delivery of, using, or storing these materials:

1. Hazardous chemicals including:

    1.1. Acids
    1.2. Lime
    1.3. Glues
    1.4. Adhesives
    1.5. Paints
    1.6. Solvents
    1.7. Curing compounds

2. Soil stabilizers and binders
3. Fertilizers
4. Detergents
5. Plaster
6. Petroleum products including:

    6.1. Fuel
    6.2. Oil
    6.3. Grease

7. Asphalt components and concrete components
8. Pesticides and herbicides

Employees trained in emergency spill cleanup procedures must be present during unloading of hazardous materials or chemicals.

If practical, use less hazardous products.

Material Storage

Use these storage procedures:

1. Store liquids, petroleum products, and substances listed in CFR Title 40, Parts 110, 117, and 302 in containers or drums approved by the United States Environmental Protection Agency, and place them in secondary containment facilities.
2. Secondary containment facilities must be impervious to the materials stored there for a minimum contact time of 72 hours.
3. Throughout the rainy season, cover secondary containment facilities during non-working days and when precipitation is predicted. Secondary containment facilities must be adequately ventilated.
4. Keep secondary containment facility free of accumulated rainwater or spills. After precipitation, or in the event of spills or leaks, collect accumulated liquid and place into drums within 24 hours. Handle these liquids as hazardous waste under "Hazardous Waste" unless testing determines them to be nonhazardous.
5. Do not store incompatible materials, such as chlorine and ammonia, in the same secondary containment facility.
6. Store materials in the original containers with the original product labels maintained in legible condition. Replace damaged or illegible labels immediately.
7. Secondary containment facility must have the capacity to contain precipitation from a 24-hour-long, 25-year storm; and 10 percent of the aggregate volume of all containers, or entire volume of the largest container within the facility, whichever is greater.
8. Store bagged or boxed material on pallets. Throughout the rainy season, protect bagged or boxed material from wind and rain during non-working days and while precipitation is predicted.

9. Provide sufficient separation between stored containers to allow for spill cleanup or emergency response access. Storage areas must be kept clean, well organized, and equipped with cleanup supplies appropriate for the materials being stored.
10. Repair or replace perimeter controls, containment structures, covers, and liners as necessary. Inspect storage areas before and after precipitation, and at least weekly during other times.

Stockpile Management

Implement practices described in this section for managing stockpiles:

1. During the rainy season
2. During the non-rainy season when the National Weather Service predicts precipitation with a probability of at least 30 percent

Use these stockpile management procedures:

1. Reduce or eliminate potential air and water pollution from stockpiled material including soil, paving material, or pressure treated wood.
2. Locate stockpiles:

    2.1. If within the floodplain, at least 100 feet from concentrated flows of storm water, drainage courses, or inlets unless approved
    2.2. If outside the floodplain, at least 50 feet from concentrated flows of storm water, drainage courses, or inlets unless approved

Active and inactive soil stockpiles must be:

1. Covered with soil stabilization measures, plastic sheeting, or geosynthetic fabric
2. Surrounded with a linear sediment barrier

Portland cement concrete rubble, AC, HMA, AC and HMA rubble, aggregate base or aggregate sub-base stockpiles must be:

1. Covered with plastic sheeting, or geosynthetic fabric
2. Surrounded with a linear sediment barrier

Pressure treated wood stockpiles must be:

1. Placed on pallets
2. Covered with impermeable material

Cold mix asphalt concrete stockpiles must be:

1. Placed on impervious surface
2. Covered with impermeable material
3. Protected from run-on and runoff

If you discontinue adding or removing material for up to 21 days the stockpile is considered still active during that period.

Control wind erosion during the non-rainy season and dry weather under Section 10, "Dust Control".

Repair or replace linear sediment barriers and covers as needed to keep them functioning properly. If sediment accumulates to 1/3 of the linear sediment barrier height, remove sediment.

Waste Management

Solid Waste

Do not allow litter or debris to accumulate anywhere on the job site, including storm drain grates, trash racks, and ditch lines. Pick up and remove trash and debris from the job site at least once a week. WPC manager must monitor solid waste storage and disposal procedures on the job site.

If practicable, recycle nonhazardous job site waste and excess material. If recycling is not practicable, disposal must comply with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way."

Furnish enough closed-lid dumpsters of sufficient size to contain the solid waste generated by work activities. When refuse reaches the fill line, empty dumpsters. Dumpsters must be watertight. Do not wash out dumpsters at the job site. Furnish additional containers and more frequent pickup during the demolition phase of construction.

Solid waste includes:

1. Brick
2. Mortar
3. Timber
4. Metal scraps
5. Sawdust
6. Pipe
7. Electrical cuttings
8. Non-hazardous equipment parts
9. Styrofoam and other packaging materials
10. Vegetative material and plant containers from highway planting
11. Litter and smoking material, including litter generated randomly by the public
12. Other trash and debris

Furnish and use trash receptacles in the job site yard, field trailers, and locations where workers gather for lunch and breaks.

Hazardous Waste

Use hazardous waste management practices if waste is generated on the job site from these substances:

1. Petroleum products
2. Asphalt products
3. Concrete curing compound
4. Pesticides
5. Acids
6. Paints
7. Stains
8. Solvents
9. Wood preservatives
10. Roofing tar
11. Road flares
12. Lime
13. Glues and adhesives
14. Materials classified as hazardous by California Code of Regulations, Title 22, Division 4.5; or listed in CFR Title 40, Parts 110, 117, 261, or 302

WPC manager must oversee and enforce hazardous waste management practices. Minimize the production of hazardous materials and hazardous waste at the job site. If damaged, repair or replace perimeter controls, containment structures, and covers.

If hazardous material levels are unknown, use a laboratory certified by the Environmental Laboratory Accreditation Program (ELAP) under the California Department of Public Health (CDPH) to sample and test waste to determine safe methods for storage and disposal.

Separate potentially hazardous waste from nonhazardous waste at the job site. Hazardous waste must be handled, stored, and disposed of under California Code of Regulations, Title 22, Division 4.5, Section 66262.34; and in CFR Title 49, Parts 261, 262, and 263.

Store hazardous waste in sealed containers constructed and labeled with the contents and date accumulated under California Code of Regulations, Title 22, Division 4.5; and in CFR Title 49, Parts 172, 173, 178, and 179. Keep hazardous waste containers in temporary containment facilities under "Material Storage" of these special provisions.

Furnish containers with adequate storage volume at convenient locations for hazardous waste collection. Do not overfill hazardous waste containers. Do not mix hazardous wastes. Do not allow potentially hazardous waste to accumulate on the ground. Store containers of dry waste that are not watertight on pallets. Store hazardous waste away from storm drains, watercourses, moving vehicles, and equipment.

Clean water based or oil based paint from brushes or equipment within a contained area and in a way that does not contaminate soil, watercourses, or storm drain systems. Handle and dispose of these as hazardous waste: paints, thinners, solvents, residues, and sludges that cannot be recycled or reused. When thoroughly dry, dispose of these as solid waste: dry, latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths.

Dispose of hazardous waste within 90 days of being generated. Use a licensed hazardous waste transporter to take hazardous waste to a Class I Disposal Site. Submit a copy of uniform hazardous waste manifest forms within 24 hours of transporting hazardous waste.

WPC manager must inspect these daily:

1. Storage areas for hazardous materials and wastes
2. Hazardous waste disposal and transporting activities
3. Hazardous material delivery and storage activities

Contaminated Soil

Identify contaminated soil from spills or leaks by noticing discoloration, odors, or differences in soil properties. Soil with evidence of contamination must be sampled and tested by a laboratory certified by ELAP.

If levels of contamination are found to be hazardous, handle and dispose of the soil as hazardous waste.

Prevent the flow of water, including ground water, from mixing with contaminated soil by using one or a combination of these measures:

1. Berms
2. Cofferdams
3. Grout curtains
4. Freeze walls
5. Concrete seal course

If water mixes with contaminated soil and becomes contaminated, sample and test the water using a laboratory certified by ELAP. If levels of contamination are found to be hazardous, handle and dispose of the water as hazardous waste.

Concrete Waste

Use practices to prevent the discharge of portland cement concrete, AC, or HMA waste into storm drain systems or watercourses.

Collect and dispose of portland cement concrete, AC, or HMA waste at locations where:

1. Concrete material, including grout, is used
2. Concrete dust and debris result from demolition
3. Sawcutting, coring, grinding, grooving, or hydro-concrete demolition of portland cement concrete, AC, or HMA creates a residue or slurry
4. Concrete truck or other concrete-coated equipment is cleaned at the job site

Sanitary and Septic Waste

Do not bury or discharge wastewater from sanitary or septic systems within Department right of way. WPC manager must inspect sanitary or septic waste storage and monitor disposal procedures at least weekly. Sanitary facilities that discharge to the sanitary sewer system must be properly connected and free from leaks. Place sanitary facilities at least 50 feet away from storm drains, watercourse, and flow lines.

Obtain written approval from local health agency, city, county, and sewer district before discharging from a sanitary or septic system directly into a sanitary sewer system, and submit a copy to the Engineer. Comply with local health agency provisions while using an on-site disposal system.

Liquid Waste

Use practices to prevent job site liquid waste from entering storm drain systems or watercourses. Liquid wastes include the following:

1. Drilling slurries or fluids
2. Grease-free or oil-free wastewater or rinse water
3. Dredgings, including liquid waste from drainage system cleaning
4. Liquid waste running off a surface including wash or rinse water
5. Other non-storm water liquids not covered by separate permits

Hold liquid waste in structurally sound, leak proof containers such as:

1. Roll-off bins
2. Portable tanks

Liquid waste containers must be of sufficient quantity and volume to prevent overflow, spills and leaks.
Store containers:

1. At least 50 feet from moving vehicles and equipment
2. If within the floodplain, at least 100 feet from concentrated flows of storm water, drainage courses, watercourses, or storm drain inlets unless approved
3. If outside the floodplain, at least 50 feet from concentrated flows of storm water, drainage courses, watercourses, or storm drain inlets unless approved

Remove and dispose of deposited solids from sediment traps under "Solid Waste" unless the Engineer authorizes another method.

Liquid waste may require testing to determine hazardous material content before disposal.

Drilling fluids and residue must be disposed of outside the highway right of way.

If an approved location is available within the job site, fluids and residue exempt under California Code of Regulations, Title 23, Section 2511(g) may be dried by evaporation in a leak proof container. Dispose of remaining solid waste under "Solid Waste" of these special provisions.

Non-Storm Water Management

Water Control and Conservation

Manage water used for work activities to prevent erosion or discharge of pollutants into storm drain systems or watercourses. Obtain approval before washing anything on the job site with water that could discharge into a storm drain system or watercourse. Report discharges immediately.

If water is used at the job site, implement water conservation practices . Inspect irrigation areas. Adjust watering schedules to prevent erosion, excess watering, or runoff. Shut off water source to broken lines, sprinklers, or valves, and repair breaks within 24 hours. If possible, reuse water from waterline flushing for landscape irrigation. Sweep and vacuum paved areas: do not wash with water.

Direct job site water runoff, including water from water line repair, to areas where it can infiltrate into the ground and not enter storm drain systems or watercourses. Do not allow spilled water to escape water truck filling areas. If possible, direct water from off-site sources around the job site. Minimize the contact of off-site water with job site water.

Illegal Connection and Discharge Detection and Reporting

Inspect the job site and the site perimeter before starting work for evidence of illegal connections, discharges, or dumping. After starting work, inspect the job site and perimeter on a daily schedule.

When illegal connections, discharges, or dumping are discovered, notify the Engineer immediately. Take no further action unless ordered by the Engineer. Assume unlabeled or unidentifiable material is hazardous.

Look for the following evidence of illegal connections, discharges, or dumping:

1. Debris or trash piles
2. Staining or discoloration on pavement or soils
3. Pungent odors coming from drainage systems
4. Discoloration or oily sheen on water
5. Stains or residue in ditches, channels or drain boxes
6. Abnormal water flow during dry weather
7. Excessive sediment deposits
8. Nonstandard drainage junction structures
9. Broken concrete or other disturbances near junction structures

Vehicle and Equipment Cleaning

Limit vehicle and equipment cleaning or washing at the job site except what is necessary to control vehicle tracking or hazardous waste. Notify the Engineer before cleaning vehicles and equipment at the job site with soap, solvents, or steam. Contain and recycle or dispose of resulting waste under "Liquid Waste" or "Hazardous Waste" of these special provisions, whichever is applicable. Do not use diesel to clean vehicles or equipment, and minimize the use of solvents.

Clean or wash vehicles and equipment in a structure equipped with disposal facilities. If using a structure is not possible, vehicles and equipment must be cleaned or washed in an outside area:

1. Paved with AC, HMA, or portland cement concrete
2. Surrounded by a containment berm
3. Equipped with a sump to collect and dispose of wash water
4. If within the floodplain, located at least 100 feet from concentrated flows of storm water, drainage courses, watercourses, or storm drain inlets unless approved
5. If outside the floodplain, located at least 50 feet from concentrated flows of storm water, drainage courses, watercourses, or storm drain inlets unless approved

When washing vehicles or equipment with water, use as little water as possible. Hoses must be equipped with a positive shutoff valve.

Discharge liquid from wash racks to a recycle system or to another approved system. Remove liquids and sediment as necessary.

WPC manger must inspect vehicle and equipment cleaning facilities:

1. Daily when vehicle and equipment cleaning occurs daily
2. Weekly when vehicle and equipment cleaning does not occur daily

Vehicle and Equipment Fueling and Maintenance

If practicable, perform maintenance on vehicles and equipment off the job site.

If fueling or maintenance must be done at the job site, designate a site, or sites, and obtain approval before using. Minimize mobile fueling or maintenance.

If vehicle and equipment fueling and maintenance must be done on the job site, areas for these activities must be:

1. On level ground
2. Protected from stormwater run-on
3. If within the floodplain, located at least 100 feet from concentrated flows of storm water, drainage courses, watercourses, or storm drain inlets unless approved
4. If outside the floodplain, located at least 50 feet from concentrated flows of storm water, drainage courses, watercourses, or storm drain inlets unless approved

Use containment berms or dikes around the fueling and maintenance area. Keep adequate quantities of absorbent spill cleanup material and spill kits in the fueling and maintenance area and on fueling trucks. Dispose of spill cleanup material and kits immediately after use. Use drip pans or absorbent pads during fueling or maintenance.

Fueling or maintenance activities must not be left unattended. Fueling nozzles must be equipped with an automatic shutoff control. Vapor recovery fueling nozzles must be used where required by the Air Quality Management District. When not in use, nozzles must be secured upright. Do not top-off fuel tanks.

Recycle or properly dispose of used batteries and tires.

WPC manager must inspect vehicle and equipment maintenance and fueling areas:

1. Daily when vehicle and equipment maintenance and fueling occurs daily
2. Weekly when vehicle and equipment maintenance and fueling does not occur daily

WPC manager must inspect vehicles and equipment at the job site for leaks and spills on a daily schedule. Operators must inspect vehicles and equipment each day of use.

If leaks cannot be repaired immediately, remove the vehicle or equipment from the job site.

Material and Equipment Used Over Water

Place drip pans and absorbent pads under vehicles or equipment used over water. Keep an adequate supply of spill cleanup material with the vehicle or equipment. If the vehicle or equipment will be idle for more than one hour, place drip pans or plastic sheeting under vehicles or equipment on docks, barges, or other surfaces over water.

Furnish watertight curbs or toe boards on barges, platforms, docks, or other surfaces over water to contain material, debris, and tools. Secure material to prevent spills or discharge into water due to wind.

Structure Removal Over or Adjacent to Water

Do not allow demolished material to enter storm water systems or watercourses. Use approved covers and platforms to collect debris. Use attachments on equipment to catch debris on small demolition activities. Empty debris catching devices daily and handle debris under "Waste Management" of these special provisions.

WPC manager must inspect demolition sites within 50 feet of storm water systems or watercourses daily.

Paving, Sealing, Sawcutting, and Grinding Activities

Prevent these materials from entering storm drain systems or water courses:

1. Cementitious material
2. Asphaltic material
3. Aggregate or screenings
4. Grinding or sawcutting residue
5. Pavement chunks
6. Shoulder backing
7. Methacrylate

Cover drainage inlets and use linear sediment barriers to protect downhill watercourses until paving, sealing, sawcutting, or grinding activities are completed and excess material has been removed. Cover drainage inlets and manholes during the application of seal coat, tack coat, slurry seal, or fog seal.

During the rainy season or when precipitation is predicted, limit paving, sawcutting, and grinding to places where runoff can be captured.

Do not start seal coat, tack coat, slurry seal, or fog seal activities when precipitation is predicted during application or curing period. Do not excavate material from existing roadways during precipitation.

Use a vacuum to remove slurry from sawcutting activities immediately after slurry is produced. Do not allow slurry to run onto lanes open to public traffic or off the pavement.

Collect residue from portland cement concrete grinding activities with a vacuum attachment on the grinding machine. Do not leave residue on pavement or allow residue to flow across pavement.

If approved, material excavated from existing roadways may be stockpiled under "Stockpile Management" of these special provisions.

Do not coat asphalt trucks and equipment with substances that contain soap, foaming agents, or toxic chemicals.

When paving equipment is not in use, park over drip pans or plastic sheeting with absorbent material to catch drips.

Thermoplastic Striping and Pavement Markers

Thermoplastic striping and preheating equipment shutoff valves must work properly at all times. Do not preheat, transfer, or load thermoplastic within 50 feet of drainage inlets or watercourses. Do not fill preheating container above a level that is 6 inches below the top. Truck beds must be cleaned daily of scraps or melted thermoplastic.

Do not unload, transfer, or load bituminous material for pavement markers within 50 feet of drainage inlets or watercourses. Release all pressure from melting tanks before removing the lid to fill or service. Do not fill melting tanks above a level that is 6 inches below the top.

Collect bituminous material from the roadway after marker removal.

Pile Driving

Keep spill kits and cleanup material at pile driving locations. Pile driving equipment must be parked over drip pans, absorbent pads, or plastic sheeting with absorbent material. When precipitation is predicted, protect pile driving equipment by parking on plywood and covering with plastic.

When not in use, store pile driving equipment:

1. On level ground
2. Protected from stormwater run-on
3. If within the floodplain, at least 100 feet from concentrated flows of storm water, drainage courses, watercourses, or storm drain inlets unless approved
4. If outside the floodplain, at least 50 feet from concentrated flows of storm water, drainage courses, watercourses, or storm drain inlets unless approved

If practicable, use vegetable oil instead of hydraulic fluid.

WPC manager must inspect pile driving area for leaks and spills:

1. Daily when pile driving occurs daily
2. Weekly when pile driving does not occur daily

Concrete Curing

Do not overspray chemical curing compound. Minimize drift by spraying as close to the concrete as possible. Cover drainage inlets before applying curing compound.

Minimize the use and discharge of water by using wet blankets or similar methods to maintain moisture while curing concrete.

Concrete Finishing

Collect and dispose of water and solid waste from high-pressure water blasting. Cover drainage inlets within 50 feet before sandblasting. Minimize drift of dust and blast material by keeping the nozzle close to the surface of the concrete. Blast residue may contain hazardous material.

Inspect containment structures for concrete finishing activities for damage before each day of use and before predicted precipitation. Remove liquid and solid waste from the containment structure after each work shift.

Sweeping

Sweeping must be done using hand or mechanical methods such as vacuuming.

Sweeping must be done:

1. At the end of each work shift
2. When the National Weather Service predicts precipitation with a probability of at least 30 percent
3. On paved roads at job site entrance and exit locations
4. On paved areas within the job site that flow to storm drains or water bodies

You may stockpile collected material at the job site. Dispose of collected material at least once per week. Remove collected material including sediment from paved shoulders, drain inlets, curbs and dikes, and other drainage areas.

Sediment collected from the roadway during sweeping may be disposed of within the job site. Protect disposal areas against erosion.

Remove and dispose of trash collected during sweeping under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way".

Dewatering

Dewatering consists of discharging accumulated storm water, ground water, or surface water from excavations or temporary containment facilities.

If dewatering and discharging activities are specified under another work item such as "Temporary Active Treatment System" or "Dewatering and Discharge", then perform dewatering work as specified in those sections.

If dewatering and discharging activities are not specified under another work item, then:

1. At least 10 days before starting dewatering, submit a Dewatering and Discharge Plan under Section 5-1.02, "Plans and Working Drawings," and "Water Pollution Control" of the Standard Specifications. Dewatering and Discharge Plan must include:

    1.1. Title sheet and table of contents
    1.2. Description of dewatering and discharge activities detailing locations, quantity of water, equipment, and discharge point
    1.3. Estimated schedule for dewatering and discharge (start and end dates, intermittent or continuous)
    1.4. Discharge alternatives such as dust control or percolation
    1.5. Visual monitoring procedures with inspection log

2. Conduct dewatering activities under the Field Guide for Construction Dewatering.
3. Ensure that dewatering discharge does not cause erosion, scour, or sedimentary deposits that impact natural bedding materials.
4. Discharge water within project limits. If water cannot be discharged within project limits due to site constraints, dispose of it in the same way specified for material in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way".
5. Do not discharge storm water or non-storm water that has an odor, discoloration other than sediment, an oily sheen, or foam on the surface. Notify the Engineer immediately upon discovering any of those conditions.

6. WPC manager must inspect dewatering activities:

    6.1. Daily when dewatering work occurs daily
    6.2. Weekly when dewatering work does not occur daily

PAYMENT

The contract lump sum price paid for construction site management includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in spill prevention and control, material management, waste management, non-storm water management, and dewatering and identifying, sampling, testing, handling, and disposing of hazardous waste, as specified in the Standard Specifications and these special provisions, and as ordered by the Engineer.

10-1.04 TEMPORARY STORM WATER RUN-ON BYPASS AND EXCAVATION DEWATERING

Summary

This work includes temporary diversion of storm water run-on around work areas; and excavation dewatering as described in this section.

This work includes designing, implementing, monitoring, maintaining, and later removing the temporary storm water run-on bypass system and the temporary non-storm water treatment system (TNSWTS) in conformance with "Water Pollution Control" and "Construction Site Management" of these special provisions and this special provision. Maintenance includes disposal of sediments and other material removed from the collection, conveyance and treatment systems.

TEMPORARY STORM WATER RUN-ON BYPASS

The Contractor shall furnish all tools, equipment, materials, and supplies, and shall perform all labor as required to divert storm water in order to prevent run-on entering work areas including, but not limited to, tunnel excavations, structure excavations for footings, walls, excavations for storm drain systems, sanitary sewer systems, structure demolition, utilities and appurtenances to complete the work. Storm water run-on being bypassed shall not be allowed to mix with non-storm water.

Storm water Run-on Bypass Plan (SRBP)

The Contractor shall submit to the Engineer, as provided in "Working Drawings," of these special provisions, a Storm water Run-on Bypass Plan (SRBP) within the Dewatering and Discharge Plan (DDP), described elsewhere in this section. The SRBP shall include:

1. Identification and description of all major sources of storm water run-on discharges that are expected to enter work areas.
2. Water pollution control drawings that show temporary bypass measures for bypassing storm water run-on from above, and around the work areas at the project site. The drawings shall show how natural run-on shall be diverted and prevented from entering into work areas and show the storm drain discharge location and receiving water.
3. Description of the best management practices (BMPs) with information on the sizing and installation of the conveyance system including pipes, pumps, and their inspection and maintenance procedures to ensure that no storm water runon discharges enter the work areas.

Temporary Bypass Measures

The Contractor shall select and deploy temporary bypass measures or BMPs that shall consist of a system of structures and measures that intercept storm water run-on discharges upstream of work areas, transport it around the work area, and discharge it downstream with minimal water quality degradation from either construction activities or the construction of the BMPs. The temporary bypass measures shall be designed to divert and convey storm water run-on in a manner that does not cause erosion and scour, and shall not result in discharge of sediment at the discharge location to the storm drain system.

The Contractor's selection of temporary BMPs shall conform to the Department's "Construction Site Best Management Practices (BMPs) Manual," including addenda to the Manual issued up to and including the date of advertisement of this contract. Copies of this Manual may be obtained from the Department of Transportation, Material Operations Branch, Publication Distribution Unit, 1900 Royal Oaks Drive, Sacramento, California 95815, Telephone: (916) 445 3520, and may also be obtained from the Department's Internet website at:

http://www.dot.ca.gov/hq/construc/stormwater/CSBMPM_303_Final.pdf.

Temporary BMPs including but not limited to any or all of following components shall be employed in conformance with this Manual:

1. Earth Dikes/Drainage Swales &Lined Ditches (SS-9)
2. Outlet Protection/Velocity Dissipation Devices (SS-10)
3. Slope Drains (SS-11)
4. Check Dam (SC-4)

Any substance used to assemble or maintain diversion structures, or to minimize seepage underneath diversion structures, such as grout, shall be non-toxic, non-hazardous.

The size and type of temporary culverts or pipes to be installed shall be capable of conveying the 10 year, 24 hour storm event. Pipe joints for temporary culverts or pipes shall be watertight in conformance with the provisions in Section 61-1.02, "Performance Requirements for Culvert and Drainage Pipe Joints," of the Standard Specifications. The Contractor shall be responsible for incorporating any required fittings or appurtenances to ensure that the temporary bypass measures can be placed without inducing stresses that could damage the pipes used to convey the bypass flow.

The material, size and type of supports for temporary culverts shall be at the option of the Contractor; however, supports shall be constructed in a manner that will provide adequate supports for the culvert.

The Contractor shall be responsible for preventing, at Contractor's expense, any leakage in the temporary storm water run-on bypass measures. Any portion of the temporary storm water run-on bypass measures that is damaged from any cause during the progress of the work shall be repaired or replaced by the Contractor at the Contractor's expense. If during the progress of work for a particular section it becomes necessary to reposition, relocate portions or reconstruct the temporary drainage bypass measures, the work shall be done at the Contractor's expense.

When no longer required for the work as determined by the Engineer, temporary run-on bypass measures shall be removed. Removed facilities shall become the property of the Contractor and shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Inspection and Maintenance

The Contractor shall conduct a daily inspection of storm water run-on bypass equipment, when in use, and ensure that all components are functional and routinely maintained. If any component of the equipment is damaged so that the performance of the equipment is diminished below allowable operational levels, the component shall be immediately repaired or replaced with substitute equipment. Bypassed storm water run-on that mixes with non-storm water or storm water runoff from high risk areas shall be treated prior to disposal as described within "Collection and Conveyance System" and "Treatment Systems" in this section. Inspection reports shall be submitted to the Engineer along with the Daily Inspection Report (DIR) described elsewhere in this section.

EXCAVATION DEWATERING

Accumulated precipitation and groundwater encountered in all excavations shall be considered as non-storm water. This work includes dewatering, collection, conveyance, treatment, and disposal of non-storm water encountered in all excavations including, but not limited to tunnel excavations, structure excavations for footings, walls, excavations for storm drain systems, sanitary sewer systems, utilities and appurtenances to complete the work.

Concrete washout water from delivery trucks and shotcrete spraying equipment used in the construction of the tunnel shall not be allowed to mix with non-storm water. Disposal of concrete washout water shall be in accordance with "Temporary Concrete Washout (Portable)" of these special provisions.

The Department's "Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual" (Preparation Manual) is available at:

http://www.dot.ca.gov/hq/construc/SWPPP_WPCP_Preparation.pdf

The "Field Guide to Construction Site Dewatering" (Dewatering Guide) provides guidance on this work. and is available at:

http://www.dot.ca.gov/hq/construc/stormwater/DewateringGuide.htm

Discharge non-storm water using any of the following methods:

1. Discharge into a Publicly Owned Treatment Works (POTW) facility (sanitary sewer) under a batch discharge permit. Apply for and comply with the provisions contained in the permit and pay all fees assessed by the POTW facility in connection with the discharge.
2. Discharge into a storm drain system in compliance with general waste discharge requirements for Order No. R2-2006-0075, NPDES General Permit No. CAG912002, issued by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) for "Discharge Or Reuse Of Extracted and Treated Groundwater polluted by Fuel Leaks and Other Related Wastes at Service Stations and Similar Sites and these special provisions. This permit is hereafter referred to as the "Order No. R2-2006-0075" in this section, and can be obtained from the SFBRWQCB. Attention is directed to "Relations With California Regional Water Quality Control Board," for discharges to the storm drain system. If the discharge is to the storm drain system, comply with the provisions of Order No. R2-2006-0075 and pay all fees in connection with obtaining coverage under the Order No. R2-2006-0075.
3. Use water treated under Order No. R2-2006-0075 for dust control.
4. Percolate water treated under Order No. R2-2006-0075 into soil in inactive work areas.

Maintain copies of the permits at the job site and make them available during construction.

Submittals

Before discharging submit:

1. Dewatering and Discharge Plan (DDP).
2. POTW permit including sampling and analysis data for the non-storm water to be discharged to the sanitary sewer.
3. Notice of Intent (NOI) of discharge under Order No. R2-2006-0075.
4. A report certifying the adequacy of each component of the planned TNSWTS and an Operation and Maintenance Manual in conformance with Order No. R2-2006-0075 and these special provisions.

Dewatering and Discharge Plan

The dewatering and discharge plan (DDP) must include:

1. Title sheet;
2. Table of contents;
3. Certification and approval sheet (Section 100 of the Preparation Manual);
4. Amendment log and format (Section 200 of the Preparation Manual);
5. Storm Water Run-On Bypass Plan (SRBP);
6. Description and schedule of the dewatering and discharge operations;
7. Discharge alternatives, including dust control, percolation, storm sewers, and surface waters;
8. Treatment system description, components;
9. Coagulant Prevention Plan for chemical coagulants and/or flocculants used in the treatment system, that describes the best management practices (BMPs) to prevent accidental spillage, overfeeding into the treatment system, or other mishandling of coagulant agents; and, a monitoring plan for all coagulants to be used; description of the agent (chemical and trade name description); Pure product freshwater and/or marine aquatic toxicity data for the agent; Monitoring proposal to detect residual agent at concentrations at or below established freshwater and/or marine acute toxicity levels for that agent;
10. Anticipated flow rates;
11. Operation and system maintenance procedures and example maintenance log;
12. Field-recorded data, visual inspection, and calibration procedures and example logs;
13. Measuring equipment descriptions; and
14. Working drawings of dewatering and discharge operations showing:

    14.1. Section and plan views of storm water effluent treatment systems;
    14.2. Location of sampling points for water quality measurements;
    14.3. Flow path and placement of pipes, hoses, pumps, holding tanks, and other equipment used to convey water;
    14.4. General position of treatment dewatering and discharge components relative to excavations or other operations requiring dewatering; and
    14.5. Point of non-storm water discharge.

15. Permit applications, NOI and Permits authorizing discharge to storm drain system and/or sanitary sewer.

Within 10 days after contract approval, follow this process for DDP approval:

1. Submit 3 copies of the DDP and allow 15 days for the Engineer's review. If revisions are required, the Engineer provides comments and specifies the date that the review stopped
2. Change and resubmit the DDP within 5 days of receipt of the Engineer's comments. The Engineer's review resumes when the complete DDP is resubmitted. Allow 5 days for the Engineer's second review
3. Revise and resubmit within 5 days of the Engineer's second review
. When the Engineer accepts the DDP as complete, the Engineer will submit the DDP to the San Francisco Bay RWQCB for their review and approval
5. If the San Francisco Bay RWQCB provides comments to the DDP, the Contractor shall incorporate these comments within 5 days of the receipt. The Contractor shall submit four (4) copies of the final DDP upon notification of final approval
6. Construction activities, requiring storm water run-on bypass or excavation dewatering, shall begin no sooner than 30 days after the Engineer approves the DDP
7. After 30 days, the Engineer may conditionally approve the DDP while minor revisions are being completed

If the Engineer fails to complete the review within the time allowed and if, in the opinion of the Engineer, completion of the work is delayed or interfered with because of the Engineer's or the RWQCB's review, the Department pays you for resulting losses, and grants an extension of time.

A Non-Stormwater Information Package (Information Package) has been prepared for this contract and is available as described in "Supplemental Project Information" of these special provisions. This Information Package includes:

1. Estimated groundwater seepage rates in the project area.
2. Web site address where a copy of the RWQCB General Waste Discharge Requirements for Order No. R2-2006-0075, NPDES General Permit No. CAG912002 can be obtained
3. Local POTW facility information.
4. Final Environmental Groundwater Investigation Report, September 2009 prepared for the Doyle Drive Replacement Project, San Francisco, California.

Temporary Non-Storm Water Treatment System (TNSWTS)

Design and implement an appropriate water treatment system for the site conditions and anticipated flow rate to achieve and maintain compliance with receiving water limitations and discharge effluent limitations. System components may include:

1. Treatment system.
2. Collection and conveyance system.
3. Temporary holding tanks.
4. Discharge attenuator.

Design the TNSWTS to remove pollutants expected or introduced by the Contractor's construction methods and materials employed, in the non-storm water influent to achieve and maintain compliance with the effluent limitations and receiving water limitations listed in the Order No. R2-2006-0075.

Treatment Systems

Treatment systems must be designed to remove turbidity-producing suspended solids and other constituents found in the non-storm water, constituents found in groundwater that are listed in the Final Environmental Groundwater Investigation Report, September 2009 prepared for the Doyle Drive Replacement Project, San Francisco, California.

Attention is directed to "Supplemental Project Information," of these special provisions for obtaining a copy of the Site Investigation Report.

If settling tanks alone do not provide sufficient sediment removal to meet the water quality limits for turbidity, use other control measures to meet discharge standards. Primary and secondary treatment may be required, or the design of the treatment system may require combined use of the various treatment components in series to achieve effective treatment. Ensure that the treatment system components are steam cleaned to remove any residual contaminants. Treatment system components may include:

1. Desilting basins,
2. Weir tanks,
3. Settling tanks,
4. Sediment traps,

5. Gravity bag filters,
6. Sand media filters,
7. Pressurized bag filters,
8. Cartridge filters,
9. In-line chemical coagulants and/or flocculants,
10. Activated clay filters,
11. Activated carbon filters, or
12. A combination of these systems to provide primary and secondary treatment.

Chemical coagulants and/or flocculants proposed for use in the treatment of groundwater must be approved by the RWQCB. You are fully and solely responsible for securing approval from the RWQCB. Written approval from the RWQCB must be submitted to the Engineer for review prior to any use of flocculants on this project. The Information Package includes an outline of the information required by the RWQCB for approval of the chemical coagulants and/or flocculants for use in the Treatment System.

Disposal of sediments removed during maintenance of the Treatment System must comply with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

If necessary, treat water discharged to surface water or storm water drainage systems to adjust the pH and dissolved oxygen. Treatment for water with high pH may include the addition of carbon dioxide, sulfuric acid, phosphoric acid, citric acid, or nitric acid in conformance with the supplier's specifications. Treatment for water with low pH may include filtration through a limestone bed or the addition of sodium hydroxide. Treatment for water with low dissolved oxygen may include aeration.

Attention is directed to "Supplemental Project Information," in these special provisions for "Log of Test Borings," and the "Non-Stormwater Information Package," for estimating the groundwater seepage (flow rate) in the area to design the treatment facilities to accommodate anticipated flow rates. Continuous pumping from well points outside the excavation is prohibited.

The various components must be maintained to prevent leaks and provide proper function. If a component of the dewatering equipment is not functioning properly, the dewatering operation must be discontinued and the component must be repaired or replaced.

Collection and Conveyance System

You may divert the water pumped during dewatering operations from one footing excavation to another footing excavation. Prior to backfilling the excavation, the remaining groundwater must be pumped from the excavation and treated prior to discharge.

Provide all pumps and piping to convey the water to temporary holding tanks and the point of discharge.

Use a flow meter, as described in "Flow Rate Monitoring" of this section, to measure all discharges from dewatering operations.

Materials shall conform to the provisions in Section 6, "Control of Materials," Section 7-1.16, "Contractor's Responsibility for the Work and Materials," and Section 74-2, "Drainage Pumping Equipment," of the Standard Specifications and these special provisions.

Temporary Holding Tanks

Water pumped during dewatering operations that is not diverted to other excavations must be stored in temporary holding tanks placed at the work area for treatment to remove sediment.

Use temporary holding tanks including transportable closed top holding tanks or tanker trucks. A sufficient number of holding tanks shall be provided based on the following:

1. Anticipated flow rates,
2. Pumping rates,
3. Capacity inefficiencies due to sediment retention within the holding tanks,
4. Sediment settling rates
5. Sediment removal frequency
6. Anticipated water loss or reuse rates.

Provide temporary holding tanks with a holding capacity sufficient to handle the water removed from dewatering operations, and prevent delay of work.

Each temporary holding tank must have an inlet and outlet capable of receiving and discharging flows at a sufficient rate to dewater the excavation.

Maintain a minimum freeboard of 1 foot in each of the temporary holding tanks at all times. Clean the holding tanks when 25 percent of the tank's volume is filled with sediments.

Discharging Water

Use treated non-storm water or uncontaminated ground or surface water for dust control in active work areas when possible, or discharge the water to an inactive area where the grade prevents sheet flow and the soil will allow percolation. The discharge point in the inactive area must include a velocity dissipator. The discharge volume must not exceed the area's capacity for percolation.

The Contractor may propose to reuse treated non-storm water from the TNSWTS as a water supply source for the tire wash system described in "Temporary Tire Wash System," of these special provisions.

Do not discharge into a body of water where erosion, scour, or sedimentary deposits could occur that impact natural bedding or aquatic life. Monitor the water at the discharge point using water quality measurements and visual observation in conformance with the regulatory permit and these special provisions.

Storm water must be diverted away from excavations that would require dewatering in conformance with the SRBP.

MONITORING AND REPORTING PROGRAM (MRP)

Monitoring Locations and Parameters

The Contractor shall be responsible for fully implementing the "Monitoring and Reporting Program (MRP)" as described in Attachment E and Attachment G of the Order No. R2-2006-0075. The Contractor shall propose and identify site specific monitoring locations in the MRP for the Engineer's approval.

Certified Technician(s)

The Contractor shall furnish Certified Technician(s) with the qualifications described in this section to operate the TNSWTS. The Contractor shall submit to the Engineer a statement of qualifications, describing the training, previous work history and expertise of the individual(s) selected to serve as Certified Technician(s). The Certified Technician(s) shall be certified through an approved Operator's Training Program. The Certified Technician shall provide written proof of operator certification training to the Engineer; Provide names and contact information for all individuals involved with the site design, installation process, maintenance, operation of, and monitoring of the TNSWTS. Operator certification shall consist of a Grade II or Grade III Wastewater Treatment Plant Operator certification issued by the State of California Water Resources Control Board, Office of Operator Certification (OOC) or a Department approved equivalent. The Contractor shall retain competent staff to carry out the tasks listed in provisions VI.C.6, VI.C.7, VI.C.8 and VI.C.9 in the Order No. R2-2006-0075. Valid technician certificate(s) shall be posted onsite.

The Certified Technician shall have the following specific levels of training:

1. Operators shall have training specific to using an TNSWTS and liquid coagulants for storm water discharges in California.
2. The training shall be in the form of a formal class with a certificate and requirements for testing and certificate renewal.
3. Training shall include a minimum of eight hours classroom and 32 hours field training. The course shall cover the following topics:
   a. Coagulation Basics –Chemistry and physical processes
   b. TNSWTS System Design and Operating Principles
   c. TNSWTS Control Systems
   d. Coagulant Selection – Jar testing, dose determination, etc.
   e. Aquatic Safety/Toxicity of Coagulants, proper handling and safety
   f. Monitoring, Sampling, and Analysis
   g. Reporting and Recordkeeping
   h. Emergency Response

Daily Inspection Report (DIR)

The Certified Technician shall be responsible for compiling the Daily Inspection Report (DIR) to be submitted to the Engineer on a weekly basis and performing other monitoring and sampling work. The DIR form shall include the following items: Physical Observations; Discharge Volume Records; Water Quality Monitoring Records described elsewhere in this section. The DIR form shall be developed as part of the NSDCP and approved by the Engineer prior to use.

All information and recorded data collected or submitted as part of the DIR shall be certified as true and accurate and signed by the Certified Technician.

Visual Inspection

During each day of discharge, perform daily inspection of the effluent at the discharge site and include, in the DIR, observations of:

1. Date and Time.
2. Weather conditions,
3. Wind direction and velocity,
4. The presence or absence of water fowl or aquatic wildlife,
5. The color and clarity of the effluent discharge, and
6. Erosion or ponding downstream of the discharge site.

The DIR must include photographs of the discharge point and areas downstream of the discharge location. These photographs must be labeled with the time, date, and location.

Flow Rate Monitoring

A flow meter that has been approved by the Engineer for exclusive use in dewatering during construction must be used to measure all excavation discharges. All calibrations must be done in conformance with the manufacturer's instructions in the presence of the Engineer.

Record the flow-meter totalizer readings and compute average daily volumes for every day that dewatering is conducted.

Penalties and Withholdings

Know and comply with provisions of Federal, State, and local regulations and requirements that govern the work and storm water and non-storm water discharges from the job site and areas of disturbance outside the project limits during construction under Section 7-1.01, "Laws to be Observed," Section 7-1.11, "Preservation of Property," and Section 7-1.12, "Indemnification and Insurance," of the Standard Specifications.

You are responsible for all penalties assessed as a result of your failure to comply with the provisions in "Water Pollution Control" of these special provisions or with the applicable provisions of the Federal, State, and local regulations and requirements.

Penalties include fines, penalties, and damages, whether proposed, assessed, or levied against the Department or you, including those levied under the Federal Clean Water Act and the State Porter-Cologne Water Quality Control Act, by governmental agencies or as a result of citizen suits. Penalties also include payments made or costs incurred in settlement for alleged violations of applicable laws, regulations, or requirements. Costs incurred could include sums spent instead of penalties, in mitigation or to remediate or correct violations.

The Department will withhold payment, in an amount estimated by the Department, to include the full amount of penalties and mitigation costs proposed, assessed, or levied as a result of a violation of the permits, or Federal or State law, regulations, or requirements. Funds will be withheld until final disposition of these costs has been made. You remain liable for the full amount until the potential liability is finally resolved with the entity seeking the penalties. Instead of the withhold, you may provide a suitable bond in favor of the Department to cover the highest estimated liability for any disputed penalties proposed as a result of the violation of the permits, law, regulations, or requirements.

If a regulatory agency identifies a violation of the permits and modifications thereto, or other Federal, State, or local requirements, the Department will withhold payment as follows:

1. The Department will give you 30 days notice of the Department's intention to withhold funds from payments that may become due before acceptance of the contract. After acceptance of the contract, funds will be withheld without prior notice.
2. If the amount being withheld from partial payments under Section 9-1.06, "Partial Payments," of the Standard Specifications exceeds the amount to be withheld for violations, no additional payment will be withheld.
3. If the Department withholds funds and it is subsequently determined that the State is not subject to the entire amount of the costs and liabilities assessed or proposed in connection with the matter for which the withhold was made, the Department will return the excess amount withheld in the progress payment following the determination. If the matter is resolved for less than the amount withheld, the Department will pay interest at a rate of 6 percent per year on the excess withhold.

Notify the Engineer immediately upon request from a regulatory agency to enter, inspect, sample, monitor, or otherwise access the job site or obtain records pertaining to water pollution control work. Provide copies of correspondence, notices of violation, enforcement actions, or proposed fines by regulatory agencies to the requesting regulatory agency.

PAYMENT

The contract lump sum price paid for temporary storm water run-on bypass and excavation dewatering shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, including providing power to operate all equipment, and for doing all the work involved in this section; and as directed by the Engineer.

10-1.05 STREET SWEEPING

GENERAL

Summary

This work includes street sweeping.

The SWPPP must describe and include the use of street sweeping as a water pollution control practice for sediment control and tracking control.

Submittals

At least 5 business days before starting clearing and grubbing, earthwork, or other activities with the potential for tracking sediment or debris, submit:

1. Number of sweepers described in the SWPPP
2. Type of sweeper technology

Quality Control and Assurance

Retain and submit records of street sweeping including:

1. Quantity of sweeping waste disposal
2. Sweeping times and locations

CONSTRUCTION

Street Sweepers

Sweepers must use one of these technologies:

1. Mechanical sweeper followed by a vacuum-assisted sweeper
2. Vacuum-assisted dry (waterless) sweeper
3. Regenerative-air sweeper

Operation

Street sweeping must be done at:

1. Paved roads at job site entrance and exit locations
2. Paved areas within the job site that flow to storm drains or water bodies

Street sweeping must be done:

1. During clearing and grubbing activities
2. During earthwork activities
3. During trenching activities
4. During roadway structural section activities
5. When vehicles are entering and leaving the job site
6. After soil disturbing activities
7. After observing offsite tracking of material

Monitor paved areas and roadway within the jobsite. Street sweeping must be done:

1. Within 1 hour, if sediment or debris is observed during activities that require sweeping
2.. Within 24 hours, if sediment or debris is observed during activities that do not require sweeping

At least 1 sweeper must be on the job site at all times when sweeping work is required. The sweeper must be in good working order.

Perform street sweeping to minimize dust. If dust generation is excessive or sediment pickup is ineffective, use water or a vacuum.

You may stockpile collected material on the jobsite according to the approved SWPPP. Dispose of collected material at least once per week.

Material collected during street sweeping must be removed and disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Your WPCM must inspect paved roads at job site access points:

1. Daily if earthwork and other sediment or debris generating activities occur daily
2. Weekly if earthwork and other sediment or debris generating activities do not occur daily
3. When the National Weather Service predicts precipitation with a probability of at least 30 percent

MEASUREMENT AND PAYMENT

The contract lump sum price paid for street sweeping includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in street sweeping, including disposal of collected material, as shown on the plans, as specified in the Standard Specifications, these special provisions, and as directed by the Engineer.

10-1.06 TEMPORARY HYDRAULIC MULCH (BONDED FIBER MATRIX)

GENERAL

Summary

This work includes applying, maintaining, and removing temporary hydraulic mulch (bonded fiber matrix). Hydraulic mulch uses a mixture of fiber, tackifier, and water to stabilize active and nonactive disturbed soil areas.

The SWPPP must describe and include the use of temporary hydraulic mulch (bonded fiber matrix) as a water pollution control practice for soil stabilization.

Submittals

At least 5 business days before applying hydraulic mulch, submit:

1. Material Safety Data Sheet for the tackifier.
2. Product label describing the tackifier as an erosion control product.
3. List of pollutant indicators and potential pollutants for the use of temporary hydraulic mulch. Pollutant indicators are described under "Sampling and Analysis Plan for Non-Visible Pollutants" in the Preparation Manual.
4. Determination of acute and chronic toxicity for aquatic organisms conforming to EPA methods for the tackifier.
5. Composition of ingredients including chemical formulation.

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for:

1. Tackifier
2. Fiber

Quality Control and Assurance

Retain and submit records of temporary hydraulic mulch applications including:

1. Compliance with specified rates
2. Application area
3. Application time
4. Quantity

MATERIALS

Tackifier

The tackifier must be:

1. Nonflammable
2. Nontoxic to aquatic organisms
3. Free from growth or germination inhibiting factors

4. Bonded to the fiber or prepackaged with the fiber by the manufacturer
5. At least 10 percent of the weight of the dry fiber and include the weight of the activating agents and additives
6. Organic, high viscosity colloidal polysaccharide with activating agents, or a blended hydrocolloid-based binder

Fiber

Fiber must be:

1. Long strand, whole wood fibers, thermo-mechanically processed from clean, whole wood chips
2. Not made from sawdust, cardboard, paper, or paper byproducts
3. At least 25 percent of fibers 3/8 inch long
4. At least 50 percent held on a No. 25 sieve
5. Free from lead paint, printing ink, varnish, petroleum products, seed germination inhibitors, or chlorine bleach
6. Free from synthetic or plastic materials
7. At most 7 percent ash

Coloring Agent

Use a biodegradable nontoxic coloring agent free from copper, mercury, and arsenic to ensure the hydraulic mulch contrasts with the application area.

CONSTRUCTION

Application

Apply temporary hydraulic mulch when an area is ready to receive temporary erosion control under "Move-in/Move-out (Temporary Erosion Control)."

Dilute hydraulic mulch with water to spread the mulch evenly.

Use hydroseeding equipment to apply hydraulic mulch.

Apply hydraulic mulch:

1. In the proportions indicated in the table below. Successive applications or passes may be needed to achieve the required proportion rate:

Material	Application Rate lbs/acre
Bonded Fiber (includes fiber and tackifier material)	3500lbs/acre

2. To form a continuous mat with no gaps between the mat and the soil surface.
3. From 2 or more directions to achieve a continuous mat.
4. In layers to avoid slumping and to aid drying.
5. During dry weather or at least 24 hours before predicted rain.

Do not apply hydraulic mulch if:

1. Water is standing on or moving across the soil surface
2. Soil is frozen
3. Air temperature is below 40 ºF during the tackifier curing period unless allowed by the tackifier manufacturer and approved by the Engineer

Do not over-spray hydraulic mulch onto the traveled way, sidewalks, lined drainage channels, or existing vegetation.

Maintenance

Reapply hydraulic mulch within 24 hours of discovering visible erosion unless the Engineer approves a longer period.

Removal

Remove hydraulic mulch by mechanically blending it into the soil with track laying equipment, disking, or other approved method.

Temporary hydraulic mulch disturbed or displaced by your vehicles, equipment, or operations must be reapplied at your expense.

Cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence are not included in the cost for performing maintenance.

MEASUREMENT AND PAYMENT

Temporary hydraulic mulch (bonded fiber matrix) is measured by the square yard from measurements along the slope of the areas covered by the hydraulic mulch.

The contract price paid per square yard for temporary hydraulic mulch (bonded fiber matrix) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in applying temporary hydraulic mulch, complete in place, including removal of hydraulic mulch, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The State and you share the cost of maintaining the temporary hydraulic mulch. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.07 TEMPORARY EROSION CONTROL BLANKET

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary erosion control blanket. Temporary erosion control blanket is used to cover and protect disturbed soil areas and soil from erosion by wind or water. Temporary erosion control blanket reduces channel erosion by protecting against scour created by concentrated flow.

The SWPPP must describe and include the use of temporary erosion control blanket as a water pollution control practice for soil stabilization.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for erosion control blanket.

If you substitute the steel wire staple with an alternative attachment device, submit a sample of the device for approval at least 5 business days before installation.

MATERIALS

Erosion Control Blanket

Erosion control blanket must be:

1. Described as a rolled erosion control product (RECP)
2. Classified as temporary and degradable or long-term and non-degradable
3. Machine-made mats
4. Provided in rolled strips
5. Classified by the Erosion Control Technology Council (ECTC)

Erosion control blanket classified as temporary and degradable must be as follows:

1. Coir netting:

    1.1. Classified as ECTC Type 4
    1.2. Classified as an open weave textile and from 13 to 18 strands per foot in each direction
    1.3. Designed to last for at least three years after installation
    1.4. With a USLE C-Factor of not more than 0.25 at a 1:1 (horizontal:vertical) slope
    1.5. Comprised of 100 percent unbleached and undyed spun coir yarn made of coconut fiber
    1.6. With an average open area from 63 to 70 percent
    1.7. From 72 to 158 inches in width
    1.8. Capable to withstand a maximum shear stress of 2.25 pounds per square foot under ASTM D6460
    1.9. With a minimum tensile strength of 125 pounds per foot under ASTM D 5035
    1.10. From 1.20 to 1.67 pounds per square yard in weight

Erosion control blanket classified as long-term and non-degradable must:

1. Be a geosynthetic fabric
2. Comply with the specifications for rock slope protection fabric (Class 8) in Section 88-1.06, "Channel and Shore Protection," of the Standard Specifications

Staples

You may use an alternative attachment device such as a geosynthetic pins or plastic pegs to install erosion control blanket.

CONSTRUCTION

Before placing erosion control blanket, remove obstructions including rocks, clods, and debris greater than 1 inch in diameter from the ground.

If fiber rolls are to be placed in the same area as erosion control blankets, install the blankets before placing the fiber rolls.

If hydroseeding is to be done in the same area as erosion control blanket:

1. You may hydroseed before or after placing the coir netting

If temporary erosion control blanket is installed on disturbed soil areas including embankment and excavation slopes:

1. Place the blanket loosely on the embankment or excavation slope with the longitudinal joints perpendicular to the slope contour lines
3. Place the blanket on the upper portion of the slope overlapping the blanket on the lower portion of the slope for transverse joints
4. Place the blanket on the side of the prevailing wind shall overlapping the blanket on the downwind side of the slope for longitudinal joints
2. Overlap and staple the longitudinal and transverse joints
5. Secure the ends of the blanket in key trenches

If temporary erosion control blanket is installed in area of concentrated runoff including ditches and swales:

1. Place the blanket loosely along the ditch or swale with the longitudinal edges and joints parallel to the centerline of the ditch or swale
2. Place the blanket on the upper portion of the slope overlapping the blanket on the lower portion of the slope for transverse joints
3. Secure transverse joints of blankets in intermediate joint trenches
4. Overlap and staple the longitudinal and transverse joints
5. Secure the ends of the blanket in intermediate and key trenches

MAINTENANCE

Remove sediment deposits, trash, and debris from temporary erosion control blanket as needed or when directed by the Engineer. If removed sediment is deposited within project limits, it must be stabilized and not subject to erosion by wind or water. Trash and debris must be removed and disposed of as specified in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Maintain temporary erosion control blanket by:

1. Removing sediment from the surface of the blanket when it is deeper than 2 inches
2. Repairing or replacing the blanket when the area treated with temporary erosion control blanket becomes exposed or exhibits visible erosion
3. Repairing or replacing the erosion control blanket when washouts occur between joints or beneath the erosion control blanket
4. Repairing or replacing the erosion control when it becomes detached, torn, or unraveled

Repair temporary erosion control blanket within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary erosion control blanket, repair erosion control blanket at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

REMOVAL

When the Engineer determines that temporary erosion control blanket is not required, it must be removed and disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary erosion control blanket must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary erosion control blanket is measured by the square yard of the actual area covered excluding overlaps.

The contract price paid per square yard for temporary erosion control blanket includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing temporary erosion control blanket, complete in place, including trench excavation and backfill, and removal of temporary erosion control blanket, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The State and you share the cost of maintaining the temporary erosion control blanket. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.08 TEMPORARY COVER

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary cover.

The SWPPP must describe and include the use of temporary cover as a water pollution control practice for soil stabilization and stockpile management.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for:

1. Gravel-filled bag fabric
2. Temporary cover fabric

If you substitute a material in the following list, submit a sample of the alternative material for approval at least 5 business days before installation:

1. Alternative restrainer
2. Alternative linear sediment barrier

MATERIALS

Geosynthetic Fabrics

Geosynthetic fabrics must consist of one of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Sample under ASTM D 4354, Procedure C.

Test under ASTM D 4759. All properties are based on Minimum Average Roll Value (MARV).

Identify, store, and handle under ASTM D 4873.

Protect geosynthetics from moisture, sunlight and damage during shipping and storage. Label each unit with the manufacturer's name, identifying information and product identification.

Gravel-filled bag fabric must comply with:

Specification	Requirements
Grab breaking load 1-inch grip, lb, min. in each direction	205
Apparent elongation percent, min., in each direction	50
Water Flow Rate max. average roll value, gallons per minute/square foot	80-150
Permittivity 1/sec., min	1.2
Apparent opening size max. average roll value, U.S. Standard sieve size	40-80
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	70

The temporary cover fabric must be geosynthetic cover fabric, plastic sheeting, or a combination of both. Temporary cover fabric must be either:

1. Plastic sheeting consisting of a single-ply geomembrane material, 10 mils thick, that complies with ASTM D 5199
2. Geosynthetic cover fabric that complies with the following properties:

Specification	Requirements
Grab breaking load 1-inch grip, lb, min. in each direction	200
Apparent elongation percent, min., in each direction	50
Water Flow Rate max. average roll value, gallons per minute/square foot	75-120
Permittivity 1/sec., min	0.08
Apparent opening size max. average roll value, U.S. Standard sieve size	100
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	70

Gravel

Gravel for gravel-filled bags must be:

1. From 3/8 to 3/4 inch in diameter
2. Clean and free from clay balls, organic matter, and other deleterious materials

Gravel-filled Bags

Gravel-filled bags must:

1. Be made from gravel-filled bag fabric.
2. Have inside dimensions from 24 to 32 inches in length, and from 16 to 20 inches in width.
3. Have the opening bound to retain the gravel. The opening must be sewn with yarn, bound with wire, or secured with a closure device.
4. Weigh from 30 to 50 pounds when filled with gravel.

Restrainers

Restrainers must be used to secure the cover fabric or plastic sheeting to the surface of the slope or stockpile. Restrainers must be one of the following:

1. Made of gravel-filled bags that are roped together and spaced no more than a 6 feet apart
2. Made of wooden lath and anchor restrainers as shown on the plans and the following:

    2.1 Wooden lath must be 2" x 4" x 8', made from fir or pine, and comply with Section 88-2.12, "Lumber," of the Standard Specifications
    2.2 Anchor restrainers must be made from steel reinforcing bars and spaced no more than 4 feet apart along the wooden lath

3. An approved alternate method

Rope

Rope must be at least 3/8 inch in diameter.

Rope must be one of the following:

1. Biodegradable, such as sisal or manila
2. Nondegradable, such as polypropelene or nylon

Linear Sediment Barrier

Linear sediment barriers consist of one or more of the following:

1. Gravel bag berm
2. Earthen berm
3. Approved alternate method

CONSTRUCTION

Temporary Cover Fabric

Install temporary cover fabric by:

1. Placing the temporary cover fabric loosely on the slope or stockpile with the longitudinal edges perpendicular to the slope contours
2. Placing the temporary cover fabric on the upper portion of the slope to overlap cover fabric on the lower portion of the slope
3. Placing the temporary cover fabric on the side of the prevailing wind to overlap the cover fabric on the downwind side of the slope
4. Anchoring the perimeter edge of the temporary cover fabric in key trenches
5. Overlapping edges of the temporary cover fabric by at least 2 feet
6. Placing restrainers at the overlap area and along the toe of the slope. Between overlaps, the restrainers must be spaced a maximum of 8 feet on center.
7. Ensuring that, if anchor restraints are used, the leg of the steel reinforcing bar pierces the temporary cover fabric and holds the wooden lath firmly against the surface of the slope or stockpile.

Linear Sediment Barrier

Protect excavation and embankment slopes with linear sediment barrier by:

1. Preventing run-on and concentrated flows from damaging the slopes
2. Placing the barrier approximately parallel to the slope contour at the toe of the slope
4. Angling the last 6 feet of the barrier up-slope

Protect stockpiles with linear sediment barrier by:

1. Preventing run-on and concentrated flows from touching the stockpiled material
2. Surrounding the stockpile with a linear sediment barrier
3. Adding more linear sediment barrier within 24 hours of adding more material to the stockpile

If earthen berms are used as a linear sediment barrier, they must be:

1. At least 8 inches high and 36 inches wide
2. Compacted by hand or mechanical method

If gravel bag berms are used as a linear sediment barrier:

1. Place gravel bags as a single layer
2. Place gravel bags end-to-end to eliminate gaps

If you need to increase the height of the gravel bag berm:

1. Increase height by adding rows of gravel-filled bags
2. Stack bags in a way that the bags in the top row overlap the joints in the lower row
3. Stabilize berm by adding rows at the bottom

If you remove the temporary cover to do other work, replace and secure temporary cover within one hour.

MAINTENANCE

Maintain temporary cover to minimize exposure of the slopes or stockpile and prevent movement of the material beyond the linear sediment barrier.

Maintain temporary cover by:

1. Relocating and securing restrainers to keep the erosion control blankets in place. Temporary cover fabric that breaks free must be immediately secured.
2. Repairing or replacing the temporary cover fabric when the area covered by temporary cover becomes exposed or exhibits visible erosion.
3. Repairing or replacing the linear sediment barrier when washouts occur between joints or beneath the linear sediment barrier.
4. Repairing or replacing the temporary cover fabric when it becomes detached, torn, or unraveled.

Repair temporary cover within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary cover, repair temporary cover at your expense.

REMOVAL

When the Engineer determines that temporary cover is not required, it must be removed and disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary cover must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary cover is measured by the square yard of the actual area covered excluding overlaps.

The contract price paid per square yard for temporary cover includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing temporary cover, complete in place, including restrainers and removal of temporary cover, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.09 TEMPORARY CHECK DAM

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary check dams.

The SWPPP must describe and include the use of temporary check dams as a water pollution control practice for soil stabilization in flow conveyances.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for:

1. Fiber rolls
2. Gravel-filled bag fabric

MATERIALS

Fiber Rolls

Fiber rolls must:

1. Last for at least one year after installation
2. Be Type 1 or Type 2

If specified, Type 1 fiber rolls must be:

1. Made from an erosion control blanket:

    1.1. Classified by the Erosion Control Technology Council (ECTC) as ECTC 2D
    1.2. With a Universal Soil Loss Equation (USLE) C-Factor of not more than 0.20 at a 2:1 (horizontal:vertical) slope
    1.3. Capable to withstand a maximum shear stress of 1.75 pounds per square foot under ASTM D 6460
    1.4. With a minimum tensile strength of 75 pounds per foot under ASTM D 5035
    1.5. With top and bottom surfaces covered with lightweight non-synthetic netting
    1.6. Either of the following:

        1.6.1. Double net coconut blanket
        1.6.2. Double net excelsior blanket with 80 percent of the wood excelsior fibers being 6 inches or longer

2. Rolled along the width
3. Secured with natural fiber twine every 6 feet and 6 inches from each end
4. Finished to be either:

    4.1. From 8 to 10 inches in diameter, from 10 to 20 feet long, and at least 0.5 pounds per linear foot
    4.2. From 10 to 12 inches in diameter, at least 10 feet long, and at least 2 pounds per linear foot

If specified, Type 2 fiber rolls must:

1. Be filled with rice straw
2. Be covered with a biodegradable jute, sisal, or coir fiber netting
3. Have the netting secured tightly at each end
4. Be finished to be either:

    4.1. From 8 to 10 inches in diameter, from 10 to 20 feet long, and at least 1.1 pounds per linear foot
    4.2. From 10 to 12 inches in diameter, at least 10 feet long, and at least 3 pounds per linear foot

Wood Stakes

Wood stakes must be:

1. Untreated fir, redwood, cedar, or pine and cut from sound timber
2. Straight and free of loose or unsound knots and other defects which would render the stakes unfit for use
3. Pointed on the end to be driven into the ground

For fiber rolls, wood stakes must be at least:

1. 1" x 1" x 24" in size for Type 1 installation
2. 1" x 2" x 24" in size for Type 2 installation

Rope

For Type 2 installation, rope must:

1. Be biodegradable, such as sisal or manila
2. Have a minimum diameter of 1/4 inch

Gravel-filled Bag Fabric

Geosynthetic fabric for temporary gravel bag berm must consist of one of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Sample under ASTM D 4354, Procedure C.
Test under ASTM D 4759. All properties are based on Minimum Average Roll Value (MARV).
Identify, store, and handle under ASTM D 4873.
Protect geosynthetics from moisture, sunlight and damage during shipping and storage. Label each unit with the manufacturer's name, identifying information and product identification.
Gravel-filled bag fabric must comply with:

Specification	Requirements
Grab breaking load 1-inch grip, lb, min. in each direction	205
Apparent elongation percent, min., in each direction	50
Water Flow Rate max. average roll value, gallons per minute/square foot	80-150
Permittivity 1/sec., min	1.2
Apparent opening size max. average roll value, U.S. Standard sieve size	40-80
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	70

Gravel

Gravel for gravel-filled bags must be:

1. From 3/8 to 3/4 inch in diameter
2. Clean and free from clay balls, organic matter, and other deleterious materials

Gravel-filled Bags

Gravel-filled bags must:

1. Be made from gravel-filled bag fabric.
2. Have inside dimensions from 24 to 32 inches in length, and from 16 to 20 inches in width.
3. Have the opening bound to retain the gravel. The opening must be sewn with yarn, bound with wire, or secured with a closure device.
4. Weigh from 30 to 50 pounds when filled with gravel.

CONSTRUCTION

Before placing temporary check dam, remove obstructions including rocks, clods, and debris greater than one inch in diameter from the ground.

If check dams are to be placed in the same areas as erosion control blankets, then install the blankets before placing the check dams.

Temporary check dams must be:

1. Placed approximately perpendicular to the centerline of the ditch or drainage line
2. Installed with sufficient spillway depth to prevent flanking of concentrated flow around the ends of the check dam
3. Type 1 for lashed fiber rolls, Type 2 for gravel-filled bags, or a combination:

3.1. If the ditch is lined with concrete or hot mix asphalt, use temporary check dam (Type 2)
3.2. If the ditch is unlined, you may use temporary check dam (Type 1) or (Type 2)

Temporary check dam (Type 1) must be:

1. Secured with rope and notched wood stakes.
2. Installed by driving stakes into the soil until the notch is even with the top of the fiber roll.
3. Installed by lacing the rope between stakes and over the fiber roll. Knot the rope at each stake.
4. Tightened by driving the stakes further into the soil forcing the fiber roll against the surface of the ditch or drainage line.

Temporary check dam (Type 2) must be:

1. Placed as a single layer of gravel bags
2. End-to-end to eliminate gaps

If you need to increase the height of the temporary check dam (Type 2):

1. Increase height by adding rows of gravel-filled bags
2. Stack bags in a way that the bags in the top row overlap the joints in the lower row
3. Stabilize dam by adding rows of bags at the bottom

MAINTENANCE

Maintain temporary check dams to provide sediment holding capacity and to reduce concentrated flow velocities.

Remove sediment deposits, trash, and debris from temporary check dams as needed or when directed by the Engineer. If removed sediment is deposited within project limits, it must be stabilized and not subject to erosion by wind or water. Trash and debris must be removed and disposed of as specified in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Maintain temporary check dams by:

1. Removing sediment from behind the check dam when sediment is 1/3 the height of the check dam above ground
2. Repairing or adjusting the check dams when scour and other evidence of concentrated flow occur beneath the fiber roll
3. Repairing or replacing the fiber rolls or gravel-filled bags when they become split, torn, or unraveled
4. Adding stakes when the fiber rolls slump or sag
5. Replacing broken or split wood stakes

Repair temporary check dams within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary check dams, repair temporary check dams at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

REMOVAL

When the Engineer determines that temporary check dams are not required, they must be removed and disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary check dams must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary check dam is measured by the linear foot along the centerline of the check dams. Where temporary fiber rolls are joined and overlapped, the overlap is measured as a single installed check dam.

The contract price paid per linear foot for temporary check dams includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the temporary check dams, complete in place, including removal of materials, cleanup and disposal of retained sediment and debris, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The State and you share the cost of maintaining the temporary check dams. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.10 TEMPORARY CONCRETE WASHOUT (PORTABLE)

GENERAL

Summary

This work includes removal and disposal of concrete waste by furnishing, maintaining, and removing portable temporary concrete washouts.

SWPPP must describe and include the use of a portable temporary concrete washout as a water pollution control practice for waste management and materials pollution control.

Submittals

At least 5 business days before concrete activities start, submit:

1. Name and location of off-site concrete waste disposal facility to receive concrete waste
2. Copy of permit issued by RWQCB for off-site commercial disposal facility
3. Copy of license for off-site commercial disposal facility
4. Copy of permit issued by state or local agency having jurisdiction over disposal facility if disposal site is located outside of the State of California

Quality Control and Assurance

Retain and submit records of disposed concrete waste including:

1. Weight tickets
2. Delivery and removal of temporary concrete washouts

MATERIALS

Portable Temporary Concrete Washout

Portable temporary concrete washout must:

1. Be a commercially available watertight container.
2. Have sufficient capacity to contain all liquid and concrete waste generated by washout activities without seepage or spills.
3. Have at least 55-gallon capacity.
4. Be labeled for the exclusive use as a concrete waste and washout facility. Stencil "Concrete Waste material" in 3-inch high letters on white background. Top of stenciling must be 12 inches from the top of the container.

Concrete Washout Sign

Concrete washout sign must comply with the provisions in Section 12-3.06B, "Portable Signs" of the Standard Specifications and:

1. Be approved by the Engineer
2. Consist of base, framework, and sign panel
3. Be made of plywood
4. Be minimum 2' x 4' in size
5. Read "Concrete Washout" with 3 inches high black letters on white background

CONSTRUCTION

Placement

Place portable temporary concrete washouts at job site:

1. Before concrete placement activities start
2. In the immediate area of concrete work as approved by the Engineer
3. No closer than 50 feet from storm drain inlets, open drainage facilities, ESAs, or watercourses
4. Away from construction traffic or public access areas

Install a concrete washout sign adjacent to each portable temporary concrete washout location.

Operation

Use portable temporary concrete washouts for:

1. Washout from concrete delivery trucks
2. Slurries containing portland cement concrete or hot mix asphalt from sawcutting, coring, grinding, grooving, and hydro-concrete demolition
3. Concrete waste from mortar mixing stations

Relocate portable temporary concrete washouts as needed for concrete construction work.
Replace portable temporary concrete washouts when filled to capacity. Do not fill higher than 6 inches below rim.
Your WPC manager must inspect portable temporary concrete washouts:

1. Daily if concrete work occurs daily
2. Weekly if concrete work does not occur daily

Maintenance

When relocating or transporting a portable temporary concrete washout within the job site, secure it to prevent spilling of concrete waste material. If any spilled material is observed, remove spilled material and place it into portable temporary concrete washout.

Removal

Dispose of concrete waste material at a facility specifically licensed to receive solid concrete waste, liquid concrete waste, or both. When portable temporary concrete washout is full, remove and dispose of concrete waste within 2 days.

PAYMENT

The contract lump sum price paid for temporary concrete washout (portable) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing, maintaining, and removing the portable temporary concrete washout, including removal and disposal of concrete waste, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.11 TEMPORARY FIBER ROLL

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary fiber roll.
The SWPPP must describe and include the use of temporary fiber roll as a water pollution control practice for sediment control.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for fiber roll.

MATERIALS

Fiber Roll

Fiber roll must:

1. Last for at least one year after installation
2. Be Type 1 or Type 2

If specified, Type 1 fiber roll must be:

1. Made from an erosion control blanket:

    1.1. Classified by the Erosion Control Technology Council (ECTC) as ECTC 2D
    1.2. With a Universal Soil Loss Equation (USLE) C-Factor of not more than 0.20 at a 2:1 (horizontal:vertical) slope
    1.3. Capable to withstand a maximum shear stress of 1.75 pounds per square foot under ASTM D 6460

1.4. With a minimum tensile strength of 75 pounds per foot under ASTM D 5035
1.5. With top and bottom surfaces covered with lightweight non-synthetic netting
1.6. That complies with one of the following:

1.6.1. Double net coconut blanket
1.6.2. Double net excelsior blanket with 80 percent of the wood excelsior fibers being 6 inches or longer

2. Rolled along the width
3. Secured with natural fiber twine every 6 feet and 6 inches from each end
4. Finished to be either:

4.1. From 8 to 10 inches in diameter, from 10 to 20 feet long, and at least 0.5 pounds per linear foot
4.2. From 10 to 12 inches in diameter, at least 10 feet long, and at least 2 pounds per linear foot

If specified, Type 2 fiber roll must:

1. Be filled with ricestraw
2. Be covered with a biodegradable jute, sisal, or coir fiber netting
3. Have the netting secured tightly at each end
4. Be finished to be either:

4.1. From 8 to 10 inches in diameter, from 10 to 20 feet long, and at least 1.1 pounds per linear foot
4.2. From 10 to 12 inches in diameter, at least 10 feet long, and at least 3 pounds per linear foot

Wood Stakes

Wood stakes must be:

1. Untreated fir, redwood, cedar, or pine and cut from sound timber
2. Straight and free of loose or unsound knots and other defects which would render the stakes unfit for use
3. Pointed on the end to be driven into the ground

For fiber roll, wood stakes must be at least:

1. 1" x 1" x 24" in size for Type 1 installation
2. 1" x 2" x 24" in size for Type 2 installation

Rope

For Type 2 installation, rope must:

1. Be biodegradable, such as sisal or manila
2. Have a minimum diameter of 1/4 inch

CONSTRUCTION

Before placing fiber roll, remove obstructions including rocks, clods, and debris greater than one inch in diameter from the ground.

If fiber roll is to be placed in the same area as erosion control blanket, install the blanket before placing the fiber roll. For other soil stabilization practices such as hydraulic mulch or compost, place the fiber roll and then apply the soil stabilization practice.

Place fiber roll on slopes at the following spacing unless the plans show a different spacing:

1. 10 feet apart for slopes steeper than 2:1 (horizontal:vertical)
2. 15 feet apart for slopes from 2:1 to 4:1 (horizontal:vertical)
3. 20 feet apart for slopes from 4:1 to 10:1 (horizontal:vertical)
4. 50 feet apart for slopes flatter than 10:1 (horizontal:vertical)

Place fiber roll approximately parallel to the slope contour. For any 20 foot section of fiber roll, do not allow the fiber roll to vary more then 5 percent from level.

Type 1 and Type 2 fiber roll may be installed using installation method Type 1, Type 2, or a combination:

For installation method Type 1, install fiber roll by:

1. Placing in a furrow that is from 2 to 4 inches deep
2. Securing with wood stakes every 4 feet along the length of the fiber roll
3. Securing the ends of the fiber roll by placing a stake 6 inches from the end of the roll
4. Driving the stakes into the soil so that the top of the stake is less then 2 inches above the top of the fiber roll

For installation method Type 2, install fiber roll by:

1. Securing with rope and notched wood stakes.
2. Driving stakes into the soil until the notch is even with the top of the fiber roll.
3. Lacing the rope between stakes and over the fiber roll. Knot the rope at each stake.
4. Tightening the fiber roll to the surface of the slope by driving the stakes further into the soil.

MAINTENANCE

Maintain temporary fiber roll to provide sediment holding capacity and to reduce runoff velocities.

Remove sediment deposits, trash, and debris from temporary fiber roll as needed or when directed by the Engineer. If removed sediment is deposited within project limits, it must be stabilized and not subject to erosion by wind or water. Trash and debris must be removed and disposed of as specified in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Maintain temporary fiber roll by:

1. Removing sediment from behind the fiber roll when sediment is 1/3 the height of the fiber roll above ground
2. Repairing or adjusting the fiber roll when rills and other evidence of concentrated runoff occur beneath the fiber roll.
3. Repairing or replacing the fiber roll when they become split, torn, or unraveled
4. Adding stakes when the fiber roll slump or sag
5. Replacing broken or split wood stakes

Repair temporary fiber roll within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary fiber roll, repair temporary fiber roll at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

REMOVAL

When the Engineer determines that temporary fiber roll is not required, they must be removed and disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary fiber roll must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary fiber roll is measured by the linear foot along the centerline of the installed roll. Where temporary fiber roll is joined and overlapped, the overlap is measured as a single installed roll.

The contract price paid per linear foot for temporary fiber roll includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the temporary fiber roll, complete in place, including removal of materials, cleanup and disposal of retained sediment and debris, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer

The State and you share the cost of maintaining the temporary fiber roll. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.12 TEMPORARY SILT FENCE

GENERAL

Summary

This work includes installing, maintaining, and removing temporary silt fence.

The SWPPP must describe and include the use of temporary silt fence as a water pollution control practice for sediment control.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for silt fence fabric.

MATERIALS

Silt Fence Fabric

Geosynthetic fabric for temporary silt fence must consist of one of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Sample under ASTM D 4354, Procedure C.
Test under ASTM D 4759. All properties must be based on Minimum Average Roll Value (MARV).
Identify, store, and handle under ASTM D 4873.
Protect geosynthetics from moisture, sunlight, and damage during shipping and storage. Label each unit with the manufacturer's name, identifying information, and product identification.
Silt fence fabric must comply with:

Property	ASTM Designation	Specification	
		Woven	Non-woven
Grab breaking load 1-inch grip, lb, min. in each direction	D 4632	120	120
Apparent elongation percent, min., in each direction	D 4632	15	50
Water Flow Rate max. average roll value, gallons per minute/square foot	D 4491	10-50	100-150
Permittivity 1/sec., min.	D 4491	0.05	0.05
Apparent opening size max. average roll value, U.S. Standard sieve size	D 4751	30	30
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	D 4595	70	

Posts

Posts must be wood or metal.
Wood posts must be:

1. Untreated fir, redwood, cedar, or pine and cut from sound timber
2. Straight and free of loose or unsound knots and other defects that would render the stakes unfit for use
3. Pointed on the end to be driven into the ground
4. At least 2" x 2" in size, and 4 feet long

Metal posts must:

1. Be made of steel.
2. Have a "U," "T," "L," or other cross sectional shape that can resist failure from lateral loads.
3. Be pointed on the end to be driven into the ground.
4. Weigh at least 0.75-pound per foot.
5. Be at least 4 feet long.
6. Have a safety cap attached to the exposed end. The safety cap must be orange or red plastic and fit snugly to the metal post.

CONSTRUCTION

Silt fence must be:

1. Constructed with silt fence fabric, posts, and fasteners
2. Prefabricated or assembled at the job site

Silt fence fabric must be attached to posts using these methods:

1. If prefabricated silt fence is used, posts must be inserted into sewn pockets
2. If assembled on the job site:

    2.1. If wood posts are used, fasteners must be staples or nails
    2.2. If steel posts are used, fasteners must be tie wires or locking plastic fasteners
    2.3. Spacing of the fasteners must be no more than 8 inches apart

Place silt fence approximately parallel to the slope contour. For any 50 foot section of silt fence, do not allow the elevation at the base of the fence to vary more than 1/3 of the fence height.

Install silt fence by:

1. Placing the bottom of the fabric in a trench that is 6 inches deep
2. Securing with posts placed on the downhill side of the fabric
3. Backfilling the trench with soil and hand or mechanically tamping to secure the fabric in the trench

If you reinforce the silt fence fabric with wire or plastic mesh, you may increase the post spacing to a maximum of 10 feet. The field-assembled reinforced silt fence must be able to retain saturated sediment without collapsing.

Connect silt fence sections by:

1. Joining separate sections of silt fence to form reaches that are no more than 500 feet long
2. Securing the end posts of each section by wrapping the tops of the posts with at least two wraps of 16-gage diameter tie wire
3. Ensuring that each reach is a continuous run of silt fence from end to end or from an end to an opening, including joined panels

If you mechanically push the silt fence fabric vertically through the soil, you must demonstrate that the silt fence fabric will not be damaged and will not slip out of the soil, resulting in sediment passing under the silt fence fabric.

MAINTENANCE

Maintain temporary silt fence to provide sediment holding capacity and to reduce runoff velocities.

Remove sediment deposits, trash, and debris from temporary silt fence as needed or when directed by the Engineer. If removed sediment is deposited within project limits, it must be stabilized and not subject to erosion by wind or water. Trash and debris must be removed and disposed of as specified in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Maintain temporary silt fence by:

1. Removing sediment from behind the silt fence when sediment is 1/3 the height of the silt fence above ground
2. Repairing or adjusting the silt fence when rills and other evidence of concentrated runoff occur beneath the silt fence fabric
3. Repairing or replacing the silt fence fabric when it become split, torn, or unraveled

Repair temporary silt fence within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary silt fence, repair temporary silt fence at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

REMOVAL

When the Engineer determines that temporary silt fence is not required, remove and dispose of fence under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary silt fence must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary silt fence is measured by the linear foot along the centerline of the installed fence.

The contract price paid per linear foot for temporary silt fence includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the temporary silt fence, complete in place, including removal of materials, cleanup and disposal of retained sediment and debris, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The State and you share the cost of maintaining the temporary silt fence. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.13 TEMPORARY REINFORCED SILT FENCE

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary reinforced silt fence.

The SWPPP must describe and include the use of temporary reinforced silt fence as a water pollution control practice for sediment control.

Temporary reinforced silt fence must be Type 1.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for:

1. Silt fence fabric
2. Safety cap for metal posts
3. High visibility fabric, if specified

MATERIALS

Geosynthetic Fabrics

Geosynthetic fabrics for temporary reinforced silt fence must consist of one of the following:

1. Polyester
2. Polyethylene
3. Polypropylene
4. Combined polyester and polypropylene

Sample under ASTM D 4354, Procedure C.

Test under ASTM D 4759. All properties must be based on Minimum Average Roll Value (MARV).

Identify, store, and handle under ASTM D 4873.

Protect geosynthetics from moisture, sunlight, and damage during shipping and storage. Label each unit with the manufacturer's name, identifying information, and product identification.

Silt fence fabric must comply with:

Property	ASTM Designation	Specification	
		Woven	Non-woven
Grab breaking load 1-inch grip, lb, Min. in each direction	D 4632	120	120
Apparent elongation percent, Min., in each direction	D 4632	15	50
Water Flow Rate Max. average roll value, gallons per minute/square foot	D 4491	10-50	100-150
Permittivity 1/sec., Min.	D 4491	0.05	0.05
Apparent opening size Max. average roll value, U.S. Standard sieve size	D 4751	30	30
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	D 4355	70	

If Type 1 is specified, high visibility fabric must:

1. Contain ultraviolet inhibitors
2. Comply with the following:

Property	Specifications	Requirements
Width, inches, Min	Measured	48
Opening size inches	Measured	1" x 1" (Min) 2" x 2" (Max)
Color	Observed	Orange
Grab breaking load 1-inch grip, lb, Min. in each direction	ASTM D4632	260
Apparent elongation percent, Min., in each direction	ASTM D4632	5
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	ASTM D4355	70

Posts

Posts must be steel and:

1. Have a "U," "T," "L," or other cross sectional shape that can resist failure from lateral loads
2. Be pointed on the end to be driven into the ground
3. Weigh at least 0.75-pound per foot, and be:

    3.1. At least 6 feet in length for Type 1 installation
    3.2. At least 5 feet in length for Type 2 installation

4. Have a safety cap attached to the exposed end. The safety cap must be orange or red plastic and fit snugly to the metal post

Wire Mesh

Wire mesh must comply with Section 80-3.01D, "Wire Mesh," of the Standard Specifications and these requirements:

1. Have vertical and horizontal wires of at least 14-gage that are welded at each intersection
2. Have a maximum opening of 2 inches wide by 4 inches high
3. Supplied in rolls of at least 50 feet

Wire

Wire for guy wires and tie wires must be iron or steel and must be 16-gage.

Anchors

Fabricate anchors from No. 4 steel reinforcing bar.

If approved, you may install used materials. The used materials must be good, sound, and suitable for the purpose intended.

CONSTRUCTION

General

Place reinforced silt fence parallel to the slope contour. For any 50 foot section of reinforced silt fence, do not allow the elevation at the base of the fence to vary more than 1/3 of the fence height.

Install reinforced silt fence by:

1. Digging a trench that is 6 inches deep.
2. Placing the wire mesh and bottom of silt fence fabric in the trench.
3. Placing posts on the downhill side of fabric and wire mesh.
4. Silt fence fabric and wire mesh must be attached to posts using these methods:

    4.1. Fasteners must be tie wires or locking plastic fasteners.
    4.2. Spacing of fasteners must be no more than 8 inches apart.

5. Attaching silt fence fabric to the wire mesh with tie wires or locking plastic fasteners. Horizontal spacing of fasteners must be no more than 3 feet along the length of the fence and vertical spacing must be no more that 8 inches apart from top to bottom.
6. Backfilling trench with soil by hand or mechanically tamping to secure fabric and wire mesh in the trench.
7. Attaching guy wires and anchors at each post. At least of two anchors and guy wires must be installed at angle points and end posts.

Connect reinforced silt fence sections by:

1. Joining separate sections of silt fence to form reaches that are no more than 500 feet long
2. Securing end posts of each section by wrapping the tops of posts with at least two wraps of 16-gage tie wire
3. Ensuring that each reach is a continuous run of silt fence from end to end or from an end to an opening, including joined panels

If reinforced silt fence Type 1 is specified, attach high visibility fabric to steel posts using tie wires or locking plastic fasteners.

Maintenance

Maintain temporary reinforced silt fence to provide sediment holding capacity and to reduce runoff velocities.

Remove sediment deposits, trash, and debris from temporary reinforced silt fence as needed or ordered. If removed sediment is deposited within project limits, it must be stabilized and not subject to erosion by wind or water. Remove and dispose of trash and debris as specified in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Maintain temporary reinforced silt fence by:

1. Removing sediment from behind silt fence when sediment is 1/3 the height of the silt fence above ground
2. Repairing or adjusting silt fence when rills and other evidence of concentrated runoff occur beneath the silt fence fabric
3. Repairing or replacing silt fence fabric when it becomes split, torn, or unraveled
4. Repairing failures that appear as pushouts at the bottom of the fence by:

    4.1. Adding more posts at the failure
    4.2. Embedding posts deeper into the soil

5. Repairing failures that appear as leaning at the top of the fence by:

   5.1. Adding more anchors and guy wires to existing posts
   5.2. Adding more posts, anchors, and guy wires

Repair temporary reinforced silt fence within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary reinforced silt fence, repair temporary silt fence at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

Removal

When the Engineer determines that temporary reinforced silt fence is no longer required, remove and dispose of it under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Backfill and repair ground disturbance caused by the installation and removal of temporary reinforced silt fence, including holes and depressions, under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary reinforced silt fence is measured by the linear foot along the centerline of the installed fence.

The contract price paid per linear foot for temporary reinforced silt fence includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the temporary reinforced silt fence, complete in place, including removal of materials, cleanup and disposal of retained sediment and debris, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as ordered by the Engineer.

The State and you share the cost of maintaining the temporary reinforced silt fence. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.14 TEMPORARY FENCE

Temporary fence shall be furnished, constructed, maintained, and later removed as shown on the plans, as specified in these special provisions and as directed by the Engineer.

Except as otherwise specified in this section, temporary fence shall conform to the plan details and the specifications for permanent fence of similar character as provided in Section 80, "Fences," of the Standard Specifications.

Used materials may be installed provided the used materials are good, sound and are suitable for the purpose intended, as determined by the Engineer.

Materials may be commercial quality provided the dimensions and sizes of the materials are equal to, or greater than, the dimensions and sizes shown on the plans or specified herein.

Posts shall be either metal or wood at the Contractor's option.

Galvanizing and painting of steel items will not be required.

Treating wood with a wood preservative will not be required.

Concrete footings for metal posts will not be required.

Temporary fence that is damaged during the progress of the work shall be repaired or replaced by the Contractor at the Contractor's expense.

When no longer required for the work, as determined by the Engineer, temporary fence shall be removed. Removed facilities shall become the property of the Contractor and shall be removed from the site of the work, except as otherwise provided in this section.

Removed temporary fence materials that are not damaged may be constructed in the permanent work provided the materials conform to the requirements specified for the permanent work and such materials are new when used for the temporary fence.

Holes caused by the removal of temporary fence shall be backfilled in conformance with the provisions in the second paragraph of Section 15-1.02, "Preservation of Property," of the Standard Specifications.

The various types and kinds of temporary fence will be measured and paid for in the same manner specified for permanent fence of similar character as provided in Section 80, "Fences," of the Standard Specifications.

Full compensation for maintaining, removing, and disposing of temporary fence shall be considered as included in the contract prices paid per linear foot for the various types of temporary fence and no additional compensation will be allowed therefor.

10-1.15 TEMPORARY FENCE (TYPE CL-6, SLATTED)

Temporary fence (Type CL-6, Slatted) shall be furnished, constructed, maintained, and later removed as shown on the plans, as specified in these special provisions and as directed by the Engineer.

Temporary fence (Type CL-6, slatted) consisting of chain link fence (Type CL-6) with plastic slats inserted vertically in the chain link fabric shall conform to the provisions in Section 80, "Fences," of the Standard Specifications and these special provisions.

Chain link fence fabric shall be woven from 9-gage galvanized steel wire. Mesh openings in the chain link fence fabric shall be approximately 3-1/4 inches vertically and 5-1/4 inches horizontally.

Plastic slats shall be manufactured from a high density virgin polyethylene with ultraviolet inhibitors, shall be dark red or redwood in color, and shall conform to the following:

A. Plastic slats shall have a flat tubular cross section with a wall thickness of approximately 0.03-inch; depth of approximately 0.325-inch; width of approximately 2.38 inches; and a length equal to the designated fence height.
B. The plastic slats shall have the following material specifications:

Property	Value	ASTM Designation
Melt Index	0.24	D 1238
Density	0.951	D 1505
Low Temperature Brittleness	-76° F	D 746
Tensile Strength	3,700 psi	D 638

Used materials may be installed provided the used materials are good, sound and are suitable for the purpose intended, as determined by the Engineer.

Materials may be commercial quality provided the dimensions and sizes of the materials are equal to, or greater than, the dimensions and sizes shown on the plans or specified herein.

Posts shall be metal.

Galvanizing and painting of steel items will not be required.

Treating wood with a wood preservative will not be required.

Concrete footings for metal posts will not be required.

Temporary fence (Type CL-6, Slatted) that is damaged during the progress of the work shall be repaired or replaced by the Contractor at the Contractor's expense.

When no longer required for the work, as determined by the Engineer, temporary fence (Type CL-6, Slatted) shall be removed. Removed facilities shall become the property of the Contractor and shall be removed from the site of the work, except as otherwise provided in this section.

Removed temporary fence materials that are not damaged may be constructed in the permanent work provided the materials conform to the requirements specified for the permanent work and such materials are new when used for the temporary fence (Type CL-6, Slatted).

Holes caused by the removal of temporary fence (Type CL-6, Slatted) shall be backfilled in conformance with the provisions in the second paragraph of Section 15-1.02, "Preservation of Property," of the Standard Specifications.

Full compensation for maintaining, removing, and disposing of temporary fence (Type CL-6, Slatted) shall be considered as included in the contract prices paid per foot for temporary fence (Type CL-6, Slatted) and no additional compensation will be allowed therefor.

10-1.16 TEMPORARY FENCE (TYPE ESA)

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary fence (Type ESA). Temporary fence (Type ESA) provides a visible boundary adjacent to protected areas such as an environmentally sensitive area.

Signs are required for temporary fence (Type ESA).

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for:

1. High visibility fabric
2. Safety cap for metal posts

MATERIALS

High Visibility Fabric

High visibility fabric for temporary fence (Type ESA) must consist of one of the following:

1. Polyethylene
2. Polypropylene
3. Combined polyethylene and polypropylene

Sample under ASTM D 4354, Procedure C.
Test under ASTM D 4759. All properties must be based on Minimum Average Roll Value.
Identify, store, and handle under ASTM D 4873.
High visibility fabric must:

1. Contain ultraviolet inhibitors
2. Comply with the following:

Property	Specifications	Requirements
Width, inches, Min	Measured	48
Opening size inches	Measured	1" x 1" (Min) 2" x 2" (Max)
Color	Observed	Orange
Grab breaking load 1-inch grip, lb, Min. in each direction	ASTM D4632	260
Apparent elongation percent, Min., in each direction	ASTM D4632	5
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	ASTM D4355	70

Posts

Posts must be wood or steel.
Wood posts must be:

1. Untreated fir, redwood, cedar, or pine and cut from sound timber
2. Straight and free of loose or unsound knots and other defects that would render the stakes unfit for use
3. Pointed on the end to be driven into the ground
4. At least 2" x 2" in size and 6 feet long

Steel posts must:

1. Have a "U," "T," "L," or other cross sectional shape that can resist failure from lateral loads.
2. Be pointed on the end to be driven into the ground.
3. Weigh at least 0.75-pound per foot.
4. Be at least 6 feet long.
5. Have a safety cap attached to the exposed end. The safety cap must be yellow, orange or red plastic and fit snugly to the metal post.

Signs

If specified, signs must be:

1. Weatherproof and fade-proof and may include plastic laminated printed paper affixed to an inflexible weatherproof backer board
2. Attached to the high visibility fabric with tie wire or locking plastic fasteners

CONSTRUCTION

General

Install temporary fence (Type ESA):

1. With high visibility fabric, posts, and fasteners as follows:

    1.1. If wood posts are used, fasteners must be staples or nails
    1.2. If steel posts are used, fasteners must be tie wires or locking plastic fasteners
    1.3. Spacing of the fasteners must be no more than 8 inches apart

2. Before clearing and grubbing activities
3. From outside of the protected area
4. With posts spaced 8 feet apart and embedded at least 16 inches in the soil

If specified, signs must be:

1. Attached with the top of the sign panel flush with the top of the high visibility fabric
2. Placed 100 feet apart along the length and at each end of the fence

If trees and other plants need protection, install fence to:

1. Enclose the foliage canopy (drip line) of protected plants
2. Protect visible roots from encroachment

Maintenance

Maintain temporary fence (Type ESA) by:

1. Keeping posts in a vertical position
2. Reattaching fabric to posts
3. Replacing damaged sections of fabric
4. Replacing and securing signs

Removal

When the Engineer determines that temporary fence (Type ESA) is no longer required, remove and dispose of it under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Backfill and repair ground disturbance caused by the installation and removal of temporary fence (Type ESA), including holes and depressions, under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary fence (Type ESA) is measured and paid for by the linear foot in the same manner specified for fence (Type BW or WM) in Section 80, "Fences," of the Standard Specifications.

The contract price paid per linear foot for temporary fence (Type ESA) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the temporary fence (Type ESA), complete in place, including maintenance, removal of materials, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as ordered by the Engineer.

10-1.17 TEMPORARY GRAVEL BAG BERM

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary gravel bag berm.

The SWPPP must describe and include the use of temporary gravel bag berm as a water pollution control practice for sediment control.

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for gravel-filled bag fabric.

MATERIALS

Gravel-filled Bag Fabric

Geosynthetic fabric for temporary gravel bag berm must consist of one of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Sample under ASTM D 4354, Procedure C.
Test under ASTM D 4759. All properties must be based on Minimum Average Roll Value (MARV).
Identify, store, and handle under ASTM D 4873.
Protect geosynthetics from moisture, sunlight, and damage during shipping and storage. Label each unit with the manufacturer's name, identifying information, and product identification.
Gravel-filled bag fabric must comply with:

Specification	Requirements
Grab breaking load 1-inch grip, lb, min. in each direction	205
Apparent elongation percent, min., in each direction	50
Water Flow Rate max. average roll value, gallons per minute/square foot	80-150
Permittivity 1/sec., min	1.2
Apparent opening size max. average roll value, U.S. Standard sieve size	40-80
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	70

Gravel

Gravel for gravel-filled bags must be:

1. From 3/8 to 3/4 inch in diameter
2. Clean and free from clay balls, organic matter, and other deleterious materials

Gravel-filled Bags

Gravel-filled bags must:

1. Be made from gravel-filled bag fabric.
2. Have inside dimensions from 24 to 32 inches in length, and from 16 to 20 inches in width.
3. Have the opening bound to retain the gravel. The opening must be sewn with yarn, bound with wire, or secured with a closure device.
4. Weigh from 30 to 50 pounds when filled with gravel.

CONSTRUCTION

Before constructing temporary gravel bag berm, remove obstructions including rocks, clods, and debris greater than 1 inch in diameter from the ground.

Temporary gravel bag berm must:

1. Be placed as a single layer of gravel bags to create a linear sediment barrier
2. Be placed end-to-end to eliminate gaps
3. Be placed approximately parallel to the slope contour
4. Have the last 6 feet of the gravel bag berm angled up-slope

If you need to increase the height of the temporary gravel bag berm:

1. Increase height by adding rows of gravel-filled bags
2. Stack bags in a way that the bags in the top row overlap the joints in the lower row
3. Stabilize berm by adding rows at the bottom

If used within shoulder area, gravel-filled bags must be placed behind temporary railing (Type K).

MAINTENANCE

Maintain temporary gravel bag berm to provide sediment holding capacity and to reduce runoff velocities.

Remove sediment deposits, trash, and debris from temporary gravel bag berm as needed or when directed by the Engineer. If removed sediment is deposited within project limits, it must be stabilized and not subject to erosion by wind or water. Trash and debris must be removed and disposed of as specified in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Maintain temporary gravel bag berm by:

1. Removing sediment from behind the gravel bag berm when sediment is 1/3 the height of the gravel bag berm above ground
2. Repairing or adjusting the gravel-filled bags when rills and other evidence of concentrated runoff occur beneath the gravel-filled bags
3. Repairing or replacing the gravel-filled bags when they become split, torn, or unraveled

Repair temporary gravel bag berm within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary gravel bag berm, repair temporary gravel bag berm at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

REMOVAL

When the Engineer determines that temporary gravel bag berm is not required, they must be removed and disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary gravel bag berm must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary gravel bag berm is measured by the linear foot along the centerline of the installed berm.

The contract price paid per linear foot for temporary gravel bag berm includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the temporary gravel bag berm, complete in place, including removal of materials, cleanup and disposal of retained sediment and debris, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The State and you share the cost of maintaining the temporary gravel bag berm. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.18 TEMPORARY CONSTRUCTION ENTRANCE

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary construction entrance to provide temporary access.

The SWPPP must describe and include the use of temporary construction entrance as a water pollution control practice for tracking control.

Temporary construction entrance must be Type 1, Type 2, or a combination.

Submittals

Submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for:

1. Temporary entrance fabric
2. Rock

Submit details for alternatives at least 5 business days before installation. You may propose alternatives for the following items:

1. Alternative sump
2. Alternative corrugated steel panels

If the Engineer approves, you may eliminate the sump.

MATERIALS

Temporary Entrance Fabric

Temporary entrance fabric must comply with Section 88-1.04, "Rock Slope Protection Fabric," of the Standard Specifications and be woven Type B or non-woven Type B.

Rock

Rock must be Type A or Type B.
Rock (Type A) must comply with:

1. Requirements under Section 72-2.02, "Materials," of the Standard Specifications
2. Following sizes:

Square Screen Size (inch)	Percentage Passing	Percentage Retained
6	100	0
3	0	100

Rock (Type B) must be Railway Ballast Number 25. Do not use blast furnace slag. Railway Ballast Number 25 must comply with:

1. Description in AREMA Manual for Railway Engineering.
2. Following sizes:

Nominal Size Square Opening	Percentage Passing								
	3"	2-1/2"	2"	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4
2-1/2"-3/8"	100	80-100	60-85	50-70	25-50	-	5-20	0-10	0-3

3. Following properties:

Specification	Requirements
Percent material passing No. 200 sieve, max. ASTM: C 117	1.0
Bulk specific gravity, min. ASTM: C 127	2.60
Absorption, percent min. ASTM: C 127	1.0
Clay lumps and friable particles, percent max. ASTM: C 142	0.5
Degradation, percent max. ASTM: C 535	30
Soundness (Sodium Sulfate), percent max. ASTM: C 88	5.0
Flat, elongated particles, or both, percent max. ASTM: D 4791	5.0

Corrugated Steel Panels

Corrugated steel panels must:

1. Be made of steel.
2. Be pressed or shop welded
3. Have a slot or hook for connecting panels together

CONSTRUCTION

Prepare location for temporary construction entrance by:

1. Removing vegetation to ground level and clear away debris
2. Grading ground to uniform plane
3. Grading ground surface to drain
4. Removing sharp objects that may damage fabric
5. Compacting the top 1.5 feet of soil to at least 90 percent relative compaction

If temporary entrance (Type 1) is specified, use rock (Type A).

If temporary construction entrance (Type 2) is specified, use Rock (Type B) under corrugated steel panels. Use at least 6 corrugated steel panels for each entrance. Couple panels together.

Install temporary construction entrance by:

1. Positioning fabric along the length of the entrance
2. Overlapping sides and ends of fabric by at least 12 inches
3. Spreading rock over fabric in the direction of traffic
4. Covering fabric with rock within 24 hours
5. Keeping a 6 inch layer of rock over fabric to prevent damage to fabric by spreading equipment

Do not drive on fabric until rock is spread.

Unless the Engineer eliminates the sump, install a sump within 20 feet of each temporary construction entrance.

Repair fabric damaged during rock spreading by placing a new fabric over the damaged area. New fabric must be large enough to cover damaged area and provide at least 18-inch overlap on all edges.

Maintenance

Maintain temporary construction entrance to minimize generation of dust and tracking of soil and sediment onto public roads. If dust or sediment tracking increases, place additional rock unless the Engineer approves another method.

Repair temporary construction entrance if:

1. Fabric is exposed
2. Depressions in the entrance surface develop
3. Rock is displaced

Repair temporary construction entrance within 24 hours of discovering damage unless the Engineer approves a longer period.

During use of temporary construction entrance, do not allow soil, sediment, or other debris tracked onto pavement to enter storm drains, open drainage facilities, or watercourses. When material is tracked onto pavement, remove it within 24 hours unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace the temporary construction entrance, repair it at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

Removal

When the Engineer determines that temporary construction entrance is not required, remove and dispose of it under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Backfill and repair ground disturbance, including holes and depressions, caused by installation and removal of temporary construction entrance under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Temporary construction entrance is determined from actual count in place. Temporary construction entrance is measured one time only and no additional measurement will be recognized.

The contract unit price paid for temporary construction entrance includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing temporary construction entrance, complete in place, including removal of temporary construction entrance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

No additional compensation will be made if the temporary construction entrance is relocated during the course of construction.

The State and you share the cost of maintaining temporary construction entrance. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.19 MOVE-IN/MOVE-OUT (TEMPORARY EROSION CONTROL)

GENERAL

Summary

This work includes moving onto the project when an area is ready to receive temporary erosion control, setting up required personnel and equipment for the application of erosion control materials, and moving out all personnel and equipment when temporary erosion control in that area is completed.

Temporary erosion control consists of any water pollution control practice for soil stabilization.

When notified by the Engineer that an area is ready for temporary erosion control, start erosion control work within 5 business days.

MEASUREMENT AND PAYMENT

Move-in/move-out (temporary erosion control) is measured as units from actual count. A move-in followed by a move-out is considered one unit.

The contract unit price paid for move-in/move-out (temporary erosion control) includes full compensation for furnishing all labor, materials (excluding temporary erosion control materials), tools, equipment, and incidentals and for doing all the work involved in moving in and removing from the project all personnel and equipment necessary for application of temporary erosion control, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.20 TEMPORARY DRAINAGE INLET PROTECTION

GENERAL

Summary

This work includes constructing, maintaining, and removing temporary drainage inlet protection. Drainage inlet protection settles and filters sediment before stormwater runoff discharges into storm drainage systems.

The SWPPP must describe and include the use of temporary drainage inlet protection as a water pollution control practice for sediment control.

Provide temporary drainage inlet protection to meet the changing conditions around the drainage inlet. Temporary drainage inlet protection must be:

1. Appropriate type to meet the conditions around the drainage inlet
2. Type 1, Type 2, Type 3A, Type 3B, Type 4, Type 4B, Type 5, Type 6A, Type 6B, or a combination

Submittals

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for:

1. Erosion control blanket
2. Fiber rolls
3. Safety cap for metal posts
4. Silt fence fabric
5. Sediment filter bag
6. Foam barrier
7. Rigid plastic barrier
8. Gravel-filled bag fabric

If you substitute the steel wire staple with an alternative attachment device, submit a sample of the device for approval at least 5 business days before installation.

MATERIALS

Geosynthetic Fabrics

Geosynthetic fabrics for temporary drainage inlet protection must consist of one of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Geosynthetic fabrics for temporary drainage inlet must comply with the specifications for water pollution control in Section 88-1.05, "Water Pollution Control," of the Standard Specifications.

Foam barrier must comply with:

Foam Barrier

Property	ASTM Designation	Specification
Grab breaking load 1-inch grip, lb, min. in each direction	D 4632	200
Apparent elongation percent, min., in each direction	D 4632	15
Water Flow Rate max. average roll value, gallons per minute/square foot	D 4491	100-150
Permittivity 1/sec., min.	D 4491	0.05
Apparent opening size max. average roll value, U.S. Standard sieve size	D 4751	40
Ultraviolet Degradation percent of original unexposed grab breaking load 500 hr, minimum	D 4595	70

Sample under ASTM D 4354, Procedure C.
Test under ASTM D 4759. All properties are based on Minimum Average Roll Value (MARV).
Identify, store, and handle under ASTM D 4873.

Erosion Control Blanket

Erosion control blanket must be:

1. Described as a rolled erosion control product (RECP)
2. Classified as temporary and degradable or long-term and non-degradable
3. Machine-made mats
4. Provided in rolled strips
5. Classified by the Erosion Control Technology Council (ECTC)

Erosion control blanket classified as temporary and degradable must be as follows:

1. Coir netting:

    1.1. Classified as ECTC Type 4
    1.2. Classified as an open weave textile and from 13 to 18 strands per foot in each direction
    1.3. Designed to last for at least three years after installation
    1.4. With a USLE C-Factor of not more than 0.25 at a 1:1 (horizontal:vertical) slope
    1.5. Comprised of 100 percent unbleached and undyed spun coir yarn made of coconut fiber
    1.6. With an average open area from 63 to 70 percent
    1.7. From 72 to 158 inches in width
    1.8. Capable to withstand a maximum shear stress of 2.25 pounds per square foot under ASTM D6460
    1.9. With a minimum tensile strength of 125 pounds per foot under ASTM D 5035
    1.10. From 1.20 to 1.67 pounds per square yard in weight

Erosion control blanket classified as long-term and non-degradable must:

1. Be a geosynthetic fabric
2. Comply with the specifications for rock slope protection fabric (Class 8) in Section 88-1.06, "Channel and Shore Protection," of the Standard Specifications

Staples

You may use an alternative attachment device such as a geosynthetic pins or plastic pegs to install erosion control blanket.

Rock

Rock must comply with:

1. Requirements under Section 72-2.02, "Materials," of the Standard Specifications
2. Following sizes:

Square Screen Size (inch)	Percentage Passing	Percentage Retained
6	100	0
3	0	100

Rope

Rope for fiber rolls must be:

1. Biodegradable, such as sisal or manila
2. At least 1/4 inch in diameter

Fiber Rolls

Fiber rolls must:

1. Last for at least one year after installation
2. Be Type 1 or Type 2

For Type 1, fiber rolls must be:

1. Made from an erosion control blanket classified as temporary and degradable
2. Rolled along the width
3. Secured with natural fiber twine every 6'-6" from each end
4. Finished to be either:

    4.1. From 8 to 10 inches in diameter, from 10 to 20 feet long, and at least 0.5 pounds per linear foot
    4.2. From 10 to 12 inches in diameter, at least 10 feet long, and at least 2 pounds per linear foot

For Type 2, fiber rolls must:

1. Be filled with rice straw
2. Be covered with biodegradable jute, sisal, or coir fiber netting
3. Have netting secured tightly at each end
4. Be finished to be either:

    4.1. From 8 to 10 inches in diameter, from 10 to 20 feet long, and at least 1.1 pounds per linear foot
    4.2. From 10 to 12 inches in diameter, at least 10 feet long, and at least 3 pounds per linear foot

Wood Stakes

Wood stakes must be:

1. Untreated fir, redwood, cedar, or pine and cut from sound timber
2. Straight and free of loose or unsound knots and other defects which would render the stakes unfit for use
3. Pointed on the end to be driven into the ground

For fiber rolls, wood stakes must be at least:

1. 1" x 1" x 24" in size for Type 1 installation
2. 1" x 2" x 24" in size for Type 2 installation

Posts

Posts must be wood or metal.

Wood posts must be:

1. Untreated fir, redwood, cedar, or pine and cut from sound timber
2. Straight and free of loose or unsound knots and other defects that would render the stakes unfit for use
3. Pointed on the end to be driven into the ground
4. At least 2" x 2" in size, and 4 feet long

Metal posts must:

1. Be made of steel.
2. Have a "U," "T," "L," or other cross sectional shape that can resist failure from lateral loads.
3. Be pointed on the end to be driven into the ground.
4. Weigh at least 0.75-pound per foot.
5. Be at least 4 feet long.
6. Have a safety cap attached to the exposed end. The safety cap must be orange or red plastic and fit snugly to the metal post.

Silt Fence

Silt fence must be:

1. Constructed with silt fence fabric, posts, and fasteners
2. Prefabricated or assembled at the job site

Silt fence fabric must be attached to posts using these methods:

1. If prefabricated silt fence is used, posts must be inserted into sewn pockets
2. If assembled on the job site:

    2.1. If wood posts are used, fasteners must be staples or nails
    2.2. If steel posts are used, fasteners must be tie wires or locking plastic fasteners
    2.3. Spacing of the fasteners must be at least 8 inches

Gravel-filled Bags

Gravel-filled bags must:

1. Be made from fabric.
2. Have inside dimensions from 24 to 32 inches in length, and from 16 to 20 inches in width.
3. Have the opening bound to retain the gravel. The opening must be sewn with yarn, bound with wire, or secured with a closure device.
4. Weigh from 30 to 50 pounds when filled with gravel.

Gravel for gravel-filled bags must be:

1. From 3/8 to 3/4 inch in diameter
2. Clean and free from clay balls, organic matter, and other deleterious materials

Sediment Filter Bag

Sediment filter bag must:

1. Be made of fabric
2. Be sized to fit the catch basin or drainage inlet
3. Include a high-flow bypass

Sediment filter bag may include a metal frame. Sediment filter bags that do not have a metal frame and are deeper than 18 inches must:

1. Include lifting loops and dump straps
2. Include a restraint cord to keep the sides of the bag away from the walls of the catch basin

Foam Barriers

Foam barriers must:

1. Be filled with a urethane foam core
2. Have a geosynthetic fabric cover and flap
3. Have a triangular, circular, or square shaped cross section
4. Have a vertical height of at least 5 inches after installation
5. Have a horizontal flap of at least 8 inches in width
6. Have a length of at least 4 feet per unit
7. Have the ability to interlock separate units into a longer barrier so that water does not flow between the units
8. Be secured to:

    8.1. Pavement with 1-inch concrete nails with 1-inch washers and solvent-free adhesive
    8.2. Soil with 6-inch nails with 1-inch washers

Rigid Plastic Barriers

Rigid plastic barriers must:

1. Have an integrated filter
2. Have a formed outer jacket of perforated high density polyethylene (HDPE) or polyethylene terephthalate (PET)
3. Have a flattened tubular shaped cross section
4. Be made from virgin or recycled materials
5. Be free from biodegradable filler materials that degrade the physical or chemical characteristics of the finished filter core or outer jacket
6. Have a length of at least 4 feet per unit
7. Have the ability to interlock separate units into a longer barrier so that water does not flow between the units
8. Be secured to:

    8.1 Pavement with 1-inch concrete nails with 1-inch washers and solvent-free adhesive, with gravel-filled bags, or a combination
    8.2 Soil with 6-inch nails with 1-inch washers and wood stakes

9. Comply with the following properties:

Specification	Requirements
Grab tensile strength of outer jacket material, pounds/square inch, min. in each direction ASTM D 4632*	4000
Break strength of outer jacket, pounds/square inch ASTM D 4632*	1300
Permittivity of filter core, 1/sec., min. ASTM D 4491	0.38
Flow rate of filter core, gallons per minute per square foot, ASTM D 4491	100 min. 200 max.
Filter core aperture size, max., Average Opening Size (AOS), microns	425
Ultraviolet stability (outer jacket & filter core), percent tensile strength retained after 500 hours, min. ASTM D 4355 (xenon-arc lamp and water spray weathering method)	90

* or appropriate test method for specific polymer

If used at a curb inlet without a grate, rigid plastic barriers must:

1. Have a horizontal flap of at least 6 inches with an under-seal gasket to prevent underflows
2. Include a high-flow bypass
3. Have a vertical height of at least 7 inches after installation
4. Be sized to fit the catch basin or drainage inlet

If used at a grated catch basin without a curb inlet, rigid plastic barriers must:

1. Cover the grate by at least 2 inches on each side and have an under-seal gasket to prevent underflows
2. Include a high-flow bypass
3. Have a vertical height of at least 1.5 inches after installation
4. Be sized to fit the catch basin or drainage inlet

If used at a curb inlet with a grate, rigid plastic barriers must:

1. Have a horizontal flap that covers the grate by at least 2 inches on the 3 sides away from the curb opening and have an under-seal gasket to prevent underflows
2. Include a high-flow bypass
3. Have a vertical section that covers the curb opening by at least 5 inches after installation
4. Be sized to fit the catch basin or drainage inlet

If used as a linear sediment barrier, rigid plastic barriers:

1. Must have an installed height of at least 6 inches
2. May have a horizontal flap of at least 4 inches

Linear Sediment Barrier

Linear sediment barriers must consist of one or more of the following:

1. Silt fence
2. Gravel-filled bags
3. Fiber roll
4. Rigid plastic barrier
5. Foam barrier

Flexible Sediment Barrier

Flexible sediment barriers consist of one or more of the following:

1. Rigid plastic barrier
2. Foam barrier

CONSTRUCTION

For drainage inlet protection at drainage inlets in paved and unpaved areas:

1. Prevent ponded runoff from encroaching on the traveled way or overtopping the curb or dike. Use linear sediment barriers to redirect runoff and control ponding.
2. Clear the area around each drainage inlet of obstructions including rocks, clods, and debris greater than one inch in diameter before installing the drainage inlet protection.
3. Install a linear sediment barrier up-slope of the existing drainage inlet and parallel with the curb, dike, or flow line to prevent sediment from entering the drainage inlet.

Erosion Control Blanket

To install erosion control blanket and geosynthetic fabric:

1. Secure blanket or fabric to the surface of the excavated sediment trap with staples and embed in a trench adjacent to the drainage inlet
2. Anchor the perimeter edge of the erosion control blanket in a trench

Silt Fence

If silt fence is used as a linear sediment barrier:

1. Place fence along the perimeter of the erosion control blanket, with the posts facing the drainage inlet
2. Install fence with the bottom edge of the silt fence fabric in a trench. Backfill the trench with soil and compact manually

Gravel Bag Berm

If gravel bag berm is used as a linear sediment barrier:

1. Place gravel-filled bags end-to-end to eliminate gaps
2. Stack bags in a way that the bags in the top row overlap the joints in the lower row

If gravel bag berms are used for Type 3A and Type 3B:

1. Place gravel-filled bags end-to-end to eliminate gaps
2. Stack bags in a way that the bags in the top row overlap the joints in the lower row
3. Arrange bags to create a spillway by removing one or more gravel-filled bags from the upper layer

If used within shoulder area, place gravel-filled bags behind temporary railing (Type K).

Fiber Rolls

If fiber rolls are used as a linear sediment barrier:

1. Place fiber rolls in a furrow.
2. Secure fiber rolls with stakes installed along the length of the fiber rolls. Stakes must be installed from 6 to 12 inches from the end of the rolls.

If fiber rolls are used as a linear sediment barrier for Type 4A, place them over the erosion control blanket.

Foam Barriers

If foam barriers are used as a linear sediment barrier:

1. Install barriers with the horizontal flap in a 3 inch deep trench and secured with nails and washers placed no more than 4 feet apart
2. Secure barriers with 2 nails at the connection points where separate units overlap
3. Place barriers without nails or stakes piercing the core

Flexible Sediment Barriers

If flexible sediment barriers are used:

1. Secure barriers to the pavement with nails and adhesive, gravel-filled bags, or a combination
2. Install barriers flush against the sides of concrete, asphalt concrete, or hot mix asphalt curbs or dikes
3. Place barriers to provide a tight joint with the curb or dike and anchored in a way that runoff cannot flow behind the barrier

If flexible sediment barriers are used for Type 4B:

1. Secure barriers to the pavement according to the angle and spacing shown on the plans
2. Place barriers to provide a tight joint with the curb or dike. Cut the cover fabric or jacket to ensure a tight fit

Rigid Sediment Barriers

If rigid sediment barriers are used at a grated catch basin without a curb inlet:

1. Place barriers using the gasket to prevent runoff from flowing under the barrier
2. Secure barriers to the pavement with nails and adhesive, gravel-filled bags, or a combination

If rigid sediment barriers are used for linear sediment barriers:

1. Install barriers in a trench. Backfill the trench with soil and compact manually
2. Place barrier with separate units overlapping at least 4 inches
3. Reinforce barriers with a wood stake at each overlap
4. Fasten barriers to the wood stakes with steel screws, 16 gauge galvanized steel wire, or with UV stabilized cable ties that are from 5 to 7 inches in length

Sediment Filter Bags

Install sediment filter bags for Type 5 by:

1. Removing the drainage inlet grate
2. Placing the sediment bag in the opening
3. Replacing the grate to secure the sediment filter bag in place

MAINTENANCE

Maintain temporary drainage inlet protection to provide sediment holding capacity and to reduce runoff velocities.

Remove sediment deposits, trash, and debris from temporary drainage inlet protection as needed or when directed by the Engineer. If removed sediment is deposited within project limits, it must be stabilized and not subject to erosion by wind or water. Trash and debris must be removed and disposed of as specified in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Maintain temporary drainage inlet protection by removing sediment from:

1. Behind flexible sediment barriers when sediment exceeds 1 inch in depth
2. Surface of the erosion control blanket when sediment exceeds 1 inch in depth
3. Sediment trap for Type 2 when the volume has been reduced by approximately one-half
4. Behind silt fence when the sediment is 1/3 the height of the silt fence fabric above ground
5. Sediment filter bags when filled or when the restraint cords are no longer visible

If rills and other evidence of concentrated runoff occur beneath the linear sediment barrier, repair or adjust the barrier.

If silt fence fabric becomes split, torn, or unraveled, repair or replace silt fence.

If geosynthetic fabric becomes split, torn, or unraveled, repair or replace foam barriers.

Repair or replace sagging or slumping linear sediment barriers with additional stakes. Replace broken or split wood stakes.

Reattach foam barriers and rigid plastic barriers that become detached or dislodged from the pavement.

Repair split or torn rigid plastic barriers with 16 gauge galvanized steel wire or UV stabilized cable ties that are from 5 to 7 inches in length.

For sediment filter bags without metal frames, empty by placing one inch steel reinforcing bars through the lifting loops and then lift the filled bag from the drainage inlet. For sediment filter bags with metal frames, empty by lifting the metal frame from the drainage inlet. Rinse before replacing in the drainage inlet. When rinsing the sediment filter bags, do not allow the rinse water to enter a drain inlet or waterway.

Repair temporary drainage inlet protection within 24 hours of discovering damage unless the Engineer approves a longer period.

If your vehicles, equipment, or activities disturb or displace temporary drainage inlet protection, repair temporary drainage inlet protection at your expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or your negligence.

REMOVAL

When the Engineer determines that the temporary drainage inlet protection is not required, it must be removed and disposed of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Ground disturbance, including holes and depressions, caused by the installation and removal of the temporary drainage inlet protection must be backfilled and repaired under Section 15-1.02, "Preservation of Property," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Quantities of temporary drainage inlet protection will be determined from actual count in place. The protection will be measured one time only and no additional measurement will be recognized.

The contract unit price paid for temporary drainage inlet protection includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the temporary drainage inlet protection, complete in place, including removal of materials, cleanup and disposal of retained sediment and debris, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

No additional compensation will be made if the temporary drainage inlet protection is relocated during the course of construction.

The State and you share the cost of maintaining the temporary drainage inlet protection. The State determines the maintenance cost under Section 9-1.03, "Force Account Payment," of the Standard Specifications and pays you one-half of that cost.

10-1.21 TEMPORARY TIRE WASH SYSTEM

GENERAL

Summary

This work includes designing, placing, operating, monitoring, maintaining, and later removing a temporary tire wash system. The tire wash system must be portable and be used to remove sediment from tires and undercarriages of all trucks and equipment prior to exiting areas for contractor's use, and to prevent sediment from being tracked onto public roadways.

The SWPPP must describe and include the use of temporary tire wash system as a water pollution control practice for non-stormwater management and materials pollution control.

For information on documents under these special provisions, refer to the Department's "Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual" (Preparation Manual) and "Construction Site Best Management Practices (BMPs) Manual".

The Preparation Manual and Dewatering Guide are available from the Department's Construction Storm Water and Water Pollution Control web site at:

http://www.dot.ca.gov/hq/construc/stormwater/stormwater1.htm

Treated non-storm water from the Temporary Non-Storm Water Treatment System (TNSWTS) as described in "Temporary Storm Water Run-on Bypass and Excavation Dewatering" of these special provisions, may be used as a water supply source for the temporary tire wash system.

Wastewater that can no longer be recycled in the tire washing system shall be considered as non-storm water and shall be collected and conveyed to the TNSWTS for treatment and disposal. If you do not use an TNSWTS, discharge into a POTW system.

If uncontaminated groundwater, stormwater, or both are discharged to a POTW, obtain a municipal batch discharge permit. You are responsible for all costs and pre-treatment requirements related to obtaining the municipal batch discharge permit and discharging the water.

Solids removed from the tire wash system shall be disposed of in accordance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Submittals

Submit the following within SWPPP for review and approval of the Engineer:

1. A description of the tire wash system including:

    1.1. Description of all components used in the tire wash system including, but not limited to:

        1.1.1. Estimated tire washes per day
        1.1.2. Water Supply; anticipated flow rates for wash water used per tire wash
        1.1.3. Control panel
        1.1.4. Automatic sensor
        1.1.5. Flocculent pump
        1.1.6. Vacuum truck
        1.1.7. Wastewater recycling and disposal; anticipated wastewater flow rates conveyed to the TNSWTS
        1.1.8. Solids removal and disposal
        1.1.9 Electric power supply to operate tire wash system

    1.2. Description of any chemicals used in the process to recycle water for tire washing including but not limited to flocculent and polymers. The documentation and monitoring requirements in the Coagulant Prevention Plan submittal required in "Temporary Storm Water Run-on Bypass and Excavation Dewatering" of these special provisions shall fully apply to any chemicals used in the tire wash system.

    1.3. Operation and system maintenance procedures and example maintenance log
    1.4. Field-recorded data, visual inspection, and calibration procedures and example logs
    1.5. Working drawings for tire wash system including the wastewater and solids handling processes showing:

        1.5.1. Section and plan views of tire wash system
        1.5.2. Location of sampling points for water quality measurements
        1.5.3. Flow path and placement of pipes, hoses, pumps, holding tanks, and other equipment used to convey water supply and wastewater recycling and disposal to TNSWTS
        1.5.4. General position of tire wash and discharge components relative to operations requiring tire washing
        1.5.5. Point of tire wash waste water discharge

2. Daily Inspection Report. The report form must:

    2.1. Be approved by the Engineer before use
    2.2. Include tire wash wastewater discharge volumes and number of trucks washed per day
    2.3. Date and time
    2.4. Photographs labeled with the time, date, and location
    2.5. Inspection of roadways to ensure tracking of sediment is being prevented successfully by the tire wash system
    2.6. Inspection of all components of the tire wash system to ensure proper functioning of these systems

3. POTW municipal batch discharge permit, if used
4. If you use chemical coagulants, in-line flocculants, or both, in the tire wash system, submit a Coagulant Prevention Plan (CPP) within the SWPP. The CPP must include:

    4.1. Description of the best management practices (BMPs) to prevent accidental spillage, overfeeding into the treatment system, or other mishandling of coagulant agents
    4.2. Monitoring plan for all coagulant or flocculant agents to be used
    4.3. Description of the agent (chemical and trade name description)

4.4. Determination of acute and chronic toxicity for aquatic organisms conforming to EPA methods for the agents
4.5. Monitoring proposal to detect residual agent at concentrations at or below established acute toxicity levels for freshwater and marine conditions for that agent
4.6. Copy of the documentation showing RWQCB approval of the CPP and approval of the chemical coagulants or in-line flocculants proposed

The CPP must be approved by the RWQCB. It is your responsibility to obtain approval of the CPP from the RWQCB. If the RWQCB does not approve your proposal to use chemical coagulants or in-line flocculants, you must propose an alternative treatment system component to comply with the receiving water and effluent discharge limitations.

Quality Control and Assurance

Retain and submit records of temporary tire wash system including:

1. Delivery and removal of temporary tire wash system components.
2. Daily inspection report that includes all information and recorded data collected. This report must be certified as true and accurate and signed by those who gather the information.

MATERIALS

Tire Wash System

Design and implement an appropriate tire wash system for the site conditions including number of truck trips per day that need tire washing, the anticipated wash water needed per tire wash, disposal of wastewater that cannot be recycled and solids generated from the system and designed to withstand the weights and widths of trucks. The tire wash system must include components including but not limited to:

1. Collection and conveyance of treated effluent from the TNSWTS that may be used as a water supply source for the tire washing system
2. Control Panel and automatic sensors to activate washers when trucks are driven through the system
3. Flocculent pump
4. Vacuum truck
5. Solids separation tank to remove the solids from the waste generated from tire washing
6. System to recycle water for tire washing
7. Scraper conveyor to automatically evacuate solids
8. Collection and conveyance system for conveying wastewater that can be no longer recycled to TNSWTS

The allowable alternatives for temporary tire wash system shall consist of one of the following or a Department approved equivalent system:

1. MAXIMUS Series – Portable Tire Wash System manufactured by Innovative Equipment Solutions 174 Cornerstone Blvd, Ste. B, Hot Springs, AR 71913. Office: 501-525-8484, Toll Free: 1-866-303-4IES (4437). Information and details can be found at : http://www.innovativeequipment.org/portable.html

2. Portable STB 30 Tire Wash - Portable Tire Wash System manufactured by Stanton Systems, 50 Richard Road, Ivyland, PA 18974. Toll Free: 1-800-884-9281. Information and details can be found at: http://www.stantonsystems.com/portable-tire-wash/portable-tire-wash.html

3. MobyDick "Quick" 220 C+ Tire Washer - Portable Tire Wash System manufactured by InterClean Equipment, Inc., 3939 Bestech Drive Suite B, Ypsilanti, MI 48197. Phone: (734) 975-2967 or 1-800-INTERCLEAN (1-800-468-3725). Information and details can be found at: http://www.interclean.com/

CONSTRUCTION

Placement

Place tire wash system components at the job site:

1. Before tunnel excavation work
2. In the ingress/egress areas used by trucks as approved by the Engineer
3. Away from construction traffic or public access areas

Operation

Divert storm water away from the tire wash system to prevent mixing with tire wash wastewater.

If observations in the daily inspection report confirm tracking of sediment on roadways past the tire wash system:

1. Inspect the tire wash system immediately
2. Notify the Engineer
3. Start corrective measures to modify, repair, or replace the equipment used in the tire wash system, and propose alternative means to perform tire washing until the corrective measures are implemented.

After the Engineer inspects and accepts corrective measures:

1. Resume tire washing operations
2. Start inspecting every tire washing operations every 4 hours for a 24 hour period and document the observations in the Daily Inspection Report
3. Start regular-daily inspections Relocate tire washing system as needed.

Monitoring

Comply with the manufacturer's instructions for all calibrations of the flow meter. Perform calibrations in the presence of the Engineer.

While the tire wash system is operated, perform:

1. Flow rate monitoring to:

    1.1. Record daily discharge volumes for tire wash wastewater
    1.2. Compute average daily volumes

Inspection

Inspect tire washing system:

1. Daily if tire washing work occurs daily
2. Weekly if tire washing work does not occur daily

Reporting

If observations and measurements confirm that tire wash wastewater is discharged to a storm drain system:

1. Submit a Notice of Discharge Report as shown in the Preparation Manual within 3 business days
2. Document the reasons and corrective work performed to prevent a reoccurrence in the Notice of Discharge

Maintenance

Maintain the various components to prevent leaks and provide proper function. If a component of the tire wash system equipment is not functioning properly, discontinue the tire washing operation and repair or replace the component.

Removal

Backfill and repair ground disturbance, including holes and depressions, caused by the installation and removal of the temporary tire wash system. Comply with Section 15-1.02, "Preservation of Property," of the Standard Specifications.

PAYMENT

The contract lump sum price paid for the temporary tire wash system shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, for doing all the work involved in installing, operating, maintaining, and removing all components of the tire wash system, as specified in the Standard Specifications, and these special provisions, and as directed by the Engineer.

10-1.22 CONFINEMENT SYSTEM

GENERAL

Summary

This work includes constructing, and maintaining confinement system as shown on the plans and these special provisions.

The SWPPP must describe and include the use of confinement system as a water pollution control practice for tracking control.

Submittals

Submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for:

1. Pavement Reinforcement fabric

MATERIALS

Confinement System

The allowable altermnatives for confinement system shall consist of one of the following or a Department approved equal:

1. CELLULAR CONFINEMENT SYSTEM- Three dimensional cellular confinement system manufactured by Soil Stabilization Products Company, Inc. located in Merced California, P.O. Box 2779, Merced, CA 95344-0779. Telephone (800)523-9992 or (209)383-3296.

2. THE AGRIWEB SYSTEM –Soil Confinement System manufactured by Presto Products, Inc. located in Appleton, Wisconsin, P.O. Box 2399, Appleton, WI 54912-2339, Telephone (866)404-5248 or (920)738-1212. 26 Light Sky Ct. Sacramento, CA 95828 Cell (916) 600-2308.

3. NEOWEB CELLULAR CONFINEMENT SYSTEM –by Strata Systems Inc. located at 380 Dahlonega Road, Cumming, GA 30040 (800)680-7750, FAX 777-888-6680.
Local contact is Strata Regional Sales Manager(916)204-5773.

Rock

Rock aggregate shall conform to the requirements under Section 26, "Aggregate Bases," of the Standard Specifications and these special provisions. Rock aggregate shall conform to the gradation requirements in Section 29-1.02A, "Asphalt Treated Permeable Base" of the Standard Specifications. Rock aggregate shall not contain any processed, recycled materials containing asphalt or portland cement.

Soil Reinforcing Fabric

Soil reinforcement fabric shall conform to the requirements under Section 88-1.02, "Pavement Reinforcement Fabric," of the Standard Specifications.

CONSTRUCTION

Confinement system shall be install as per manufacturer's recommendation and in the general sequence as follows;
Prepare location for confinement system by:

1. Removing vegetation to ground level and clearing away debris
2. Grading the ground to a uniform plane
3. Grading the ground surface to drain
4. Removing sharp objects that could damage the fabric

Install confinement system by:

1. Positioning fabric along the footprint of deployment
2. Overlap adjacent sides and ends of fabric by at least 12 inches
3. Position confinement system over fabric and secure in place
4. Spread rock to infill confinement system and along edges as shown on the plan

Repair any confinement system damaged during rock placement and spreading.

Maintenance

Maintain confinement system to minimize settling, displacement of rock infill and exposure of the confinement system to traffic.

Repair construction roadway if:

1. Confinement system is exposed
2. Depressions in the confinement system surface develop
3. Rock is displaced

Repair confinement system within 24 hours of discovering damage unless the Engineer approves a longer period.

During use of confinement system, do not allow soil, sediment, or other debris tracked onto confinement system to enter storm drains, open drainage facilities, or watercourses. If material is tracked onto pavement, remove it within 24 hours unless the Engineer approves a longer period.

If the Contractor's vehicles, equipment, or activities disturb or displace confinement system, repair of the confinement system shall be at the Contractor's expense.

The Department does not pay maintenance costs for cleanup, repair, removal, disposal, or replacement due to improper installation or contractor negligence.

MEASUREMENT AND PAYMENT

Confinement system is measured by the square yard.

The contract price paid per square yard for confinement system includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing, and maintaining confinement system, complete in place as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.23 VIBRATION MONITORING

This work shall consist of vibration monitoring as a means of protecting the following properties from excess vibration from construction activities:

Building No. / Name	Maximum velocity (inch/second)
108 Electric Shop	0.3
123 Garage	0.3
150 VAC chapel	0.3
151 VAC house	0.3
152 VAC restroom	0.3
153 VAC garage	0.3
154 VAC maint. Garage	0.3
VA Cemetery to first road	5
105 barrack	0.3
106 band	0.3
122 gymnasium	0.3
128 enlisted family housing	0.3
129 enlisted family housing	0.3
603 commissary	0.3
631 ammunition magazine	0.3
632 ammunition magazine	0.3
Palace of Fine Arts	0.3
1151 Pool	0.3
1152 Gym	0.3
1160 warehouse	0.3
1170 warehouse	0.3
1182 warehouse	0.3
1183 warehouse	0.3
1184 warehouse	0.3
1185 warehouse	0.3
1186 warehouse	0.3
1187 warehouse	0.3
1188 warehouse	0.3
210 Guard House	0.3
649 Army reserve center	0.3
Battery Slaughter	10
635 Battery Blarney	10
636 Battery Sherwood	10
201 exchange	0.3
228 bakery	0.3
227 warehouse	0.3
229 bakery	0.3
1161 warehouse	0.3
1162 warehouse	0.3
1163 warehouse	0.3
1169 warehouse	0.3
1063 med supply	0.3
1167 warehouse	0.3
204 exchange	0.3

Vibration measurements and recording shall be conducted before and during pile driving, hauling of dirt, placing of base material, compaction, and during paving operations or other significant activity when that activity occurs within 200 feet of the above listed properties.

The baseline vibration monitoring at each site shall be conducted prior to the start of construction activities or when there is a break in the construction activities.

Vibration monitoring instrument shall be furnished and installed by the Contractor and shall be capable of continuous operation with instant monitoring results. The vibration monitoring instrument shall be placed on flat, even, asphalt concrete surface, portland cement concrete surface or undisturbed soil. The vibration monitoring system shall be capable of measuring peak particle velocity and frequency levels as low as 0.04 inch/sec using a 3-axis geophone. The vibration monitoring system shall undergo certified laboratory calibration conformance at least once a year. At the time of measurement the vibration monitoring system shall have a certificate that is not expired.

The Contractor shall have the instrument in place and functioning properly prior to any construction activities within 200 feet of the above listed properties. The vibration monitoring instrument shall be stationed on the side of the structure facing the Contractor's work site.

The vibration monitoring instrument shall be set up in a manner such that an immediate warning is given when peak particle velocity equal to or exceeding 75% of the maximum values is measured as shown in the table above. When any reading on the vibration monitoring instrument equals or exceeds values as shown in the above table, work shall immediately cease and the Contractor shall immediately take whatever action is necessary to reduce and maintain the peak particle velocity to below the maximum values as shown in the above table.

The results of the measurements shall be tabulated. A report shall be prepared to tabulate the measured vibration levels at three axes and associated frequencies. The report shall also include information such as measurement location, date, and source of vibration. The highest measured vibration levels for each axis and their relationship to the criteria shall also be included in the report. The Contractor shall submit the report no later than 24 hours after each monitoring.

The person who is responsible for the vibration monitoring and analysis shall have the following qualifications:

A. Professional Engineer, Geologist, Bachelor of Science or higher degree from a qualified program in engineering, physics or geology offered by an accredited university or college, and five years experience in vibration monitoring and control.
B. Demonstrated substantial and responsible experience in preparing and implementing construction vibration monitoring plans and analyzing vibration impacts in an urban setting.

A technician under the supervision of the qualified person may conduct the actual measurements.

Compliance with this section does not relieve the Contractor of full responsibility for damage caused by Contractor's operations as per Section 7-1.12 "Indemnification and Insurance," of the Standard Specifications.

The contract lump sum price paid for vibration monitoring shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and doing all work involved in vibration monitoring, as specified in these special provisions and as directed by the Engineer.

Additional areas to receive vibration monitoring will be paid for as extra work as provided in Section 4-1.03D "Extra Work," of the Standard Specifications.

10-1.24 SURVEY OF EXISTING NON-HIGHWAY FACILITIES

Survey of existing non-highway facilities shall consist of performing photo and video survey elevation survey and crack monitoring of existing facilities, buildings, and other improvements as specified below which might be damaged by the operations of the Contractor. The work shall be performed in conformance with the provisions in the Standard Specifications and these special provisions

Attention is directed to "Order of Work" of these special provisions regarding to pre-construction reports prior to any impact work as described below in these special provisions.

The photo and video survey, elevation survey and crack monitoring shall be conducted at the facilities listed in the tables below or as directed by the Engineer.

Pre-construction survey and monitoring shall be performed at least 20 working days prior to beginning any impact work, including but not limited to excavation, demolition activity, pile activity, shoring, installation, or other significant impact work that has a potential to cause damage to existing facilities that occurs within 200 feet of the listed facilities. Additional survey and monitoring shall be performed as the work progresses and as directed by the Engineer.

Post construction survey and monitoring shall be performed on the same facilities within 10 working days after the completion of any impact work, including but not limited to excavation, demolition activity, pile activity, shoring, installation, or other significant impact work that has a potential to cause damage to existing facilities.

LOCATIONS FOR PHOTO AND VIDEO SURVEY
Building No. / Name
108 Electric Shop
123 Garage
150 VAC chapel
151 VAC house
152 VAC restroom
153 VAC garage
154 VAC maint. Garage
VA Cemetery to first road
105 barrack
106 band
122 gymnasium
128 enlisted family housing
129 enlisted family housing
603 commissary
631 ammunition magazine
632 ammunition magazine
Palace of Fine Arts
1151 Pool
1152 Gym
1160 warehouse
1170 warehouse
1182 warehouse
1183 warehouse
1184 warehouse
1185 warehouse
1186 warehouse
1187 warehouse
1188 warehouse
210 Guard House
649 Army reserve center
Battery Slaughter
635 Battery Blarney
636 Battery Sherwood
201 exchange
228 bakery
227 warehouse
229 bakery
1161 warehouse
1162 warehouse
1163 warehouse
1169 warehouse
1063 med supply
1167 warehouse

LOCATIONS FOR CRACK MONITORING
Building No. / Name
108 Electric Shop
150 VAC chapel
151 VAC house
152 VAC restroom
153 VAC garage
154 VAC maint. Garage
105 barrack
106 band
122 gymnasium
128 enlisted family housing
129 enlisted family housing
603 commissary
631 ammunition magazine
632 ammunition magazine
Palace of Fine Arts
1151 Pool
1152 Gym
1183 warehouse
1184 warehouse
1188 warehouse
210 Guard House
649 Army reserve center
Battery Slaughter
635 Battery Blaney
228 bakery
227 warehouse
229 bakery

LOCATIONS FOR ELEVATION SURVEY
Building No. / Name
108 Electric Shop
150 VAC chapel
151 VAC house
152 VAC restroom
153 VAC garage
154 VAC maint. Garage
105 barrack
106 band
122 gymnasium
128 enlisted family housing
129 enlisted family housing
1151 Pool
1152 Gym
1160 warehouse
1170 warehouse
1182 warehouse
1183 warehouse
1184 warehouse
1188 warehouse
1169 warehouse
1167 warehouse

PHOTO SURVEY

The photo survey shall show the condition of the listed facilities, including, but not limited to, any and all deficiencies in the facilities such as cracks, settlement, leakage, distress and the like. The photo survey shall document the condition of the foundation, walls, ceiling, roof, improvements and other building elements on the interiors and exteriors of the listed facilities.

The photograph prints shall be in color, and have a printed image size of at least be 5" x 7.". All prints shall be on glossy photographic paper. Proof sheets, thumbnail prints, or contact prints are not acceptable. All negative shall be provided in protective sleeves. The negatives shall be indexed to facilitate expeditious reproduction. All photos shall be identified by date, location, orientation, and labeled with a detailed description. All photos shall be submitted in a 3-ring binder and shall include the following: protective photo sleeves, building layout (including layout of each floor as necessary), and a summary sheet indexing all photos.

The digital camera shall be color and shall have a minimum resolution of 3264 x 2448 pixels or eight megapixels. Digital photo prints shall be on either dye sublimation printer capable of color fusion and continuous tone, a color laser printer capable of printing 1200x1200 dots per inch (dpi), or a professional graphics color inkjet printer capable of printing 1440x720 dpi and using six separate color reservoirs. All digital prints shall utilize photo quality glossy heavy weight paper (as defined by the printer manufacturer and as approved by the Engineer). All digital prints shall be printed at the highest print mode or print quality available to the approved printer (photo mode or best print quality). The digital prints shall also include the path name (folder and subfolder names) and file name of the picture is location on the CD-ROM. The CD-ROM shall be written in ISO 9660 format with Joliet extensions. All digital photos saved on CD-ROM shall be saved in the JPEG file format. The image quality option of the JPEG file shall be set to high. The JPEG files should be stored in separate folders based on photo location. The CD-ROM shall be submitted to the Engineer as part of the photo survey submittal.

The Contractor shall include a letter of authenticity certifying the that every digital photo image in the photo survey submittal has not been modified using photographic software. Said letter shall be included with every photo survey submittal.

VIDEO SURVEY

The video survey shall show the condition of the listed facilities, including, but not limited to, any and all deficiencies in the facilities such as cracks, settlement, leakage, distress and the like. The video survey shall document the condition of the foundation, walls, ceiling, roof, improvements and other building elements on the interiors and exteriors of the listed facilities.

The video recording shall be narrated concurrently by the camera operator, documenting the location, orientation, time and date of the scene. The narration may be supplemented by onscreen text either generated by the camera or by other methods approved by the Engineer. The video survey shall be conducted using premium grade VHS color tape and shall be recorded in the Standard Play (SP) mode or using digital video in MPEG2 format with minimum resolution of 1440 x 1080 pixels at SP mode. No more than one facility shall be recorded on a single video recording or tape. The contractor shall submit the original, unedited video recording to the engineer. All video tape recording shall be made to the highest quality and standards. No more than one facility shall be recorded on a single videotape. Copies of the video tape shall be professionally made and shall not incur signal degradation during copying. Digital video shall also include the path name (folder and subfolder names) and file name of the MPEG2 video file. The DVD-ROM shall be written in ISO 9660 format with Joliet extensions. All digital video saved on DVD-ROM shall be saved in the MPEG2 file format. The MPEG2 files should be stored in separate folders based on video location. The DVD-ROM shall be submitted to the Engineer as part of the video survey submittal.

A written report of the record of observations shall also be submitted with the video recording. The written report shall include the date and time of the recording and the location of the facility in question. The report shall also include a table listing the anomalies with a detailed description, and orientation. The table shall also list the beginning and the ending times of the video recorder counter for each anomaly recorded on the video recording.

CRACK MONITORING

Crack monitoring shall be made on all existing cracks in each of the facilities included in this survey and shall be performed concurrent with the photo survey. The gage installation shall be done concurrent with the pre-construction photo survey. Crack monitoring shall be performed using, a calibrated crack monitoring device approved by the Engineer. The crack gage shall be capable of measuring cracks to the nearest 0.05 inch. The location of the crack gauges shall be identified in the pre-construction survey report.

Cracks shall be monitored weekly during the pre-construction photo survey and daily throughout the duration of any impact work that has a potential to cause damage to the existing facilities. The crack gauge measurements shall be recorded at the same time each day in an effort to eliminate deviations in crack magnitude due to heat fluctuations. A report detailing such readings shall be provided to the Engineer on a weekly basis.

ELEVATION SURVEY

The elevation survey shall be conducted to obtain vertical elevations of existing buildings, foundations and other improvements. A minimum of three points shall be monitored at each facility. Elevation measuring equipment shall be of a type approved by the Engineer. Such equipment shall be capable of measuring changes in elevations to the nearest .005 inch.

The elevation survey shall be performed by a Professional Land Surveyor registered in the State of California or by such a professional surveyor.

Three calendar days prior to beginning any impact work, the Contractor shall document elevations of the required points per facility and shall continue to document each point on a daily basis until the significant impact work begins. During the significant impact work, the Contractor shall document the elevations of the points three times per shift. After the impact work is complete for the specified location, the Contractor shall document the elevations on a daily basis for 2 calendar days. If there is variation in elevation of a 0.1125 inch or more, the impact work shall be halted, and the Engineer shall be immediately notified. If the work is halted due to fluctuations in elevation the Contractor shall modify their operations to eliminate future fluctuations in elevations, at no cost to the state.

Within 20 working days after the completion of any impact work, the Contractor shall submit to the Engineer a report documenting the results of the survey. Each facility shall have a separate report. The report shall be signed by a Professional Land Surveyor in the State of California who performed the survey or in whose authority the survey was made. The report shall include the location of the monitoring points, including the address of the facility surveyed and the building layout. A general layout plan shall be included in the report showing the elevations, dimensions and distances of the monitoring locations.

REPORTS AND SUBMITTALS

The photographs, video recordings, and reports of all observations shall be prepared in triplicate by the Contractor and the authorized representatives of the State and of the Contractor shall sign every document.

The Contractor shall submit a list of digital photo equipment proposed for use, including digital cameras, photographic software, photo printers and photo quality glossy heavyweight paper. The submittal shall include actual recent samples of digital photos taken with the proposed camera and printed with the proposed printer.

The survey and crack monitoring reports and submittals may be submitted in portions based on Stage Construction, if in the opinion of the Engineer, detrimental actions can be avoided in the subsequent stages. The submittal package shall include all records, documents, photos, video recordings and observations. The Engineer shall have 5 working days to review the submittal for adequacy.

The above referenced records, video recordings, and photographs are intended for use as indisputable evidence in ascertaining the extent of any damage which may occur as a result of the Contractor's operations. The above-referenced records, video tapes or DVD's and photographs are for the protection of the adjacent property owners, the Contractor, and the State. These records will be used to determine any damage from the Contractor's operations during the work.

Pre-Construction Activities

The pre-construction survey and crack monitoring documentation as specified above shall be submitted to the Engineer prior to commencement of any significant impact work as defined above. The Engineer shall have 5 working days to review the submittal for adequacy. No impact work shall take place unless the Engineer approves the pre-construction survey records.

The Contractor shall notify the Engineer 48 hours prior to beginning the photo and video survey, elevation survey and crack monitoring work.

Post-Construction Activity

The post-construction survey and crack monitoring documentation shall be submitted within 25 working days after the impact work has been completed adjacent to each of the specified facilities.

Attention is directed to Sections 7-1.1. "Preservation of Property" and 7-1.12, "Indemnification and Insurance"' of the Standard Specifications. The Contractor will immediately inform the Engineer in writing, of any damage to these and other facilities.

PAYMENT

The contract lump sum price paid for survey of existing non-highway facilities shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in photo and video survey, elevation survey and crack monitoring of existing facilities as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The Engineer may order additional photo and video survey, elevation survey and crack monitoring of existing facilities other than those facilities listed. Additional photo and video survey, elevation survey and crack monitoring of existing facilities will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications.

10-1.25 TEMPORARY ACCESS PLAN

The Contractor shall submit a Temporary Access Plan (TAP) to the Engineer for approval.

The TAP shall contain detailed plans for temporary access for all major work activities and shall contain the following items, but not limited to the work needed to create, maintain and remove temporary access roads, including all grading, drainage, surfacing materials, fencing details, restoration work and post construction stabilization. If temporary shoring is used to develop temporary access, the Contractor shall submit to the Engineer, as provided in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, a plan that details the methods, structures and calculations for temporary shoring that will be used to facilitate temporary access. The plans for temporary shoring shall be included in the submittal of the temporary access plans

SUBMITTALS

Within 5 days after contract approval, the Contractor shall submit 3 copies of the TAP to the Engineer. The Contractor shall allow 5 days for the Engineer's review. If revisions are required, the Engineer will provide comments and specify the date that the review stopped. The Contractor shall revise and resubmit the TAP within 5 days of receipt of the Engineer's comments. The Engineer's review will resume when the complete TAP is resubmitted. When the Engineer approves the TAP, the Contractor shall submit 4 copies of the approved TAP to the Engineer. The Contractor may proceed with construction activities if the Engineer conditionally approves the TAP while minor revisions are being completed.

The Contractor shall not perform earthwork (except for water pollution control work) until the TAP has been approved by the Engineer. The Engineer's review and approval shall not waive any contract requirements and shall not relieve the Contractor from complying with Federal, State and local laws, regulations, and requirements.

If there is a change in construction schedule or activities, the Contractor shall prepare an amendment to the TAP to identify additional major work activities. The Contractor shall submit the amendment to the Engineer for review within a time agreed to by the Engineer not to exceed the number of days specified for the initial submittal of the TAP. The Engineer will review the amendment within the same time allotted for the review of the initial submittal of the TAP.

The Contractor shall keep a copy of the approved TAP at the job site. The TAP shall be made available when requested by a representative of the Presidio Trust. Requests from the public shall be directed to the Engineer.

IMPLEMENTATION REQUIREMENTS

The Contractor's responsibility for TAP implementation shall continue throughout any temporary suspension of work ordered in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications.

If the Contractor or the Engineer identifies a deficiency in the implementation of the approved TAP, the deficiency shall be corrected immediately, unless an agreed date for correction is approved in writing by the Engineer.

If the Contractor fails to conform to the provisions of this section, "Temporary Access Plan," the Engineer may order the suspension of work until the project complies with the requirements of this section.

PAYMENT

The contract lump sum price paid for prepare temporary access plan shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in preparing, obtaining approval of, and amending the temporary access plan as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.26 TRAFFIC MANAGEMENT PLAN

The Contractor shall submit a Traffic Management Plan (TMP) to the Engineer for approval. The TMP shall conform to the requirements in the Transportation Management Plan Guidelines Manual and these special provisions.

The TMP shall contain detailed plans for managing traffic for all major work activities and shall contain the following:

A. Description and location of planned construction employees parking areas within the Areas for Contractor's Use.
B. Description and estimated traffic volume projections of construction employees entering and exiting the Project site. Construction employees must enter and exit the project site at the on and off ramps on Route 101 at Merchant Road near the Golden Gate Bridge Toll Plaza.
C. Description and location of laydown and storage areas within Areas for Contractor's Use.
D. Description and estimated traffic volume projections expected to and from laydown and storage areas of each of the following construction vehicles: tractors, trailers, dump, concrete trucks, delivery trucks, heavy or wide oversized loads. Traffic volume projects shall include a description of planned haul routes within the Presidio. The Contractor's planned haul routes must not conflict with other haul routes designed by the Presidio for construction work by others. The Contractor's planned haul routes must be coordinated with other contractors working within the Presidio in accordance with "Cooperation" of these special provisions. In all cases, the Contractor must comply with the City and County of San Francisco's requirements for use of adjacent streets outside the Presidio, including requirements of street-use permits, and must also adhere to any prohibitions, including those against staging.

DELIVERY AND HAULING OF MATERIAL

Delivery and hauling of all materials to construct the Project, whether to or within the project limits shall only be permitted at the access locations and during the hours on Chart No. A, "Delivery and Hauling Material Requirements," of this special provision.

Materials are defined as and not limited to items associated with the following contract items of work: traffic handling (temporary railing (Type K), temporary crash cushions), roadway excavation and embankment work, clearing and grubbing, structure excavation/backfill, bridge sub/super structure work, temporary access, rockslope protection, drainage systems, electrical systems, temporary water pollution control, and erosion control.

Work requiring continuous non-stop operations, including but not limited to, concrete placement, will be exempted from these time restrictions.

No delivery and hauling vehicles are allowed to idle for more than five (5) minutes within the Presidio.

Chart No. A
Delivery and Hauling of Material Requirements

Location: The Presidio

FROM HOUR TO HOUR	a.m. 12	1	2	3	4	5	6	7	8	9	10	11	p.m. 12	1	2	3	4	5	6	7	8	9	10	11	12
Mondays through Thursdays									X	X	X	X	X	X	X	X	X	X	X						
Fridays									X	X	X	X	X	X	X	X	X	X	X						
Saturdays							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
Sundays																									
Day before designated legal holiday							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
Designated legal holiday/ Special Events																									

Legend

X	Delivery and hauling of materials allowed. Access to the Presidio is allowed only at the on and off ramps on Route 101 at Merchant Road near the Golden Gate Bridge Toll Plaza or as shown on the plans.
	No Delivery or hauling of materials allowed

REMARKS:

SUBMITTALS

Within 5 days after contract approval, the Contractor shall submit 3 copies of the TMP to the Engineer. The Contractor shall allow 5 days for the Engineer's review. If revisions are required, the Engineer will provide comments and specify the date that the review stopped. The Contractor shall revise and resubmit the TMP within 5 days of receipt of the Engineer's comments. The Engineer's review will resume when the complete TMP is resubmitted. When the Engineer approves the TMP, the Contractor shall submit 4 copies of the approved TMP to the Engineer. The Contractor may proceed with construction activities if the Engineer conditionally approves the TMP while minor revisions are being completed.

The Contractor shall not perform work that may cause water pollution until the TMP has been approved by the Engineer. The Engineer's review and approval shall not waive any contract requirements and shall not relieve the Contractor from complying with Federal, State and local laws, regulations, and requirements.

If there is a change in construction schedule or activities, the Contractor shall prepare an amendment to the TMP to identify additional major work activities. The Contractor shall submit the amendment to the Engineer for review within a time agreed to by the Engineer not to exceed the number of days specified for the initial submittal of the TMP. The Engineer will review the amendment within the same time allotted for the review of the initial submittal of the TMP.

The Contractor shall keep a copy of the approved TMP at the job site. The TMP shall be made available when requested by a representative of the Presidio Trust. Requests from the public shall be directed to the Engineer.

IMPLEMENTATION REQUIREMENTS

The Contractor's responsibility for TMP implementation shall continue throughout any temporary suspension of work ordered in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications.

If the Contractor or the Engineer identifies a deficiency in the implementation of the approved TMP, the deficiency shall be corrected immediately, unless an agreed date for correction is approved in writing by the Engineer.

If the Contractor fails to conform to the provisions of this section, "Traffic Management Plan," the Engineer may order the suspension of work until the project complies with the requirements of this section.

PAYMENT

The contract lump sum price paid for traffic management plan shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in preparing, obtaining approval of, and amending the traffic management plan as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.27 SOUND CONTROL AND MONITORING REQUIREMENTS

GENERAL

Summary

This work includes developing a sound control plan, implementing sound control measures, monitoring sound levels during construction, and providing a sound meter to the Engineer.

Comply with the second paragraph of 14-8.02, "Noise Control," of the Standard Specifications and these special provisions. The first paragraph of Section 14-8.02 does not apply.

Definitions

audio recording: Sound captured to a medium that can be played back to the user as a listenable representation of the original sound. An audio recording is of sufficient fidelity or quality to be useful for the identification of the source(s) of the recorded sound(s).

average sound level (Leq): The sound pressure level time-averaged over a specified time period.

baseline ambient sound levels: Reference sound levels derived from a baseline ambient measurement assessment. They are the hourly Leq and Lmax for each receptor location as shown in the contract plans.

exceedance event: The event marked by a measured sound level that exceeds a numerical threshold value preset for each sound monitor.

hourly average sound level (hourly Leq): The average sound level measured over a one-hour time period.

hourly maximum sound level (hourly Lmax): The maximum sound level measured during a one-hour time period.

maximum sound level (Lmax): The maximum "slow" exponential time-weighted sound pressure level that occurs during a specified time period.

normal work hours: Monday through Friday 7:00 am to 7:00 pm and Saturdays 9:00 am to 6:00 pm.

noise restricted work hours: Monday through Thursday 7:00 pm to 7:00 am, Friday 7:00 pm to Saturday 9:00 am, Saturday 6:00 pm to Monday 7:00 am.

receptor location: Locations where baseline ambient sound levels are measured and contract noise monitoring devices will be placed as shown in the contract plans. The final locations will be determined by the Engineer.

sound level: The "slow" exponential time-weighted sound pressure level.

s**ound pressure level**: The A-weighted root-mean-square (RMS) sound pressure expressed in decibels (dBA) with respect to a reference sound pressure of 20 micropascals.

Submittals

Sound Control Plan

At least 5 days before starting operations at the job site, submit 3 copies of a Sound Control Plan (SCP) to the Engineer for review and approval in conformance with Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The SCP must include:

1. Work to be performed along with planned work durations.
2. Type and location of stationary construction equipment and facilities.
3. Type and quantity of mobile construction equipment.
4. Estimated sound levels throughout the operating cycle of stationary and mobile construction equipment reported at a distance of 50 feet from the equipment.
5. Proposed sound control measures to satisfy the project noise criteria.
6. Calculations approved by the Engineer demonstrating that the Contractor's operations utilizing the equipment and sound mitigation methods identified in this SCP are expected to satisfy the project noise criteria.
7. Contingency measures to be implemented in the event that Contractor’s operations do not comply with the project noise criteria.
8. Detailed information on proposed procedures to conduct the sound monitoring.

After the SCP is submitted, allow the Engineer 5 days to review and respond to the SCP. Allow the Engineer an additional 5 days for review and response to any SCP re-submittals or revisions. Do not start construction activities on site until the Engineer has reviewed and approved the SCP in writing.

Schedule of Values

Submit a schedule of values that shows a breakdown of costs of labor and equipment divided by the major portions of the work. The sum of the items listed in the schedule of values must equal the contract lump sum price for sound control and monitoring. The schedule of values must be approved by the Engineer before any partial payment estimate is prepared.

Quality Control and Assurance

Project Noise Criteria

Except for the work described below, the average hourly noise level (hourly Leq) and hourly maximum sound level (Lmax) from the Contractor's operations must not exceed the baseline Leq or baseline Lmax by more than 5 dBa measured at the 16 receptor locations:

1. Work performed during normal work hours
2. Continuous operations for the weekend traffic switch between stages or to final traffic configuration (requires 2 weeks notice)
3. Tunnel excavation (requires 2 weeks notice)
4. Concrete pours (requires 2 weeks notice)
5. Continuous drilling (requires 2 weeks notice)
6. Work, during noise restricted work hours, performed on mainline Hwy 1, mainline Hwy 101 and their ramps as required by the lane closure charts (requires 2 weeks notice)

Independent Acoustical Engineer

Provide an independent acoustical engineer, acceptable to the Engineer, having at least 3 years of demonstrated experience in noise engineering. The acoustical engineer is responsible for:

1. Developing the sound control plan
2. Monitoring compliance with the sound control plan
3. Monitoring sound levels during construction.

MATERIALS

Sound Level Meters

Sound level meters must:

1. Be Type 1 or Type 2 integrating-averaging sound level meters that comply with ANSI S1.4-1983 (R2006), "American National Standard Specification for Sound Level Meters," and ANSI S1.43-1997 (R2007), "American National Standard Specification for Integrating-Averaging Sound Level Meters."
2. Be housed in a weather-resistant enclosure.
3. Have an exterior weather-resistant microphone and windscreen.
4. Have an internal time clock.
5. Be capable of running continuously for at least 12 hours
6. Have wireless networking capability.

Service sound level meters before each measurement period at least on a weekly basis for the first month and then at least on a monthly basis following the first month to verify proper operation, including acoustical calibration. Replace or repair inoperative or malfunctioning sound monitors within 48 hours, and annotate the acoustical data management system accordingly. Synchronize and set the time clocks of all sound level meters per local job site time.

Provide one Quest 2200 "Type 2" sound level meter, or equivalent, and one acoustic calibrator which will be used by the Department during the life of the contract. Provide training by a person trained in noise monitoring to one Department employee designated by the Engineer. Have the sound level meter calibrated and certified by the manufacturer or other independent acoustical laboratory before delivery to the Department. Provide annual recalibration by the manufacturer or other independent acoustical laboratory. All equipment must be capable of taking measurements using the A-weighting network and the "slow" response of the sound level meter. The measurement microphone must be fitted with an appropriate windscreen. All equipment will be returned to the Contractor at the acceptance of the contract. Equipment damaged by actions of the Department or the public shall be paid for as extra work as provided in Section 4-1.03D for the Standard Specifications.

MONITORING

When work is performed during normal work hours or noise restricted work hours, including work excepted above, perform noise monitoring at the 16 receptor locations. The noise monitoring equipment must be capable of providing a real time alert to the Contractor’s superintendent and the Engineer when noise levels (Lmax or Leq) are exceeded. The sound monitoring system must store the following measured acoustical data:

1. Hourly Leq, hourly Lmax
2. Start time and duration of each exceedance event

3. The maximum sound level measured during each exceedance event
4. Continuous audio recordings

    4.1 If no exceedance event occurs, the audio recordings may be deleted after 48 hours.
    4.2 Retain at least sixty (60) seconds of audio recording directly preceding and following the exceedance event for submission to the Engineer

Provide the Engineer with a daily summary of all noise monitoring data and audio recordings of exceedance events in a format suitable to the Engineer. The daily summary shall include descriptions of operations including time and locations of work. Copies of all documentation must be kept for the length of the project. The daily report shall be signed by the Contractor's project manager or project engineer.

Should the noise level of work during noise restricted work hours exceed 5 dba above baseline ambient sound levels noise at the receptor locations the operation causing that noise must be ceased immediately. Before resuming this work, submit a revised SCP detailing new, revised or additional measures to mitigate the noise. Do not resume work until the Engineer has approved, in writing, the revised plan.

The Contractor shall minimize noise levels of work during normal work hours to maximum extent possible by applying industry recognized best practices measures.

The noise level requirements apply to the equipment on the job or related to the job, including but not limited to trucks, transit mixers or transient equipment that may or may not be owned by the Contractor. The use of loud sound signals shall be avoided in favor of light warnings except those required by safety laws for the protection of personnel.

Attention is directed to "Order of Work", "Time of Completion" and "Maintaining Traffic" of these special provisions.

Attention is directed to "Progress Schedule Method," and "Cooperation," of these special provisions. A detailed month ahead schedule showing work to be performed, equipment to be used, locations of work and work hours of specific operations must be submitted prior to the start of work on the project site. Updates shall be submitted every 2 weeks for the duration of the project. Changes may be submitted on a daily basis to the Engineer before 9:00 a.m. each working day, and shall be approved by the Engineer. Work performed during noise restricted work hours that is expected to exceed 5 dba over baseline ambient sound levels noise requires two weeks notice.

MEASUREMENT AND PAYMENT

The contract lump sum price paid for sound control and monitoring includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and doing all the work involved in complying with sound control and monitoring requirements, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.28 COOPERATION

It is anticipated that work by another contractor may be in progress adjacent to or within the limits of this project during progress of the work on this contract. The following table lists contracts anticipated to be in progress during this contract.

Contract No.	Co-Rte-PM	Location	Type of Work
04-163714 04-163724	SF-101/1-VAR	Various Locations	Landscaping, Utilities
04-163734	SF-101/1-VAR	Rte 1/101 Separation to Golden Gate Br. Toll Plaza	Reconstruct Freeway
04-163754 04-163764 04-163774	SF-101/1 VAR	Rte 101 Richardson Ave to Golden Gate Br. Toll Plaza	Reconstruct Freeway
Golden Gate Bridge District	SF-101-9.8	Golden Gate Bridge and Toll Plaza	Toll Plaza and Access Improvements
Presidio Trust	SF-101/1-VAR	Various Locations, see table below	Building, Utilities, Roadway work

Presidio Trust Projects
• Public Health Service Hospital (PHSH) district • Main Parade, Main Post Garage • Thornburg Project which includes all the buildings along Thornburg street plus a new building plus 4 of the Gorgas Warehouses • Contemporary Art Museum for the Presidio (CAMP) • Presidio Lodge Project • Main Post Utilities Infrastructure replacement • Reclaimed Water Treatment Plant • Various remediation (landfill 1 and fill site 2 removals for example) and landscape projects • Presidio Chapel (Bldg 130) rehab and addition • Building 50 (as part of the Archaeology Lab & Heritage Center) • Quartermaster Reach • Rob Hill Campground and Connector Trail • Sustainability Center (involving buildings 1241, 1242, 1243) • Removal of buildings 40, 41 • The Montgomery Street Barracks Landscape. • Cemetery Overlook. • Park Blvd Trail. • El Polin Springs/Tennessee Hollow. • Compton Playground Rehab. • Crissy Avenue slope stabilization. • Demolition of Building 1244 and construction of head house and greenhouse structures

10-1.29 PROGRESS SCHEDULE (CRITICAL PATH METHOD)

GENERAL

Summary

Comply with Section 8-1.04, "Progress Schedule," of the Standard Specifications, except you must:

1. Use a computer software to prepare the schedule
2. Furnish compatible software for the Engineer's exclusive possession and use

You are responsible for assuring that all activity sequences are logical and that each schedule shows a coordinated plan for complete performance of the work.

Definitions

contract completion date: The current extended date for completion of the contract shown on the weekly statement of working days furnished by the Engineer as specified in Section 8-1.06, "Time of Completion," of the Standard Specifications.

data date: The day after the date through which a schedule is current. Everything occurring earlier than the data date is "as-built" and everything on or after the data date is "planned."

early completion time: The difference in time between an early scheduled completion date and the contract completion date.

float: The difference between the earliest and latest allowable start or finish times for an activity.

milestone: An event activity that has zero duration and is typically used to represent the beginning or end of a certain stage of the project.

narrative report: A document submitted with each schedule that discusses topics related to project progress and scheduling.

near critical path: A chain of activities with total float exceeding that of the critical path but having no more than 10 working days of total float.

State owned float activity: The activity documenting time saved on the critical path by actions of the State. It is the last activity prior to the scheduled completion date.

time impact analysis: A schedule and narrative report developed specifically to demonstrate what effect a proposed change or delay has on the current scheduled completion date.

time-scaled network diagram: A graphic depiction of a CPM schedule comprised of activity bars with relationships for each activity represented by arrows. The tail of each arrow connects to the activity bar for the predecessor and points to the successor.

total float: The amount of time that an activity or chain of activities can be delayed before extending the scheduled completion date.

Submittals

General Requirements

Submit to the Engineer baseline, monthly updated, and final updated schedules, each consistent in all respects with the time and order of work requirements of the contract. Perform work in the sequence indicated on the current accepted schedule.

Each schedule must show:

1. Calculations using the critical path method to determine controlling activities.
2. Duration activities less than 20 working days.
3. The number of activities must be sufficient to assure adequate planning of the project, to permit monitoring and evaluation of progress, and to do an analysis of time impacts.
4. Each required constraint. Constraints other than those required by the special provisions may be included only if authorized.
5. State-owned float as the predecessor activity to the scheduled completion date.
6. Activities with identification codes for responsibility, stage, work shifts, location, and contract pay item numbers.

You may show early completion time on any schedule provided that the requirements of the contract are met. Early completion time is considered a resource for your exclusive use. You may increase early completion time by improving production, reallocating resources to be more efficient, performing sequential activities concurrently, or by completing activities earlier than planned. You may also submit for approval a VECP as specified in Section 4-1.035B, "Value Engineering Change Proposal." of the Standard Specifications that will reduce time of construction.

You may show a scheduled completion date that is later than the contract completion date on an update schedule, after the baseline schedule is accepted. Provide an explanation for a late scheduled completion date in the narrative report that is included with the schedule.

State-owned float is considered a resource for the exclusive use of the State. The Engineer may accrue State-owned float by the early completion of review of any type of required submittal when it saves time on the critical path. Prepare a time impact analysis, when requested by the Engineer, to determine the effect of the action as specified in "Time Impact Analysis." The Engineer documents State-owned float by directing you to update the State-owned float activity on the next updated schedule. Include a log of the action on the State-owned float activity and include a discussion of the action in the narrative report. The Engineer may use State-owned float to mitigate past, present, or future State delays by offsetting potential time extensions for contract change orders.

The Engineer may adjust contract working days for ordered changes that affect the scheduled completion date as specified in Section 4-1.03, "Changes," of the Standard Specifications. Prepare a time impact analysis to determine the effect of the change as specified in "Time Impact Analysis" and include the impacts acceptable to the Engineer in the next updated schedule. Changes that do not affect the controlling operation on the critical path will not be considered as the basis for a time adjustment. Changes that do affect the controlling operation on the critical path will be considered by the Engineer in decreasing time or granting an extension of time for completion of the contract. Time extensions will only be granted if the total float is absorbed and the scheduled completion date is delayed one or more working days because of the ordered change.

The Engineer's review and acceptance of schedules does not waive any contract requirements and does not relieve you of any obligation or responsibility for submitting complete and accurate information. Correct rejected schedules and resubmit them within 7 days of notification by the Engineer, at which time a new review period of 7 days will begin.

Errors or omissions on schedules do not relieve you from finishing all work within the time limit specified for completion of the contract. If, after a schedule has been accepted by the Engineer, either you or the Engineer discover that any aspect of the schedule has an error or omission, you must correct it on the next updated schedule.

Computer Software

Submit to the Engineer for review a description of proposed schedule software to be used. After the Engineer accepts the proposed software, furnish schedule software and all original software instruction manuals. All software must be compatible with the current version of the Windows operating system in use by the Engineer. The schedule software must include:

1. Latest version of Primavera SureTrak Project Manager for Windows, or equivalent
2. Latest version of schedule-comparing HST SureChange, or equivalent

If a schedule software equivalent to SureTrak is proposed, it must be capable of generating files that can be imported into SureTrak. The schedule-comparing software must be compatible with schedule software submitted and must be able to compare two schedules and provide reports of changes in activity ID, activity description, constraints, calendar assignments, durations, and logic ties.

The schedule software and schedule-comparing software will be returned to you before the final estimate. The Department will compensate you as specified in Section 4-1.03, "Extra Work," of the Standard Specifications for replacement of software or manuals damaged, lost, or stolen after delivery to the Engineer.

Instruct the Engineer in the use of the software and provide software support until the contract is accepted. Within 15 days of contract approval, provide a commercial 8-hour training session for 2 Department employees in the use of the software at a location acceptable to the Engineer. It is recommended that you also send at least 2 employees to the same training session to facilitate development of similar knowledge and skills in the use of the software. If schedule software other than SureTrak is submitted, then the training session must be a total of 16-hours for each Department employee.

Network Diagrams, Reports, and Data

Include the following with each schedule submittal:

1. Two sets of originally plotted, time-scaled network diagrams
2. Two copies of a narrative report
3. One read-only compact disk or floppy diskette containing the schedule data

The time-scaled network diagrams must conform to the following:

1. Show a continuous flow of information from left to right
2. Be based on early start and early finish dates of activities
3. Clearly show the primary paths of criticality using graphical presentation
4. Be prepared on 34" x 44"
5. Include a title block and a timeline on each page

The narrative report must be organized in the following sequence with all applicable documents included:

1. Transmittal letter
2. Work completed during the period
3. Identification of unusual conditions or restrictions regarding labor, equipment or material; including multiple shifts, 6-day work weeks, specified overtime or work at times other than regular days or hours
4. Description of the current critical path
5. Changes to the critical path and scheduled completion date since the last schedule submittal
6. Description of problem areas
7. Current and anticipated delays:

    7.1. Cause of delay
    7.2. Impact of delay on other activities, milestones, and completion dates
    7.3. Corrective action and schedule adjustments to correct the delay

8. Pending items and status thereof:

    8.1. Permits
    8.2. Change orders
    8.3. Time adjustments
    8.4. Noncompliance notices

9. Reasons for an early or late scheduled completion date in comparison to the contract completion date

Schedule submittals will only be considered complete when all documents and data have been submitted as described above.

Preconstruction Scheduling Conference

Schedule a preconstruction scheduling conference with your project manager and the Engineer within 5 days after contract approval. The Engineer will conduct the meeting and review the requirements of this section with you.

Submit a general time-scaled logic diagram displaying the major activities and sequence of planned operations and be prepared to discuss the proposed work plan and schedule methodology that comply with the requirements of this section. If you propose deviations to the construction staging, then the general time-scaled logic diagram must also display the deviations and resulting time impacts. Be prepared to discuss the proposal.

At this meeting, also submit the alphanumeric coding structure and activity identification system for labeling work activities. To easily identify relationships, each activity description must indicate its associated scope or location of work by including such terms as quantity of material, type of work, bridge number, station to station location, side of highway (such as left, right, northbound, southbound), lane number, shoulder, ramp name, ramp line descriptor, or mainline.

The Engineer reviews the logic diagram, coding structure, and activity identification system, and provide any required baseline schedule changes to you for implementation.

Baseline Schedule

Beginning the week following the preconstruction scheduling conference, meet with the Engineer weekly to discuss schedule development and resolve schedule issues until the baseline schedule is accepted.

Submit a baseline schedule within 20 days of contract approval. Allow 20 days for the Engineer's review after the baseline schedule and all support data are submitted. In addition, the baseline schedule submittal is not considered complete until the computer software is delivered and installed for use in review of the schedule.

The baseline schedule must include the entire scope of work and how you plan to complete all work contemplated. The baseline schedule must show the activities that define the critical path. Multiple critical paths and near-critical paths must be kept to a minimum. A total of not more than 50 percent of the baseline schedule activities must be critical or near critical, unless otherwise authorized.

The baseline schedule must not extend beyond the number of contract working days. The baseline schedule must have a data date of contract approval. If you start work before contract approval, the baseline schedule must have a data date of the 1st day you performed work at the job site.

If you submit an early completion baseline schedule that shows contract completion in less than 85 percent of the contract working days, the baseline schedule must be supplemented with resource allocations for every task activity and include time-scaled resource histograms. The resource allocations must be shown to a level of detail that facilitates report generation based on labor crafts and equipment classes for you and your subcontractors. Use average composite crews to display the labor loading of on-site construction activities. Optimize and level labor to reflect a reasonable plan for accomplishing the work of the contract and to assure that resources are not duplicated in concurrent activities. The time-scaled resource histograms must show labor crafts and equipment classes to be used. The Engineer may review the baseline schedule activity resource allocations using Means Productivity Standards or equivalent to determine if the schedule is practicable.

Updated Schedule

Submit an updated schedule and meet with the Engineer to review contract progress, on or before the 1st day of each month, beginning one month after the baseline schedule is accepted. Allow 15 days for the Engineer's review after the updated schedule and all support data are submitted, except that the review period will not start until the previous month's required schedule is accepted. Updated schedules that are not accepted or rejected within the review period are considered accepted by the Engineer.

The updated schedule must have a data date of the 21st day of the month or other date established by the Engineer. The updated schedule must show the status of work actually completed to date and the work yet to be performed as planned. Actual activity start dates, percent complete, and finish dates must be shown as applicable. Durations for work that has been completed must be shown on the updated schedule as the work actually occurred, including Engineer submittal review and your resubmittal times.

Schedule Revisions

If the Contractor desires to make a change to the accepted schedule, the Contractor shall request permission from the Engineer in writing, stating the reasons for the change, and proposed revisions to activities, logic and duration. The Contractor shall submit for acceptance an analysis showing the effect of the revisions on the entire project. The analysis shall include:

A. An updated schedule not including the revisions. The schedule shall have a data date just prior to implementing the proposed revisions and includes a project completion date;
B. A revised schedule that includes the proposed revisions. The schedule will have the same data date as the updated schedule and include a project completion date;
C. A narrative explanation of the revisions and their impact to the schedule; and
D. Computer files of the updated schedule and the revised schedule sequentially numbered or renamed for archive (record) purposes.

The Engineer will provide a response within 10 days to Contractor proposed schedule revisions.

Within 15 calendar days, the Contractor shall submit a revised CPM network for approval when requested by the Engineer, or when any of the following occurs:

A. there is a significant change in the Contractor's operations that will affect the critical path; or
B. the Engineer determines that an approved or anticipated change will impact the critical path, milestone or completion dates, contract progress, or work by other contractors.

The Engineer shall be allowed 10 days to review and accept or reject a schedule revision. Rejected schedule revisions shall be revised and resubmitted to the Engineer within 10 days, at which time a new 10 day review period by the Engineer will begin. Only upon approval of a change by the Engineer shall it be reflected in the next schedule update submitted by the Contractor. The revised schedule shall also include a narrative explanation of the revisions and their impact to the schedule.

Time Impact Analysis

Submit a written time impact analysis (TIA) with each request for adjustment of contract time, or when you or the Engineer consider that an approved or anticipated change may impact the critical path or contract progress.

The TIA must illustrate the impacts of each change or delay on the current scheduled completion date or internal milestone, as appropriate. The analysis must use the accepted schedule that has a data date closest to and before the event. If the Engineer determines that the accepted schedule used does not appropriately represent the conditions before the event, the accepted schedule must be updated to the day before the event being analyzed. The TIA must include an impact schedule developed from incorporating the event into the accepted schedule by adding or deleting activities, or by changing durations or logic of existing activities. If the impact schedule shows that incorporating the event modifies the critical path and scheduled completion date of the accepted schedule, the difference between scheduled completion dates of the two schedules must be equal to the adjustment of contract time. The Engineer may construct and use an appropriate project schedule or other recognized method to determine adjustments in contract time until you provide the TIA.

Submit 2 copies of your TIA within 20 days of receiving a written request for a TIA from the Engineer. Allow the Engineer 15 days after receipt to review the submitted TIA. All approved TIA schedule changes must be shown on the next updated schedule.

If a TIA you submit is rejected, meet with the Engineer to discuss and resolve issues related to the TIA. If agreement is not reached, you are allowed 15 days from the meeting with the Engineer to give notice as specified in Section 9-1.04, "Notice of Potential Claim," of the Standard Specifications. Only show actual as-built work, not unapproved changes related to the TIA, in subsequent updated schedules. If agreement is reached at a later date, approved TIA schedule changes must be shown on the next updated schedule. The Engineer withholds remaining payment on the schedule contract item if a TIA is requested and not submitted within 20 days. The schedule item payment resumes on the next estimate after the requested TIA is submitted. No other contract payment is withheld regarding TIA submittals.

Final Updated Schedule

Submit a final update, as-built schedule with actual start and finish dates for the activities, within 30 days after completion of contract work. Provide a written certificate with this submittal signed by your project manager or an officer of the company stating, "To my knowledge and belief, the enclosed final update schedule reflects the actual start and finish dates of the actual activities for the project contained herein." An officer of the company may delegate in writing the authority to sign the certificate to a responsible manager.

PAYMENT

Progress schedule (critical path method) will be paid for at a lump sum price. The contract lump sum price paid for progress schedule (critical path method) includes full compensation for furnishing all labor, material, tools, equipment, and incidentals, including computer software, and for doing all the work involved in preparing, furnishing, and updating schedules, and instructing and assisting the Engineer in the use of computer software, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Payments for the progress schedule (critical path method) contract item will be made progressively as follows:

1. A total of 25 percent of the item amount will be paid upon achieving all of the following:

    1.1. Completion of 5 percent of all contract item work.
    1.2. Acceptance of all schedules and approval of all TIAs required to the time when 5 percent of all contract item work is complete.
    1.3. Delivery of schedule software to the Engineer.
    1.4. Completion of required schedule software training.

2. A total of 50 percent of the item amount will be paid upon completion of 25 percent of all contract item work and acceptance of all schedules and approval of all TIAs required to the time when 25 percent of all contract item work is complete.
3. A total of 75 percent of the item amount will be paid upon completion of 50 percent of all contract item work and acceptance of all schedules and approval of all TIAs required to the time when 50 percent of all contract item work is complete.
4. A total of 100 percent of the item amount will be paid upon completion of all contract item work, acceptance of all schedules and approval of all TIAs required to the time when all contract item work is complete, and submittal of the certified final update schedule.

If you fail to complete any of the work or provide any of the schedules required by this section, the Engineer makes an adjustment in compensation as specified in Section 4-1.03C, "Changes in Character of Work," of the Standard Specifications for the work not performed. Adjustments in compensation for schedules will not be made for any increased or decreased work ordered by the Engineer in submitting schedules.

10-1.30 TIME-RELATED OVERHEAD

The Contractor will be compensated for time-related overhead as described below and in conformance with "Force Account Payment" of these special provisions. The Contractor will not be compensated for time-related overhead for delays to the controlling operations caused by the Engineer that occur prior to the first working day, but will be compensated for actual overhead costs incurred, as determined by an independent Certified Public Accountant audit examination and report.

Attention is directed to "Beginning of Work, Time of Completion and Liquidated Damages," "Force Account Payment," and "Progress Schedule (Critical Path Method)" of these special provisions.

The provisions in Section 9-1.08, "Adjustment of Overhead Costs," of the Standard Specifications shall not apply.

Time-related overhead shall consist of those overhead costs, including field and home office overhead, that are in proportion to the time required to complete the work. Time-related overhead shall not include costs that are not related to time, including but not limited to, mobilization, licenses, permits, and other charges incurred only once during the contract and costs for insurance coverage provided by OCIP as primary insurance for work performed at the job site as specified in "Owner Controlled Insurance Program (OCIP)" of these special provisions. Time-related overhead shall not apply to subcontractors of any tier, suppliers, fabricators, manufacturers, or other parties associated with the Contractor.

Field office overhead expenses include time-related costs associated with the normal and recurring operations of the construction project, and shall not include costs directly attributable to the work of the contract. Time-related costs of field office overhead include, but are not limited to, salaries, benefits, and equipment costs of project managers, general superintendents, field office managers and other field office staff assigned to the project, and rent, utilities, maintenance, security, supplies, and equipment costs of the project field office.

Home office overhead or general and administrative expenses refer to the fixed costs of operating the Contractor's business. These costs include, but are not limited to, general administration, insurance, personnel and subcontract administration, purchasing, accounting, and project engineering and estimating. Home office overhead costs shall exclude expenses specifically related to other contracts or other businesses of the Contractor, equipment coordination, material deliveries, and consultant and legal fees.

The quantity of time-related overhead associated with a reduction in contract time for an accepted VECP under Section 4-1.035B, "Value Engineering Change Proposal," of the Standard Specifications shall be considered a construction cost attributable to the resultant estimated net savings due to the cost reduction incentive.

If the final increased quantity of time-related overhead exceeds 149 percent of the number of working days specified in the verified Bid Item List, the Contractor shall, within 60 days of the Engineer's written request, submit to the Engineer an audit examination and report performed by an independent Certified Public Accountant of the Contractor's actual overhead costs. The audit examination and report shall depict the Contractor's project and company-wide financial records and shall specify the actual overall average daily rates for both field and home office overhead for the entire duration of the project, and whether the costs have been properly allocated. The rates of field and home office overhead shall exclude unallowable costs as determined in the Federal Acquisition Regulations, 48 CFR, Chapter 1, Part 31.

Independent Certified Public Accountant's audit examinations shall be performed in conformance with the requirements of the American Institute of Certified Public Accountants Attestation Standards. Audit examinations and reports shall determine if the rates of field office overhead and home office overhead are:

A. Allowable in conformance with the requirements of the Federal Acquisition Regulations, 48 CFR, Chapter 1, Part 31.
B. Adequately supported by reliable documentation.
C. Related solely to the project under examination.

Within 20 days of receipt of the Engineer's written request, the Contractor shall make its financial records available for audit by the State for the purpose of verifying the actual rate of time-related overhead specified in the audit submitted by the Contractor. The actual rate of time-related overhead specified in the audit, submitted by the Contractor, will be subject to approval by the Engineer.

If the Engineer requests the independent Certified Public Accountant audit, or if it is requested in writing by the Contractor, the contract item payment rate for time-related overhead, in excess of 149 percent of the number of working days specified in the verified Bid Item List, will be adjusted to reflect the actual rate.

The cost of performing an independent Certified Public Accountant audit examination and submitting the report, requested by the Engineer, will be borne equally by the State and the Contractor. The division of the cost will be made by determining the cost of providing an audit examination and report in conformance with the provisions of Section 9-1.03B, "Work Performed by Special Forces or Other Special Services," of the Standard Specifications, and paying to the Contractor one-half of that cost. The cost of performing an audit examination and submitting the independent Certified Public Accountant audit report for overhead claims other than for the purpose of verifying the actual rate of time-related overhead shall be entirely borne by the Contractor. The cost of performing an audit examination and submitting the independent Certified Public Accountant audit report to verify actual overhead costs incurred prior to the first working day shall be entirely borne by the Contractor.

The quantity of time-related overhead to be paid will be measured by the working day, designated in the verified Bid Item List as WDAY. The estimated number of working days is the number of working days, excluding days for plant establishment, as specified in "Beginning of Work, Time of Completion and Liquidated Damages" of these special provisions. The quantity of time-related overhead will be increased or decreased only as a result of suspensions or adjustments of contract time which revise the current contract completion date, and which satisfy any of the following criteria:

A. Suspensions of work ordered in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications, except:

    1. Suspensions ordered due to weather conditions being unfavorable for the suitable prosecution of the controlling operation or operations.
    2. Suspensions ordered due to the failure on the part of the Contractor to carry out orders given, or to perform the provisions of the contract.
    3. Suspensions ordered due to factors beyond the control of and not caused by the State or the Contractor, for which the Contractor is granted extensions of time in conformance with the provisions of the third paragraph of Section 8-1.07, "Liquidated Damages," of the Standard Specifications.
    4. Other suspensions that mutually benefit the State and the Contractor.

B. Extensions of contract time granted by the State in conformance with the provisions in the fifth paragraph in Section 8-1.07, "Liquidated Damages," of the Standard Specifications and set forth in approved contract change orders, in conformance with the provisions in Section 4-1.03, "Changes," of the Standard Specifications.
C. Reductions in contract time set forth in approved contract change orders, in conformance with the provisions in Section 4-1.03, "Changes," of the Standard Specifications.

A delay to the controlling operation may be concurrent and any of the following:

1. Nonexcusable: A nonexcusable delay is caused by the fault, nonperformance, or deficiency of the Contractor, subcontractors of any tier, or suppliers. No extension of contract time or additional compensation of loss is allowed.
2. Excusable: An excusable delay is caused by factors beyond the control and without the fault of the State or the Contractor. Only an extension of contract time is allowed.
3. Compensable: A compensable delay is caused solely by the fault, deficiency, error, or omission of the State. An extension of contract time and compensation for the actual cost without markup or profit are allowed.

A concurrent delay occurs when 2 separate delays overlap partially or entirely. A nonexcusable delay concurrent with either an excusable or a compensable delay is a nonexcusable delay. An excusable delay concurrent with a compensable delay is an excusable delay.

The quantity of time-related overhead is only adjusted as a result of a compensable delay and is not adjusted as a result of either a nonexcusable or an excusable delay.

An approved time impact analysis submitted as specified in "Progress Schedule (Critical Path Method)" of these special provisions is used to determine the type and duration of a delay.

In the event an early completion progress schedule, as defined in "Progress Schedule (Critical Path Method)" of these special provisions, is submitted by the Contractor and approved by the Engineer, the amount of time-related overhead eligible for payment will be based on the total number of working days for the project, in conformance with the provisions in "Beginning of Work, Time of Completion and Liquidated Damages" of these special provisions, rather than the Contractor's early completion progress schedule.

The contract price paid per working day for time-related overhead shall include full compensation for time-related overhead, including the Contractor's share of costs of the independent Certified Public Accountant audit of overhead costs requested by the Engineer, as specified in these special provisions, and as directed by the Engineer.

The provisions in Sections 4-1.03B, "Increased or Decreased Quantities," and 4-1.03C, "Changes in Character of the Work," of the Standard Specifications shall not apply to the contract item of time-related overhead.

Full compensation for additional overhead costs involved in incentive and disincentive provisions to satisfy internal milestone or multiple calendar requirements shall be considered as included in the contract items of work involved and no additional compensation will be allowed therefor.

Full compensation for additional overhead costs incurred during days of inclement weather when the contract work is extended into additional construction seasons due to delays caused by the State shall be considered as included in the time-related overhead paid during the contract working days, and no additional compensation will be allowed therefor.

Full compensation for additional overhead costs involved in performing additional contract item work that is not a controlling operation shall be considered as included in the contract items of work involved and no additional compensation will be allowed therefor.

Full compensation for overhead, other than time-related overhead measured and paid for as specified above, and other than overhead costs included in the markups specified in "Force Account Payment" of these special provisions, shall be considered as included in the various items of work and no additional compensation will be allowed therefor.

Overhead costs incurred by subcontractors of any tier, suppliers, fabricators, manufacturers, and other parties associated with the Contractor shall be considered as included in the various items of work and as specified in Section 9-1.03, "Force Account Payment," of the Standard Specifications.

For the purpose of making partial payments pursuant to the provisions in Section 9-1.06, "Partial Payments," of the Standard Specifications, the number of working days to be paid for time-related overhead in each monthly partial payment will be the number of working days, specified above to be measured for payment that occurred during that monthly estimate period, including compensable suspensions and right of way delays. Working days granted by contract change order due to extra work or changes in character of the work, will be paid for upon completion of the contract. The amount earned per working day for time-related overhead shall be the lesser of the following amounts:

A. The contract item price.
B. Twenty percent of the original total contract amount divided by the number of working days specified in "Beginning of Work, Time of Completion and Liquidated Damages," of these special provisions.

After acceptance of the contract in conformance with the provisions in Section 7-1.17, "Acceptance of Contract," of the Standard Specifications, the amount of the total contract item price for time-related overhead not yet paid, will be included for payment in the first estimate made after acceptance of the contract in conformance with the provisions in Section 9-1.07, "Payment After Acceptance," of the Standard Specifications.

10-1.31 SMALL BUSINESS UTILIZATION REPORT

Submit a completed Small Business Utilization Report form on or before the following dates for the prior reporting period:

1. January 15th
2. April 15th
3. July 15th
4. October 15th

Submit a completed final Small Business Utilization Report form within 30 days after contract acceptance.

The Department pays $250 for each report submitted. The contract unit price paid for small business utilization report includes full compensation for doing all the work involved in submitting the completed Small Business Utilization Report form. If you fail to submit a completed form by the specified time, you will not receive payment for that report.

The Department does not adjust payment for an increase or decrease in the quantity of small business utilization reports submitted. Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications does not apply.

The work to complete the final Small Business Utilization Report contract item is excluded from Section 7-1.17, "Acceptance of Contract," of the Standard Specifications.

Failure to submit the Small Business Utilization Report is not considered a performance failure. Section 9-1.053, "Performance Failure Withholds," of the Standard Specifications does not apply.

10-1.32 RIGHT OF WAY OBSTRUCTIONS

Attention is directed to the occupied improvements located within the right of way at:

605 Mason Street
San Francisco, CA

It is anticipated that these improvements will be vacated and removed by September 1, 2010.

The Contractor shall take no action that will result in unnecessary inconvenience, disproportionate injury or any action coercive in nature to the occupants of these improvements who have not yet moved from the improvements.

In the event that the improvements mentioned above are not removed by the date specified and, if in the opinion of the Engineer, the Contractor's operations are delayed or interfered with by reason of the improvements not being removed by the date specified, the State will compensate the Contractor for the delays to the extent provided in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

10-1.33 CONSTRUCTION AREA TRAFFIC CONTROL DEVICES

Flagging, signs, and temporary traffic control devices furnished, installed, maintained, and removed when no longer required shall conform to the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Category 1 temporary traffic control devices are defined as small and lightweight (less than 100 pounds) devices. These devices shall be certified as crashworthy by crash testing, crash testing of similar devices, or years of demonstrable safe performance. Category 1 temporary traffic control devices include traffic cones, plastic drums, portable delineators, and channelizers.

If requested by the Engineer, the Contractor shall provide written self-certification for crashworthiness of Category 1 temporary traffic control devices at least 5 business days before beginning any work using the devices or within 2 business days after the request if the devices are already in use. Self-certification shall be provided by the manufacturer or Contractor and shall include the following:

A. Date,
B. Federal Aid number (if applicable),
C. Contract number, district, county, route and post mile of project limits,
D. Company name of certifying vendor, street address, city, state and zip code,
E. Printed name, signature and title of certifying person; and
F. Category 1 temporary traffic control devices that will be used on the project.

The Contractor may obtain a standard form for self-certification from the Engineer.

Category 2 temporary traffic control devices are defined as small and lightweight (less than 100 pounds) devices that are not expected to produce significant vehicular velocity change, but may cause potential harm to impacting vehicles. Category 2 temporary traffic control devices include barricades and portable sign supports.

Category 2 temporary traffic control devices shall be on the Federal Highway Administration's (FHWA) list of Acceptable Crashworthy Category 2 Hardware for Work Zones. This list is maintained by FHWA and can be located at:

http://safety.fhwa.dot.gov/roadway_dept/road_hardware/listing.cfm?code=workzone

The Department also maintains this list at:

http://www.dot.ca.gov/hq/traffops/signtech/signdel/pdf/Category2.pdf

Category 2 temporary traffic control devices that have not received FHWA acceptance shall not be used. Category 2 temporary traffic control devices in use that have received FHWA acceptance shall be labeled with the FHWA acceptance letter number and the name of the manufacturer. The label shall be readable and permanently affixed by the manufacturer. Category 2 temporary traffic control devices without a label shall not be used.

If requested by the Engineer, the Contractor shall provide a written list of Category 2 temporary traffic control devices to be used on the project at least 5 business days before beginning any work using the devices or within 2 business days after the request if the devices are already in use.

Category 3 temporary traffic control devices consist of temporary traffic-handling equipment and devices that weigh 100 pounds or more and are expected to produce significant vehicular velocity change to impacting vehicles. Temporary traffic-handling equipment and devices include crash cushions, truck-mounted attenuators, temporary railing, temporary barrier, and end treatments for temporary railing and barrier.

Type III barricades may be used as sign supports if the barricades have been successfully crash tested, meeting the NCHRP Report 350 criteria, as one unit with a construction area sign attached.

Category 3 temporary traffic control devices shall be shown on the plans or on the Department's Highway Safety Features list. This list is maintained by the Division of Engineering Services and can be found at:

http://www.dot.ca.gov/hq/esc/approved_products_list/

Category 3 temporary traffic control devices that are not shown on the plans or not listed on the Department's Highway Safety Features list shall not be used.

Full compensation for providing self-certification for crashworthiness of Category 1 temporary traffic control devices and for providing a list of Category 2 temporary traffic control devices used on the project shall be considered as included in the prices paid for the various items of work requiring the use of the Category 1 or Category 2 temporary traffic control devices and no additional compensation will be allowed therefor.

10-1.34 CONSTRUCTION AREA SIGNS

Construction area signs for temporary traffic control shall be furnished, installed, maintained, and removed when no longer required in conformance with the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Attention is directed to "Furnish Sign" of these special provisions.

Attention is directed to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions. Type II retroreflective sheeting shall not be used on construction area sign panels. Type III, IV, VIII, or IX retroreflective sheeting shall be used for stationary mounted construction area sign panels.

Attention is directed to "Construction Project Information Signs" of these special provisions regarding the number and type of construction project information signs to be furnished, erected, maintained, and removed and disposed of.

The Contractor shall furnish and install 2 Type D, 84 inch by 78 inch American Reinvestment and Recovery Act (Recovery Act) project funding signs at locations designated by the Engineer before starting major construction activities visible to highway users. Upon completion of the project, the Contractor shall remove and dispose of Recovery Act signs. Manufacturing details for Recovery Act signs are available at:

http://www.dot.ca.gov/hq/traffops/signtech/signdel/bondfundspecs.htm

Unless otherwise shown on the plans or specified in these special provisions, the color of construction area warning and guide signs shall have black legend and border on orange background, except W10-1 or W47(CA) (Highway-Rail Grade Crossing Advance Warning) sign shall have black legend and border on yellow background.

Orange background on construction area signs shall be fluorescent orange.

Repair to construction area sign panels will not be allowed, except when approved by the Engineer. At nighttime under vehicular headlight illumination, sign panels that exhibit irregular luminance, shadowing or dark blotches shall be immediately replaced at the Contractor's expense.

The Contractor shall notify the appropriate regional notification center for operators of subsurface installations at least 2 business days, but not more than 14 days, prior to commencing excavation for construction area sign posts. The regional notification centers include, but are not limited to, the following:

Notification Center	Telephone Number
Underground Service Alert	811

Excavations required to install construction area signs shall be performed by hand methods without the use of power equipment, except that power equipment may be used if it is determined there are no utility facilities in the area of the proposed post holes. The post hole diameter, if backfilled with portland cement concrete, shall be at least 4 inches greater than the longer dimension of the post cross section.

Construction area signs placed within 15 feet from the edge of the travel way shall be mounted on stationary mounted sign supports as specified in "Construction Area Traffic Control Devices" of these special provisions.

The Contractor shall maintain accurate information on construction area signs. Signs that are no longer required shall be immediately covered or removed. Signs that convey inaccurate information shall be immediately replaced or the information shall be corrected. Covers shall be replaced when they no longer cover the signs properly. The Contractor shall immediately restore to the original position and location any sign that is displaced or overturned, from any cause, during the progress of work.

PAYMENT

Full compensation for furnishing and installing Recovery Act signs, including removal and disposal upon project completion, is included in the contract lump sum price paid for Construction Area Signs**,** and no separate payment will be allowed therefor.

10-1.35 MAINTAINING TRAFFIC

Maintaining traffic shall conform to the provisions in Sections 7-1.08, "Public Convenience," Section 7-1.09, "Public Safety," and Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Closure is defined as the closure of a traffic lane or lanes, including shoulder, ramp or connector lanes, within a single traffic control system.

Closures shall conform to the provisions in "Traffic Control System for Lane Closure" of these special provisions.

No lane closures are allowed on days and preceding days when the San Francisco-Oakland Bay Bridge is closed to traffic in any direction.

No simultaneous lane closures are allowed on Rte 101 and Rte 1 on this project.

Work that interferes with public traffic shall be limited to the hours when lane closures are allowed, except for work required under Sections 7-1.08, "Public Convenience," and Section 7-1.09, "Public Safety."

The full width of the traveled way shall be open for use by public traffic as shown in the table "Lane Closure Restriction for Designated Legal Holidays and Special Days" included in this section, "Maintaining Traffic."

Designated legal holidays are: January 1st, the third Monday in February, the last Monday in May, July 4th, the first Monday in September, November 11th, Thanksgiving Day, and December 25th. When a designated legal holiday falls on a Sunday, the following Monday shall be a designated legal holiday. When November 11th falls on a Saturday, the preceding Friday shall be a designated legal holiday.

Special days are: the third Monday in January, March 31.

Local authorities shall be notified at least 5 business days before work begins. The Contractor shall cooperate with local authorities to handle traffic through the work area and shall make arrangements to keep the work area clear of parked vehicles.

SC6-3(CA) (RAMP CLOSED) sign shall be used to inform motorists of the temporary closing of a connector, entrance ramp or exit ramp for 1 business day.

SC6-4(CA) (RAMP CLOSED) sign shall be used to inform motorists of the temporary closing of a connector, entrance ramp or exit ramp for more than 1 business day.

The SC6-3(CA) or SC6-4(CA) signs shall be installed at least 7 days before closing the connector or ramp, but not more than 15 days before the connector or ramp closure. The Contractor shall notify the Engineer at least 2 business days before installing the SC6-3(CA) or SC6-4(CA) signs.

Accurate information shall be maintained on the SC6-3(CA) or SC6-4(CA) signs. The SC6-3(CA) or SC6-4(CA) signs, when no longer required, shall be immediately covered or removed.

Freeways may be closed only if signed for closing 7 days in advance. The Contractor shall notify the Engineer not less than 5 business days prior to signing the freeway. If the freeway is not closed on the posted day, the closure shall be changed to allow a 3-business-day advance notice before closure.

Freeway closure charts are for the erection and removal of falsework, placement and removal of overhead sign bridges, temporary railing (Type K) placement, bridge removal and other work as approved in writing by the Engineer.

Personal vehicles of the Contractor's employees shall not be parked on the traveled way or shoulders including sections closed to public traffic.

Personal vehicles of the Contractor's employees shall not be parked within the right of way except in the area as shown on the plans as Temporary Construction Easement.

When work vehicles or equipment are parked within 6 feet of a traffic lane to perform active construction, the shoulder area shall be closed as shown on the plans.

If minor deviations from the lane requirement charts are required, a written request shall be submitted to the Engineer at least 15 days before the proposed date of the closure. The Engineer may approve the deviations if there is no significant increase in the cost to the State and if the work can be expedited and better serve the public traffic.

When complete freeway, expressway or conventional highway closure is required, only one detour for each direction of travel will be allowed for the following operations: bridge demolition, overhead sign structure installation and removal, falsework erection and removal, and loop detector installation.

Full compensation for furnishing, erecting, maintaining, and removing and disposing of the C43(CA), SC6-3(CA), and SC6-4(CA) signs shall be considered as included in the contract lump sum price paid for construction area signs and no additional compensation will be allowed therefor.

Lane Closure Restriction for Designated Legal Holidays and Special Days

Thu	Fri	Sat	Sun	Mon	Tues	Wed	Thu	Fri	Sat	Sun
x	**H** xx	xx	xx							
	SD xx									
x	xx	**H** xx	xx							
		SD xx								
	x	xx	**H** xx	xx						
			SD xx							
	x	xx	xx	**H** xx	xxx					
	x	xx	xx	**SD** xx	xxx					
				x	**H** xx					
				x	**SD** xx					
					x	**H** xx				
						SD xx				
						x	**H** xx	xx	xx	xx
							SD xx			

Legends:

	Refer to lane closure charts
x	The full width of the traveled way shall be open for use by public traffic after 4:30 AM.
xx	The full width of the traveled way shall be open for use by public traffic.
xxx	The full width of the traveled way shall be open for use by public traffic until 11:00 PM.
H	Designated Legal Holiday
SD	Special Day

Pedestrian access facilities shall be provided through construction areas within the right of way as shown on the plans and as specified herein. Pedestrian walkways shall be surfaced with hot mix asphalt, portland cement concrete or timber. The surface shall be skid resistant and free of irregularities. Hand railings shall be provided on each side of pedestrian walkways as necessary to protect pedestrian traffic from hazards due to construction operations or adjacent vehicular traffic. Protective overhead covering shall be provided as necessary to insure protection from falling objects and drip from overhead structures.

In addition to the required openings through falsework, pedestrian facilities shall be provided during pile driving, footing, wall, and other bridge construction operations. At least one walkway shall be available at all times. If the Contractor's operations require the closure of one walkway, then another walkway shall be provided nearby, off the traveled roadway.

Railings shall be constructed of wood, S4S, and shall be painted white. Railings and walkways shall be maintained in good condition. Walkways shall be kept clear of obstructions.

Full compensation for providing pedestrian facilities shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

Erection and removal of falsework at locations where falsework openings are required shall be undertaken one location at a time. During falsework erection and removal, public traffic in the lanes over which falsework is being erected or removed shall be detoured or stopped as specified in this section, "Maintaining Traffic." Falsework erection shall include adjustments or removal of components that contribute to the horizontal stability of the falsework system**.** Falsework removal shall include lowering falsework, blowing sand from sand jacks, turning screws on screw jacks, and removing wedges.

The Contractor shall have necessary materials and equipment on the site to erect or remove the falsework in any one span or over any one opening before detouring or stopping public traffic.

Chart No. 1
Freeway/Expressway Lane Requirements

County: San Francisco	Route/Direction: Rte-101 SB	PM: 8.00 to 9.6

Closure Limits: From 100 ft south of Golden Gate Toll Plaza to Lyon & Richardson intersection

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	1	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	1	1	1	1	1																		2	2	
Fridays	1	1	1	1	1																				2
Saturdays	2	1	1	1	1	1	1	1																2	
Sundays	2	2	1	1	1	1	1	1	1														2	2	

Legend:

1	Provide at least one through freeway lane open in direction of travel
2	Provide at least two adjacent through freeway lanes open in direction of travel
	Work permitted within project right of way where shoulder or lane closure is not required.

REMARKS:

Chart No. 2
Freeway/Expressway Lane Requirements

County: San Francisco	Route/Direction:Rte 101 NB	PM: 8.0 to 9.6

Closure Limits: From Lyon & Richardson intersection to 165 ft south of Golden Gate Toll Plaza

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	1	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	2	1	1	1	1	1	2																		2
Fridays	2	1	1	1	1	1	2																		2
Saturdays	2	2	1	1	1	1	1	1																	
Sundays	2	2	1	1	1	1	1	1	1	2	2													2	2

Legend:

1	Provide at least one through freeway lane open in direction of travel
2	Provide at least two adjacent through freeway lanes open in direction of travel
	Work permitted within project right of way where shoulder or lane closure is not required.

REMARKS:

Chart No. 3
Freeway/Expressway Lane Requirements

County: San Francisco	Route/Direction: Rte 1 SB	PM: 6.7 to 7.0

Closure Limits: From 250 ft south of gore (PM 6.90) to 500 ft south of gore (PM 6.85)

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	1	1	1	1	1																			1	
Fridays	1	1	1	1	1																			1	
Saturdays	1	1	1	1	1	1	1	1	1													1	1	1	
Sundays	1	1	1	1	1	1	1	1	1	1	1											1	1	1	

Legend:

1	Provide at least one through freeway lane open in direction of travel
	Work permitted within project right of way where shoulder or lane closure is not required.

REMARKS:
No Rte-1 closure shall be allowed during the 3-day weekend closure of Rte-101

Chart No. 4
Freeway/Expressway Lane Requirements

County: San Francisco	Route/Direction: Rte 1 NB	PM: 6.7 to 7.0

Closure Limits: From 500 ft south of gore (PM 6.85) to 250 ft south of gore (PM 6.90)

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	1	1	1	1	1	1	1															1	1	1	1
Fridays	1	1	1	1	1	1	1															1	1	1	1
Saturdays	1	1	1	1	1	1	1														1	1	1	1	1
Sundays	1	1	1	1	1	1	1	1	1										1	1	1	1	1	1	1

Legend:

1	Provide at least one through freeway lane open in direction of travel
2	Provide at least two adjacent through freeway lanes open in direction of travel
	Work permitted within project right of way where shoulder or lane closure is not required.

REMARKS:
NoRte-1 closure shall be allowed during the 3-day weekend closure of Rte-101

Chart No. 5
Complete Freeway/Expressway Closure Hours

County: San Francisco	Route/Direction: Rte-101 NB	PM:8.0 to 9.5

Closure Limits: From Lyon & Richardson intersection to Rte 101 NB to Rte 1 SB connector

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays	C	C	C	C	c																				
Tuesdays-Thursdays																									
Fridays																						C	C	C	C
Saturdays	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sundays	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend:

C	Freeway or expressway may be closed completely.
	No complete freeway or expressway closure is permitted.

REMARKS: These windows are only for the realignment of Doyle Dr to detour

Chart No. 6
Complete Freeway/Expressway Closure Hours

County: San Francisco	Route/Direction: Rte-101 SB	PM: 8.0 to 9.5

Closure Limits: From Lyon & Richardson intersection to Rte 101 NB to Rte 1 SB connector

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays	C	C	C	C	c																				
Tuesdays-Thursdays																									
Fridays																								c	C
Saturdays	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sundays	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend:

C	Freeway or expressway may be closed completely.
	No complete freeway or expressway closure is permitted.

REMARKS: These windows are only for the realignment of Doyle Dr to detour.

Chart No. 7
Local Street Lane Requirements

County: San Francisco	Direction: NB and SB	PM: N/A

Closure Limits: McDowell Ave between Crissy Field Ave and Lincoln Blvd

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	1	1	R	R	R	R	R	R	R	R	R	R	R	R	1	1	C	C	C	
Fridays	C	C	C	C	C	1	1	R	R	R	R	R	R	R	R	R	R	R	R	1	1	1	1	1	
Saturdays	1	1	1	1	1	1	1	1	1	R	R	R	R	R	R	R	R	R	1	1	1	1	1	1	
Sundays	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

Legend:

1	Provide at least one through traffic lane open in each direction of travel
R	Provide at least one through traffic lane, not less than 10 feet in width, for use by both directions of travel (Reversing Control)
C	Closure allowed with detour in place

REMARKS: : Only one local street closure will be allowed in the Presidio at any given time and coordination will be needed with other local street closures used by either the State or the Presidio..

Chart No. 8
Local Street Lane Requirements

County: San Francisco	Route/Direction: WB and EB	PM: NA

Closure Limits: Storey Ave between Rod Rd and Lincoln Blvd

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	1	1	R	R	R	R	R	R	R	R	R	R	R	R	R	1	1	C	C	
Fridays	C	C	C	C	C	1	1	R	R	R	R	R	R	R	R	R	R	R	R	R	1	1	1	1	
Saturdays	1	1	1	1	1	1	1	1	1	R	R	R	R	R	R	R	R	R	R	1	1	1	1	1	
Sundays	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

Legend:

1	Provide at least one connector lane open in direction of travel
R	Provide at least one through traffic lane, not less than 10 feet in width, for use by both directions of travel (Reversing control)
C	Closure allowed with detour in place.

REMARKS: Only one local street closure will be allowed in the Presidio at any given time and coordination will be needed with other local street closures used by either the State or the Presidio.

Chart No. 9
Local Street Lane Requirements

County: San Francisco	Route/Direction: NB and SB	PM: NA

Closure Limits: Lincoln Blvd between Crissy Field and Storey Ave; Cowles St between Lincoln Ave and McDowell Ave.

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	1	1	R	R	R	R	R	R	R	R	R	R	R	R	R	1	1	C	C	
Fridays	C	C	C	C	C	1	1	R	R	R	R	R	R	R	R	R	R	R	R	R	1	1	1	1	
Saturdays	1	1	1	1	1	1	1	1	1	R	R	R	R	R	R	R	R	R	R	1	1	1	1	1	
Sundays	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

Legend:

1	Provide at least one connector lane open in direction of travel
R	Provide at least one through traffic lane, not less than 10 feet in width, for use by both directions of travel (Reversing control)
C	Closure allowed with detour in place.

REMARKS: 1) Only one local street closure will be allowed in the Presidio at any given time and coordination will be needed with other local street closures used by either the State or the Presidio.
2) This chart shall be used simultaneously with Chart 11 or as directed by the Engineer only.

Chart No. 10
Local Street Lane Requirements

County: San Francisco	Route/Direction: WB	PM: NA

Closure Limits: Crissy Field Ave between Lincoln Blvd and McDowell Ave.

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Fridays	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Saturdays	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sundays	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend:

C Closure allowed with detour in place.

REMARKS: Only one local street closure will be allowed in the Presidio at any given time and coordination will be needed with other local street closures used by either the State or the Presidio.

Chart No. 11
Local Street Lane Requirements

County: San Francisco	Route/Direction: EB and WB	PM: NA

Closure Limits: Cowles St between Lincoln Ave and McDowell Ave.

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	C	C
Fridays	C	C	C	C	C	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Saturdays	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sundays	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Legend:

1 Provide at least one connector lane open in direction of travel

C Closure allowed with detour in place.

REMARKS: Only one local street closure will be allowed in the Presidio at any given time and coordination will be needed with other local street closures used by either the State or the Presidio.

Chart No. 12
Complete Freeway/Expressway Closure Hours

County: SF	Route/Direction: Rte 1 NB	PM: 5.9 to 7.0

Closure Limits: From Lake St to end of Rte 1 NB / Rte 101 NB connector

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays																									
Fridays	C	C	C	C	C																				
Saturdays	C	C	C	C	C																				
Sundays	C	C	C	C	C																				

Legend:

C Freeway or expressway may be closed completely.

No complete freeway or expressway closure is permitted.

REMARKS:
1) This traffic chart is prepared by CT D4 TMP.
2) Contractors for adjacent projects require weekly coordination cooperation meeting.
3) Contractor shall coordinate with special event at Presidio. Information is provided at www.presidio.gov/tenants/live/

Chart No. 13
Complete Connector Closure Hours/Connector Lane Requirements

County: San Francisco	Route/Direction: NB-101 to SR-1 SB	PM: 9.3 on NB 101 to 7.00 on SB 1

Closure Limits: From beginning of connector on 101 NB to the end on 1 SB

FROM HOUR TO HOUR	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mondays through Thursdays	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Fridays	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Saturdays	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sundays	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend:

1 Provide at least one connector lane open in direction of travel

C Connector may be closed completely

Work permitted within project right of way where shoulder or lane closure is not required.

REMARKS:
1) No Rte-1 closure shall be allowed during the 3-day weekend closure of Rte-101.

10-1.36 CLOSURE REQUIREMENTS AND CONDITIONS

Closures shall conform to the provisions in "Maintaining Traffic" of these special provisions and these special provisions.

CLOSURE SCHEDULE

A written schedule of planned closures for the next week period, defined as Sunday noon through the following Sunday noon, shall be submitted by noon each Monday. A written schedule shall be submitted not less than 25 days and not more than 125 days before the anticipated start of any operation that will:

1. Reduce horizontal clearances, traveled way, including shoulders, to two lanes or less due to such operations as temporary barrier placement and paving
2. Reduce the vertical clearances available to the public due to such operations as pavement overlay, overhead sign installation, or falsework or girder erection

The Closure Schedule shall show the locations and times of the proposed closures. The Closure Schedule request forms furnished by the Engineer shall be used. Closure Schedules submitted to the Engineer with incomplete or inaccurate information will be rejected and returned for correction and resubmittal. The Contractor will be notified of disapproved closures or closures that require coordination with other parties as a condition of approval.

Closure Schedule amendments, including adding additional closures, shall be submitted by noon to the Engineer, in writing, at least 3 business days in advance of a planned closure. Approval of Closure Schedule amendments will be at the discretion of the Engineer.

The Engineer shall be notified of cancelled closures 2 business days before the date of closure.

Closures that are cancelled due to unsuitable weather may be rescheduled at the discretion of the Engineer.

CONTINGENCY PLAN

A detailed contingency plan shall be prepared for reopening closures to public traffic. If required by "Beginning of Work, Time of Completion and Liquidated Damages" of these special provisions, the contingency plan shall be submitted to the Engineer before work at the job site begins. Otherwise, the contingency plan shall be submitted to the Engineer within one business day of the Engineer's request.

LATE REOPENING OF CLOSURES

If a closure is not reopened to public traffic by the specified time, work shall be suspended in conformance with the provisions in Section 8-1.05, "Temporary Suspension of Work," of the Standard Specifications. No further closures are to be made until the Engineer has accepted a work plan, submitted by the Contractor, that will insure that future closures will be reopened to public traffic at the specified time. The Engineer will have 2 business days to accept or reject the Contractor's proposed work plan. The Contractor will not be entitled to compensation for the suspension of work resulting from the late reopening of closures.

For each 10-minute interval, or fraction thereof past the time specified to reopen the closure, the Department will deduct the amount per interval shown below from moneys due or that may become due the Contractor under the contract. Damages are limited to 5 percent of project cost per occurrence and will not be assessed when the Engineer requests that the closure remain in place beyond the scheduled pickup time.

Type of Facility	Route or Segment	Period	Damages/interval ($)
Mainline	Rte 1	1st half hour 2nd half hour 2nd hour and beyond	$5,200 / 10 minutes $7,800 / 10 minutes $10,400 / 10 minutes
Mainline	Rte 101	1st half hour 2nd half hour 2nd hour and beyond	$5,200 / 10 minutes $7,800 / 10 minutes $10,400 / 10 minutes
Mainline	NB Rte 101 Full Closure	1st half hour 2nd half hour 2nd hour and beyond	$15,000 / 10 minutes $22,000 / 10 minutes $29,000 / 10 minutes
Mainline	SB Rte 101 Full Closure	1st half hour 2nd half hour 2nd hour and beyond	$17,000 / 10 minutes $27,000 / 10 minutes $34,000 / 10 minutes
Connector	NB Rte 101 To SB Rte 1	1st half hour 2nd half hour 2nd hour and beyond	$5,200 / 10 minutes $7,800 / 10 minutes $10,400 / 10 minutes

COMPENSATION

The Engineer shall be notified of delays in the Contractor's operations due to the following conditions, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of those conditions, and the Contractor's loss due to that delay could not have been avoided by rescheduling the affected closure or by judicious handling of forces, equipment and plant, the delay will be considered a right of way delay and will be compensated in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications:

1. The Contractor's proposed Closure Schedule is denied and his planned closures are within the time frame allowed for closures in "Maintaining Traffic" of these special provisions, except that the Contractor will not be entitled to compensation for amendments to the Closure Schedule that are not approved.
2. The Contractor is denied a confirmed closure.

Should the Engineer direct the Contractor to remove a closure before the time designated in the approved Closure Schedule, delay to the Contractor's schedule due to removal of the closure will be considered a right of way delay and compensation for the delay will be determined in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

10-1.37 IMPACT ATTENUATOR VEHICLE

GENERAL

Summary

Work includes protecting traffic and workers by using impact attenuator vehicle as a shadow vehicle when placing and removing components of a traffic control system, and when performing a moving lane closure.

Comply with Section 12-3.03, "Flashing Arrow Signs," of the Standard Specifications.

Impact attenuator vehicle must comply with the following test levels under National Cooperative Highway Research Program 350:

1. Test level 3 for pre-construction posted speed limit of 50 mph or more
2. Test levels 2 or 3 for pre-construction posted speed limit of 45 mph or less

Comply with the attenuator manufacturer's recommendations for:

1. Support truck
2. Trailer-mounted operation
3. Truck-mounted operation

Definitions

impact attenuator vehicle: Support truck towing a deployed attenuator mounted to a trailer or support truck with a deployed attenuator mounted to the support truck.

Submittals

Upon request, submit a Certificate of Compliance for attenuator to the Engineer under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

Quality Control and Assurance

Attenuator must be a brand listed on the Department's pre-approved list under Highway Safety Features at:

http://www.dot.ca.gov/hq/esc/approved_products_list/

MATERIALS

The combined weight of the support truck and the attenuator must be at least 19,800 pounds, except the weight of the support truck must not be less than 16,100 pounds or greater than 26,400 pounds.

If using the Trinity MPS-350 truck-mounted attenuator, the support truck must not have any underneath fuel tank mounted within 10'-6" of the rear of the support truck.

Each impact attenuator vehicle must:

1. Have standard brake lights, taillights, sidelights, and turn signals
2. Have an inverted "V" chevron pattern placed across the entire rear of the attenuator composed of alternating 4 inch wide non-reflective black stripes and 4 inch wide yellow retroreflective stripes sloping at 45 degrees
3. Have a Type II flashing arrow sign
4. Have a flashing or rotating amber light
5. Have an operable 2-way communication system for maintaining contact with workers

CONSTRUCTION

Use impact attenuator vehicle to follow behind equipment and workers who are placing and removing components of a traffic control system for a lane closure or a ramp closure. Flashing arrow sign must be operating in arrow mode during this activity. Follow at a distance to prevent intrusion into the workspace from passing traffic.

After placing components of a traffic control system for a lane closure or a ramp closure you may use impact attenuator vehicle in a closed lane and in advance of a work area to protect traffic and workers.

Use impact attenuator vehicle as a shadow vehicle under traffic control for a moving lane closure.

Secure objects including equipment, tools and ballast on impact attenuator vehicle to prevent loosening upon impact by an errant vehicle.

Do not use a damaged attenuator in the work. Replace, at your expense, an attenuator damaged from an impact during work.

MEASUREMENT AND PAYMENT

Full compensation for furnishing and operating impact attenuator vehicle is included in the contract lump sum price paid for traffic control system, and no additional compensation will be allowed therefor.

10-1.38 TRAFFIC CONTROL SYSTEM FOR LANE CLOSURE

A traffic control system shall consist of closing traffic lanes in conformance with the details shown on the plans, the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications, the provisions under "Maintaining Traffic" and "Construction Area Signs" of these special provisions, and these special provisions.

The provisions in this section will not relieve the Contractor from the responsibility to provide additional devices or take measures as may be necessary to comply with the provisions in Section 7-1.09, "Public Safety," of the Standard Specifications.

Each vehicle used to place, maintain and remove components of a traffic control system on multilane highways shall be equipped with a Type II flashing arrow sign which shall be in operation when the vehicle is being used for placing, maintaining or removing components. Vehicles equipped with Type II flashing arrow sign not involved in placing, maintaining or removing components when operated within a stationary lane closure shall only display the caution display mode. The sign shall be controllable by the operator of the vehicle while the vehicle is in motion. The flashing arrow sign shown on the plans shall not be used on vehicles which are being used to place, maintain and remove components of a traffic control system and shall be in place before a lane closure requiring its use is completed.

The 1,700-foot section of lane closure, shown along lane lines between the 1,000-foot lane closure tapers on the plans entitled "Traffic Control System for Lane Closures on Freeways and Expressways" and "Traffic Control System for Lane and Complete Closures on Freeways and Expressways" shall not be used.

The traffic cones shown to be placed transversely across closed traffic lanes and shoulders on the plans entitled "Traffic Control System for Lane Closures on Freeways and Expressways" and "Traffic Control System for Lane and Complete Closures on Freeways and Expressways" shall not be placed.

If components in the traffic control system are displaced or cease to operate or function as specified, from any cause, during the progress of the work, the Contractor shall immediately repair the components to the original condition or replace the components and shall restore the components to the original location.

When lane closures are made for work periods only, at the end of each work period, components of the traffic control system, except portable delineators placed along open trenches or excavation adjacent to the traveled way, shall be removed from the traveled way and shoulder. If the Contractor so elects, the components may be stored at selected central locations designated by the Engineer within the limits of the highway right of way.

The contract lump sum price paid for traffic control system shall include full compensation for furnishing all labor, materials (including signs), tools, equipment, and incidentals, and for doing all the work involved in placing, removing, storing, maintaining, moving to new locations, replacing, and disposing of the components of the traffic control system shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The adjustment provisions in Section 4-1.03, "Changes," of the Standard Specifications shall not apply to the item of traffic control system. Adjustments in compensation for traffic control system will be made only for increased or decreased traffic control system required by changes ordered by the Engineer and will be made on the basis of the cost of the increased or decreased traffic control necessary. The adjustment will be made on a force account basis as provided in Section 9-1.03, "Force Account Payment," of the Standard Specifications for increased work and estimated on the same basis in the case of decreased work.

Traffic control system required by work which is classed as extra work, as provided in Section 4-1.03D of the Standard Specifications, will be paid for as a part of the extra work.

10-1.39 BARRICADE

Barricades shall be furnished, placed and maintained at the locations shown on the plans, specified in the Standard Specifications or in these special provisions or where designated by the Engineer. Barricades shall conform to the provisions in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Attention is directed to "Prequalified and Tested Signing and Delineation Materials" of these special provisions regarding retroreflective sheeting for barricades.

Construction area sign and marker panels conforming to the provisions in Section 12-3.06, "Construction Area Signs," of the Standard Specifications shall be installed on barricades in a manner determined by the Engineer at the locations shown on the plans.

Sign panels for construction area signs and marker panels installed on barricades shall conform to the provisions in Section 12-3.06A, "Stationary Mounted Signs," of the Standard Specifications.

Full compensation for furnishing, installing, maintaining, and removing construction area signs and marker panels on barricades shall be considered as included in the contract unit price paid for the type of barricade involved and no separate payment will be made therefor.

Barricades shown on the plans as part of a traffic control system will be paid for as provided in "Traffic Control System for Lane Closure" of these special provisions and will not be included in the count for payment of barricades.

10-1.40 PORTABLE CHANGEABLE MESSAGE SIGNS

GENERAL

Summary

Work includes furnishing, placing, operating, maintaining, and removing portable changeable message signs.

Comply with Section 12-3.12 "Portable Changeable Message Signs," of the Standard Specifications.

Definitions

useable shoulder area: Paved or unpaved contiguous surface adjacent to the traveled way with:

1. Sufficient weight bearing capacity to support portable changeable message sign
2. Slope not greater than 6:1 (horizontal:vertical)

Submittals

Upon request, submit a Certificate of Compliance for each portable changeable message sign under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

Quality Control and Assurance

Comply with the manufacturer's operating instructions for portable changeable message sign.

Approaching drivers must be able to read the entire message for all phases at least twice at the posted speed limit before passing portable changeable message sign. You may use more than 1 portable changeable message sign to meet this requirement.

Only display the message shown on the plans or ordered by the Engineer or specified in these special provisions.

MATERIALS

Portable changeable message sign must have 24-hour timer control or remote control capability.

The text of the message displayed on portable changeable message sign must not scroll, or travel horizontally or vertically across the face of the message panel.

CONSTRUCTION

Continuously repeat the entire message in no more than 2 phases of at least 3 seconds per phase.

If useable shoulder area is at least 15 feet wide, the displayed message on portable changeable message sign must be minimum 18-inch character height. If useable shoulder area is less than 15 feet wide, you may use a smaller message panel with minimum 12-inch character height to prevent encroachment in the traveled way.

You or your representative must be available by cell phone for operations that require portable changeable message signs. Give the Engineer your cell phone number. When the Engineer contacts you, immediately comply with the Engineer's request to modify the displayed message.

Start displaying the message on portable changeable message sign 15 minutes before closing the lane.

Place portable changeable message sign in advance of the first warning sign for:

1. Each stationary lane closure
2. Each off-ramp closure
3. Each connector closure
4. Each shoulder closure
5. Each speed reduction zone

For 5 days starting on the day of signal activation, place 1 portable changeable message sign in each direction of travel and display the message, "SIGNAL AHEAD -- PREPARE TO STOP."

Place portable changeable message sign as far from the traveled way as practicable where it is legible to traffic and does not encroach on the traveled way. Place portable changeable sign before or at the crest of vertical roadway curvature where it is visible to approaching traffic. Avoid placing portable changeable message sign within or immediately after horizontal roadway curvature. Where possible, place portable changeable message sign behind guardrail or temporary railing (Type K).

Except where placed behind guardrail or temporary railing (Type K) use traffic control for shoulder closure to delineate portable changeable message sign.

Remove portable changeable message sign when not in use.

MEASUREMENT AND PAYMENT

The contract lump sum price paid for portable changeable message signs includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing, placing, operating, modifying messages, maintaining portable changeable message signs, complete in place, including transporting from location to location, removing, and repairing or replacing defective or damaged portable changeable message signs, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Portable changeable message signs ordered by the Engineer in excess of the number shown on the plans or specified in these special provisions will be paid for as extra work under Section 4-1.03D, "Extra Work," of the Standard Specifications.

10-1.41 TEMPORARY TRAFFIC SCREEN

Temporary traffic screen shall be furnished, installed, and maintained on top of temporary railing (Type K) at the locations designated on the plans, specified in the special provisions or directed by the Engineer and shall conform to the provisions specified for traffic handling equipment and devices in Section 12, "Construction Area Traffic Control Devices," of the Standard Specifications and these special provisions.

Temporary traffic screen panels shall be new or used CDX Grade, or better, plywood or weather resistant strandboard mounted and anchored on temporary railing (Type K). Wale boards shall be new or used Douglas fir, rough sawn, Construction Grade, or better. Pipe screen supports shall be new or used galvanized steel pipe, Schedule 40. Nuts, bolts, and washers shall be cadmium plated. Screws shall be black or cadmium plated flat head, cross slotted screws with full thread length.

When no longer required, as determined by the Engineer, temporary traffic screen shall be removed from the site of the work and shall become the property of the Contractor.

Temporary traffic screen will be measured by the linear foot from actual measurements along the line of the completed temporary traffic screen, at each location designated on the plans, specified or directed by the Engineer. If the Engineer orders a lateral move of temporary railing, with temporary traffic screen attached, and the repositioning is not shown on the plans, moving the temporary traffic screen will be paid for as part of the extra work for moving the temporary railing as specified in Section 12-4.01, "Measurement and Payment," of the Standard Specifications. Temporary traffic screen placed in excess of the length shown, specified or directed by the Engineer will not be paid for.

The contract price paid per linear foot for temporary traffic screen shall include full compensation for furnishing all labor, materials (including anchoring systems), tools, equipment, and incidentals, and for doing all the work involved in installing, maintaining, and removing the temporary traffic screen, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.42 TEMPORARY CRASH CUSHION MODULE

This work shall consist of furnishing, installing, and maintaining sand filled temporary crash cushion modules in groupings or arrays at each location shown on the plans, as specified in these special provisions or where designated by the Engineer. The grouping or array of sand filled modules shall form a complete sand filled temporary crash cushion in conformance with the details shown on the plans and these special provisions.

Temporary crash cushions shall be secured in place prior to commencing work for which the temporary crash cushions are required.

Whenever the work or the Contractor's operations establishes a fixed obstacle, the exposed fixed obstacle shall be protected with a sand filled temporary crash cushion. The sand filled temporary crash cushion shall be in place prior to opening the lanes adjacent to the fixed obstacle to public traffic.

Sand filled temporary crash cushions shall be maintained in place at each location, including times when work is not actively in progress. Sand filled temporary crash cushions may be removed during a work period for access to the work provided that the exposed fixed obstacle is 15 feet or more from a lane carrying public traffic and the temporary crash cushion is reset to protect the obstacle prior to the end of the work period in which the fixed obstacle was exposed. When no longer required, as determined by the Engineer, sand filled temporary crash cushions shall be removed from the site of the work.

Sand filled temporary crash cushion modules shall be one of the following, or equal, and be manufactured after March 31, 1997:

1. Energite III and Fitch Inertial Modules, manufactured by Energy Absorption Systems, Inc., 35 East Wacker Drive, Suite 1100, Chicago, IL 60601:

    1.1. Northern California: Traffic Control Service, Inc., 8585 Thys Court, Sacramento, CA 95828, telephone (800) 884-8274, FAX (916) 387-9734
    1.2. Southern California: Traffic Control Service, Inc., 1818 E. Orangethorpe, Fullerton, CA 92831-5324, telephone (800) 222-8274, FAX (714) 526-9501

2. TrafFix Sand Barrels, manufactured by TrafFix Devices, Inc., 220 Calle Pintoresco, San Clemente, CA 92672, telephone (949) 361-5663, FAX (949) 361-9205

    2.1. Northern California: United Rentals, Inc., 1533 Berger Drive, San Jose, CA 95112, telephone (408) 287-4303, FAX (408) 287-1929
    2.2. Southern California: Statewide Safety & Sign, Inc., P.O. Box 1440, Pismo Beach, CA 93448, telephone (800) 559-7080, FAX (805) 929-5786

3. CrashGard Model CC-48 Sand Barrels, manufactured by Plastic Safety Systems, Inc., 2444 Baldwin Road, Cleveland, OH 44104:

    3.1. Northern California:

        3.1.1. Capitol Barricade Safety & Sign, 6329 Elvas Ave, Sacramento, CA 95819, telephone (888) 868-5021, FAX (916) 451-5388
        3.1.2. Sierra Safety, Inc., 9093 Old State Highway, New Castle, CA 95658, telephone (916) 663-2026, FAX (916) 663-1858

    3.2. Southern California: Hi Way Safety Inc., 13310 5th Street, Chino, CA 91710, telephone (909) 591-1781, FAX (909) 627-0999

Modules contained in each temporary crash cushion shall be of the same type at each location. The color of the modules shall be the standard yellow color, as furnished by the vendor, with black lids. The modules shall exhibit good workmanship free from structural flaws and objectionable surface defects. The modules need not be new. Good used undamaged modules conforming to color and quality of the types specified herein may be utilized. If used Fitch modules requiring a seal are furnished, the top edge of the seal shall be securely fastened to the wall of the module by a continuous strip of heavy duty tape.

Modules shall be filled with sand in conformance with the manufacturer's directions, and to the sand capacity in pounds for each module shown on the plans. Sand for filling the modules shall be clean washed concrete sand of commercial quality. At the time of placing in the modules, the sand shall contain not more than 7 percent water as determined by California Test 226.

Modules damaged due to the Contractor's operations shall be repaired immediately by the Contractor at the Contractor's expense. Modules damaged beyond repair, as determined by the Engineer, due to the Contractor's operations shall be removed and replaced by the Contractor at the Contractor's expense.

Temporary crash cushion modules may be placed on movable pallets or frames. Comply with dimensions shown on the plans. The pallets or frames shall provide a full bearing base beneath the modules. The modules and supporting pallets or frames shall not be moved by sliding or skidding along the pavement or bridge deck.

A Type R or P marker panel shall be attached to the front of the crash cushion as shown on the plans, when the closest point of the crash cushion array is within 12 feet of the traveled way. The marker panel, when required, shall be firmly fastened to the crash cushion with commercial quality hardware or by other methods determined by the Engineer.

At the completion of the project, temporary crash cushion modules, sand filling, pallets or frames, and marker panels shall become the property of the Contractor and shall be removed from the site of the work. Temporary crash cushion modules shall not be installed in the permanent work.

Temporary crash cushion modules placed in conformance with Section 7-1.09, "Public Safety," of the Standard Specifications will not be measured nor paid for.

10-1.43 QUICKCHANGE MOVEABLE BARRIER SYSTEM

This work includes furnishing, installing, maintaining and removing the Quickchange Moveable Barrier System (QCMB), as shown on the plans and in conformance with the provisions in the Standard Specifications and these special provisions .

Attention is directed to "Order of Work" of these special provisions regarding furnishing the Engineer a statement from the vendor that the order for the Quickchange Moveable Barrier System has been received and accepted by the vendor.

Quickchange Moveable Barrier System (QCMB) shall be as manufactured by Barrier Systems, Inc. consisting of the following components:

A. Series 200 construction barrier consisting of heavily reinforced concrete barrier sections with special steel hinge system.
B. A transfer and transport machine (TTM) that moves the wall, with a backup machine available.
C. An ABSORB 350, Test Level 3 crash cushion.

Arrangements have been made with the manufacturer of the QCMB to insure that any successful bidder can lease the Quickchange Moveable Concrete Barrier and transfer and transport vehicle from the above named source. A materials information handout for the QCMB including the Absorb 350 is provided. The price quotations, not including sales tax, by the manufacturer for the Quickchange Moveable Barrier System including the ABSORB 350, Test Level 3 crash cushion, F.O.B. 180 River Road, Rio Vista, California 94571, telephone (707) 374-6800 is included in the supplemental information handout.

The Quickchange Moveable Barrier System shall be installed in accordance with the manufacturer's recommendations.

The Contractor shall furnish to the Engineer one copy of the manufacturer's plan and parts list for the model installed and training certificate for the operation of the transfer and transport machine (TTM).

Provide training on the operation of the TTM for 2 Department employees.

The Contractor shall provide the Engineer with the manufacturer's Certificate of Compliance in accordance with the provisions of Section 6-l.07, "Certificates of Compliance," of the Standard Specifications. The Certificate of Compliance shall certify that the system complies with the contract plans and specifications, conforms to the prequalified design and material requirements, and was manufactured in accordance with the approved quality control program.

Each length of barrier placed within 10 feet of a traffic lane shall have a reflector installed on top of the barrier. Reflectors on QCMB shall conform to the provisions in "Approved Traffic Products" for temporary railing (Type K) of these special provisions, and adhesive shall conform to the reflector manufacturer's recommendations. A marker panel shall also be installed at each end of the barrier installed adjacent to a two-lane, two-way highway and at the end facing traffic of barrier installed adjacent to a one-way roadbed. If the barrier is placed on a skew, the marker shall be installed at the end of the skew nearest the traveled way. Type P marker panels shall conform to the provisions in Section 82, "Markers and Delineators," of the Standard Specifications except that the Contractor shall furnish the marker panels.

After initial placement of Quickchange Moveable Barrier System, the Quickchange Moveable Barrier System shall be moved from location to location, as shown on the plans.

If the Engineer orders a move of the Quickchange Moveable Barrier System and the repositioning is not shown on the plans, moving the Quickchange Moveable Barrier System will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications and the Quickchange Moveable Barrier System will not be measured in the new position. Quickchange Moveable Barrier System placed in excess of the length shown, specified , or ordered will not be paid for.

If the Engineer orders a move of the Quickchange Moveable Barrier System and the TTM Operator is not on-site, the Contractor shall respond and be on-site within 1 hour.

COST BREAK-DOWN

The Contractor shall furnish the Engineer a cost break-down for the contract lump sum item of the Quickchange Moveable Barrier System. Cost break-down table shall be submitted to the Engineer for approval within 30 working days after the contract has been approved. Cost break-down table will be approved, in writing, by the Engineer before any partial payment will be made for the applicable items of the Quickchange Moveable Barrier System involved.

Attention is directed to "Time-Related Overhead" of these special provisions regarding compensation for time-related overhead.

The cost break-down shall be completed and furnished in the format shown in the sample of the cost break-down included in this section. Line item descriptions of work shown in the samples are the minimum to be submitted. Additional line item descriptions of work may be designated by the Contractor. If the Contractor elects to designate additional line item descriptions of work, the quantity, value and amount for those line items shall be completed in the same manner as for the unit descriptions shown in the sample. The line items and quantities given in the sample are to show the manner of preparing the cost break-down to be furnished by the Contractor.

The sum of the amounts for the line items of work listed in each cost break-down table for Quickchange Moveable Barrier System work shall be equal to the contract lump sum price bid for Quickchange Moveable Barrier System. Overhead and profit, except for time-related overhead, shall be included in each individual line item of work listed in a cost break-down table.

QUICKCHANGE MOVEABLE BARRIER SYSTEM COST BREAK-DOWN
Contract No. 04-163744

ITEM	ITEM DESCRIPTION	UNIT	APPROXIMATE QUANTITY	VALUE	AMOUNT
A	Series 200 Construction Barrier - Lease/Rental	LF	7000		
B	Series 200 Construction Barrier - Lease/Rental - Additional months	LF per Month			
C	QMB ABSORB 350 TL-3	EA	2		
D	QMB Barrier Transfer Machine (TTM) - Lease/Rental	EA	2		
E	QMB Barrier Transfer Machine (TTM) - Lease/Rental - Additional months	EA per Month			

TOTAL _____

No adjustment in compensation will be made in the contract lump sum prices paid for Quickchange Moveable Barrier System due to differences between the quantities shown in the cost break-down furnished by the Contractor and the quantities required to perform the work as shown on the plans and as specified in these special provisions.

Individual line item values in the approved cost break-down table will be used to determine partial payments during the progress of the work and as the basis for calculating an adjustment in compensation for the contract lump sum item of Quickchange Moveable Barrier System due to changes in line items of work ordered by the Engineer. When the total of ordered changes to line items of work increases or decreases the lump sum price bid for Quickchange Moveable Barrier System by more than 25 percent, the adjustment in compensation for the applicable lump sum item will be determined in the same manner specified for increases and decreases in the total pay quantity of an item of work in Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications.

PAYMENT

The contract lump sum price paid for Quickchange Moveable Barrier System , shall include full compensation for furnishing all labor, materials (including marker panels, the transfer and transport machine, the ABSORB 350 Test Level 3 crash cushion, and reflectors), tools, equipment, and incidentals, and for doing all work involved in furnishing, training personnel, delivering, installing, daily repositioning and removing the Quickchange Moveable Barrier System, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for daily repositioning, as shown on the plans, of the QMB shall be considered as included in the contract lump sum price for Quickchange Movable Barrier System and no additional compensation will be allowed therefor.

10-1.44 REMOVE YELLOW TRAFFIC STRIPE AND PAVEMENT MARKING (HAZARDOUS WASTE)

GENERAL

Summary

This work includes removing existing yellow thermoplastic and yellow painted traffic stripe and pavement marking at the locations shown on the plans. The residue from the removal of this material is a hazardous waste.

Residue from removal of yellow thermoplastic and yellow painted traffic stripe and pavement marking contains lead chromate. The average lead concentration is greater than or equal to 1000 mg/kg total lead or 5 mg/l soluble lead. When applied to the roadway, the yellow thermoplastic and yellow painted traffic stripe and pavement marking contained as much as 2.6 percent lead. Residue produced from the removal of this yellow thermoplastic and yellow painted traffic stripe and pavement marking contains heavy metals in concentrations that exceed thresholds established by the Health and Safety Code and 22 CA Code of Regs. For bidding purposes, assume that the residue is not regulated under the Federal Resource Conservation and Recovery Act (RCRA), 42 USC § 6901 et seq.. Yellow thermoplastic and yellow paint may produce toxic fumes when heated.

Submittals

Lead Compliance Plan: Submit a lead compliance plan under Section 7-1.07, "Lead Compliance Plan," of the Standard Specifications.

Work Plan: Submit a work plan for the removal, containment, storage, and disposal of yellow thermoplastic and yellow painted traffic stripe and pavement marking for acceptance not less than 15 days prior to the start of the removal operations. The work plan must include:

1. Objective of the operation
2. Removal equipment
3. Type of hazardous waste storage containers
4. Container storage location and how it will be secured
5. Hazardous waste sampling protocol and QA/QC requirements and procedures
6. Qualifications of sampling personnel
7. Analytical lab that will perform the analyses
8. Certification documentation of the hazardous waste hauler that will transport the hazardous waste
9. Disposal site that will accept the hazardous waste residue

The Engineer will review the work plan within 5 business days of receipt.

Do not perform work that generates hazardous waste residue until the work plan has been accepted by the Engineer. The Engineer's review and acceptance does not waive any contract requirements and does not relieve the Contractor from complying with Federal, State, and local laws, regulations, and requirements.

Correct any rejected work plan and resubmit a corrected work plan within 5 business days of notification by the Engineer; at which time a new review period of 5 business days will begin.

Analytical Test Results: Submit analytical test results of the residue from removal of yellow thermoplastic and yellow painted traffic stripe and pavement marking, including chain of custody documentation, for review and acceptance before:

1. Requesting the Engineer's signature on the waste profile requested by the disposal facility
2. Requesting the Engineer obtain an EPA ID no. for disposal
3. Removing the residue from the site

United States Environmental Protection Agency Identification Number Request: Submit a request for the U.S. EPA ID no. when the Engineer accepts analytical test results documenting that residue from removal of yellow thermoplastic and yellow painted traffic stripe and pavement marking is a hazardous waste.

Disposal Documentation: Submit receiving landfill documentation of proper disposal within 5 business days of residue transport from the project.

CONSTRUCTION

Where grinding or other approved methods are used to remove yellow thermoplastic and yellow painted traffic stripe and pavement marking that will produce a hazardous waste residue, the removed residue, including dust, must be contained and collected immediately. Use a HEPA filter-equipped vacuum attachment operated concurrently with the removal operations or other equally effective approved methods for collection of the residue.

Store hazardous waste residue in labeled and covered containers. Labels must comply with the provisions of 22 CA Code of Regs §§66262.31 and 66262.32. Mark labels with:

1. Date the hazardous waste is generated
2. The words "Hazardous Waste"
3. Composition and physical state of the hazardous waste (for example, asphalt grindings with thermoplastic or paint)
4. The word "Toxic"
5. Name, address, and telephone no. of the Engineer
6. Contract no.
7. Contractor or subcontractor name

Use metal containers approved by the U.S. Department of Transportation for the transportation and temporary storage of the removed residue. Handle the containers such that no spillage occurs. Store containers in a secured enclosure. Acceptable secure enclosures include a locked chain link fenced area or a lockable shipping container located within the project limits until disposal as approved.

Make necessary arrangements to test the yellow thermoplastic and yellow paint hazardous waste residue as required by the disposal facility and these special provisions. Testing must include, at a minimum:

1. Total lead by EPA Method 6010C
2. Total chromium by US EPA Method 7000 series
3. Soluble lead by California Waste Extraction Test
4. Soluble chromium by California Waste Extraction Test
5. Soluble lead by Toxicity Characteristic Leaching Procedure
6. Soluble chromium by Toxicity Characteristic Leaching Procedure

From the 1st 220 gallons of hazardous waste or portion thereof if less than 220 gallons of hazardous waste are produced, a minimum of 4 randomly selected samples must be taken and analyzed individually. Samples must not be composited. From each additional 880 gallons of hazardous waste or portion thereof if less than 880 gallons are produced, a minimum of 1 additional random sample must be taken and analyzed. Use chain of custody procedures consistent with Chapter 9 of U.S. EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) while transporting samples from the project to the laboratory. Each sample must be homogenized before analysis by the laboratory performing the analyses. A sample aliquot sufficient to cover the amount necessary for the total and the soluble analyses must then be taken. This aliquot must be homogenized a 2nd time and the total and soluble analyses run on this aliquot. The homogenization process must not include grinding of the samples. Submit the name and location of the disposal facility that will be accepting the hazardous waste and the analytical laboratory along with the testing requirements not less than 5 business days before the start of removal of yellow thermoplastic and yellow painted traffic stripe and pavement marking. The analytical laboratory must be certified by the CA Department of Public Health Environmental Laboratory Accreditation Program for all analyses to be performed.

After the Engineer accepts the analytical test results, dispose of yellow thermoplastic and yellow paint hazardous waste residue at a Class 1 disposal facility located in CA under the requirements of the disposal facility operator within 60 days after accumulating 220 pounds of residue and dust.

If less than 220 pounds of hazardous waste residue and dust is generated in total, it must be disposed of within 60 days after the start of accumulation of the residue and dust.

Use a hazardous waste manifest and a transporter registered with the CA Department of Toxic Substance Control. The Engineer will obtain the U.S. EPA ID no. and will sign all manifests as the generator within 2 business days of receiving and accepting the analytical test results and receiving your request for the U.S. EPA ID no.

If analytical test results demonstrate that the residue is a non–hazardous waste and the Engineer agrees, dispose of the residue at an appropriately permitted Class II or Class III facility under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

MEASUREMENT AND PAYMENT

The contract price paid per linear foot for remove yellow thermoplastic traffic stripe and remove yellow painted traffic stripe or per square foot for remove yellow thermoplastic pavement marking and remove yellow painted pavement marking includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all of the work involved in removal, containment, storage, and disposal, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for (1) work plan for the removal, containment, storage, and disposal of yellow thermoplastic and yellow painted traffic stripe and pavement marking hazardous waste residue, (2) analytical test results, (3) US EPA ID no. request, and (4) receiving landfill documentation of proper disposal are included in the contract prices paid per linear foot for remove yellow thermoplastic traffic stripe and remove yellow painted traffic stripe or per square foot for remove yellow thermoplastic pavement marking and remove yellow painted pavement marking and no separate payment will be made therefor.

Additional disposal costs for hazardous waste residue regulated under RCRA, as determined by test results, will be paid for as extra work as specified in Section 4-1.03D, "Extra Work," of the Standard Specifications.

If analytical test results demonstrate that the residue is a non–hazardous waste and the Engineer agrees to disposal at a non–hazardous waste disposal facility, no cost adjustment will be made.

10-1.45 TREATED WOOD WASTE

GENERAL

Summary

This work includes handling, storing, transporting, and disposing of treated wood waste.

Wood removed from roadside sign is treated with one or more of the following:

1. Creosote
2. Pentachlorophenol
3. Copper azole
4. Copper boron azole
5. Chromated copper arsenate
6. Ammoniacal copper zinc arsenate
7. Copper naphthenate
8. Alkaline copper quaternary

Manage treated wood waste under Title 22 CA Code of Regulations, Division 4.5, Chapter 34.

Submittals

For disposal of treated wood waste submit a copy of each completed shipping record and weight receipt to the Engineer within 5 business days of disposal.

CONSTRUCTION

Provide training to personnel who handle treated wood waste or may come in contact with treated wood waste that includes:

1. All applicable requirements of Title 8 CA Code of Regulations
2. Procedures for identifying and segregating treated wood waste
3. Safe handling practices
4. Requirements of Title 22 CA Code of Regulations, Division 4.5, Chapter 34
5. Proper disposal methods

Store treated wood waste before disposal using any of the following methods:

1. Elevate on blocks above a reasonably foreseeable run-on elevation and protect from precipitation
2. Place in water-resistant containers designed for shipping or solid waste collection
3. Place on a containment surface protected from run-on and precipitation

Prevent unauthorized access to treated wood waste using a secured enclosure such as a locked chain link fenced area or a lockable shipping container located within the project limits.

Resize and segregate treated wood waste at a location where debris from the operation including sawdust and chips can be contained. Collect and manage the debris as treated wood waste.

Provide water-resistant labels, that comply with Title 22 CA Code of Regulations, Division 4.5, Chapter 34, § 67386.5,. to clearly mark and identify treated wood waste and accumulation areas. Labels must include:

1. Caltrans, District number, Construction, contract number
2. District office address
3. Engineer's name, address, and telephone number
4. Contractor's contact name and telephone number

Before transporting treated wood waste, obtain agreement from the receiving facility that the treated wood waste will be accepted. Protect shipments of treated wood waste from loss and exposure to precipitation. Request a generator identification number from the Engineer at least 5 business days before the first shipment. Each shipment must be accompanied by a shipping record such as a manifest or bill of lading that includes:

1. Caltrans with district number
2. Construction contract number
3. District office address
4. Engineer name, address, and telephone number
5. Contractor contact name and telephone number
6. Receiving facility name and address
7. Waste description: Treated wood waste (preservative type if known or unknown/mixture)
8. Project location
9. Estimated quantity of shipment by weight or volume
10. Date of transport
11. Date of receipt by the receiving treated wood waste facility
12. Weight of shipment as measured by the receiving treated wood waste facility
13. Generator identification number

The shipping record must be at least a 4-part carbon or carbonless 8-1/2" x 11" form to allow retention of copies by the Engineer, transporter, and disposal facility.

Dispose of treated wood waste in an approved treated wood waste facility. A list of currently approved treated wood waste facilities may be viewed at:

http://www.dtsc.ca.gov/HazardousWaste/upload/TWW_Confirmed_Landfill_List.pdf

Dispose of treated wood waste within:

1. 90 days of generation if stored on blocks
2. 90 days of filling a container if containerized
3. 180 days of generation if stored on a containment surface

MEASUREMENT AND PAYMENT

Full compensation for handling, storing, transporting, and disposing treated wood waste, including personnel training, is included in the contract unit price paid for remove roadside sign and no additional compensation will be allowed therefor.

10-1.46 EXISTING HIGHWAY FACILITIES

The work performed in connection with various existing highway facilities shall conform to the provisions in Section 15, "Existing Highway Facilities," of the Standard Specifications and these special provisions.

Attention is directed to Section 7-1.06, "Safety and Health Provisions," of the Standard Specifications. Work practices and worker health and safety shall conform to the California Division of Occupational Safety and Health Construction Safety Orders Title 8, of the California Code of Regulations including Section 5158, "Other Confined Space Operations."

EARTH MATERIAL CONTAINING LEAD

General

This work includes handling earth material containing lead under the Standard Specifications and these special provisions.

Submittals

Submit a lead compliance plan under Section 7-1.07, "Lead Compliance Plan," of the Standard Specifications.

Project Conditions

Lead is present in earth material within the project limits at average concentrations below 1,000 mg/kg total lead and below 5 mg/l soluble lead. Earth material within the project limits:

1. Is not a hazardous waste
2. Does not require disposal at a permitted landfill or solid waste disposal facility

Lead has been detected in earth material in unpaved areas of the highway. Levels of lead found within the project limits range from less than 2.2 to 320 mg/kg total lead with an average concentration of 65 mg/kg total lead as analyzed by EPA Test Method 6010 or EPA Test Method 7000 series and based upon a 95% Upper Confidence Limit. Levels of lead found within the project limits have a predicted average soluble concentration of 2.6 mg/l as analyzed by the California Waste Extraction Test and based upon a 95% Upper Confidence Limit.

Construction

Handle earth material containing lead under all applicable laws, rules, and regulations, including those of the following agencies:

1. Cal/OSHA
2. CA Regional Water Quality Control Board, Region 2 – San Francisco Bay
3. CA Department of Toxic Substances Control

Manage earth material as shown in the following table.

Earth Material Management

Location	Depth	Management requirements
SB 64+82 to 87+21	Excavation limit	Dispose of outside State right of way
MN 52+50 to 59+80	Excavation limit	Dispose of outside State right of way
DN 48+00 to D 89+22	Excavation limit	Dispose of outside State right of way

If earth material is disposed of:

1. Dispose of under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way, " of the Standard Specifications
2. Disclose the lead concentration of the earth material to the receiving property owner when obtaining authorization for disposal on the property
3. Obtain the receiving property owner's acknowledgment of lead concentration disclosure in the written authorization for disposal
4. You are responsible for any additional sampling and analysis required by the receiving property owner

If you choose to dispose of earth material at a commercial landfill:

1. Transport it to a Class III or Class II landfill appropriately permitted to receive the material
2. You are responsible for identifying the appropriately permitted landfill to receive the earth material and for all associated trucking and disposal costs including any additional sampling and analysis required by the receiving landfill.

Measurement and Payment

Full compensation for handling earth material containing lead is included in the contract items of work involved, and no additional compensation will be allowed therefor.

ABANDON MANHOLE

Existing manholes, where shown on the plans to be abandoned, shall be abandoned.

Frames and covers shall be removed and reused in the work as shown on the plans.

Full compensation for removing and reusing frames and covers shall be considered as included in the contract price paid for the item of work requiring reuse of the frame and cover.

Frames and covers shall be salvaged. Full compensation for salvaging existing frames and covers shall be considered as included in the contract unit price paid for abandon manhole and no separate payment will be made therefor.

ABANDON CULVERT

Existing culverts, where shown on the plans to be abandoned, shall be abandoned in place or, at the option of the Contractor, the culverts shall be removed and disposed of. Resulting openings into existing structures that are to remain in place shall be plugged with concrete conforming to the provisions in Section 90-10 "Minor Concrete," of the Standard Specifications. The concrete shall contain not less than 505 pounds of cementitious material per cubic yard.

Abandoning culverts in place shall conform to the following:

1. Culverts that intersect the side slopes shall be removed to a depth of not less than 3 feet measured normal to the plane of the finished side slope, before being abandoned.
2. Culverts 12 inches in diameter and larger, shall, at the Contractor's option, be backfilled with either sand, controlled low strength material or slurry cement backfill conforming to the provisions in Section 19-3.062, "Slurry Cement Backfill," of the Standard Specifications by any method acceptable to the Engineer that completely fills the pipe. Sand backfill material shall be clean, free draining, and free from roots and other deleterious substances.
3. The ends of culverts shall be securely closed by a 0.5-foot thick tight fitting plug or wall of commercial quality concrete.

Culverts shall not be abandoned until their use is no longer required. The Contractor shall notify the Engineer in advance of any intended culvert abandonment.

If the Contractor elects to remove and dispose of a culvert which is specified to be abandoned, as provided herein, backfill specified for the pipe will be measured and paid for in the same manner as if the culvert has been abandoned in place.

Backfill will be measured by the cubic yard determined from the dimensions of the culverts to be abandoned.

The contract price paid per cubic yard for sand backfill shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in backfilling culverts and pipelines with sand, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Controlled low strength material and slurry cement backfill, if used at the Contractor's option, will be measured and paid for by the cubic yard as sand backfill.

Full compensation for concrete plugs, pipe removal, structure excavation, and backfill shall be considered as included in the contract price paid per linear foot for abandon culvert and no additional compensation will be allowed therefor.

ABANDON INLET

Existing pipe inlets and concrete drainage inlets, where shown on the plans to be abandoned, shall be abandoned.

The top portion of the inlets shall be removed to a depth of 3 feet below finished grade.

Removed frames and grates shall be disposed of.

REMOVE SIGN STRUCTURE

Existing sign structures, where shown on the plans to be removed, shall be removed and disposed of.

Overhead sign structure removal shall consist of removing posts, frames, portions of foundations, sign panels, walkways with safety railings, and sign lighting electrical equipment.

A sign structure shall not be removed until the structure is no longer required for the direction of public traffic.

Concrete foundations may be abandoned in place, except that the top portion, including anchor bolts, reinforcing steel, and conduits shall be removed to a depth of not less than 3 feet below the adjacent finished grade. The resulting holes shall be backfilled and compacted with material equivalent to the surrounding material.

Electrical wiring shall be removed to the nearest pull box. Fuses within spliced connections in the pull box shall be removed and disposed of.

Electrical equipment, where shown on the plans, shall be salvaged.

REMOVE PAVEMENT MARKER

Existing pavement markers, including underlying adhesive, when no longer required for traffic lane delineation as determined by the Engineer, shall be removed and disposed of.

REMOVE TRAFFIC STRIPE AND PAVEMENT MARKING

This work includes removing existing traffic stripe and pavement marking at the locations shown on the plans.

Submit a lead compliance plan under Section 7-1.07, "Lead Compliance Plan," of the Standard Specifications.

Waste residue from removal of thermoplastic and painted traffic stripe and pavement marking is a non–hazardous waste residue and contains lead in average concentrations less than 1000 mg/kg total lead and 5 mg/L soluble lead. This waste residue does not contain heavy metals in concentrations that exceed thresholds established by the Health and Safety Code and 22 CA Code of Regs and is not regulated under the Federal Resource Conservation and Recovery Act (RCRA), 42 USC § 6901 et seq.

REMOVE DRAINAGE FACILITY

Existing box culverts, culverts, manholes, inlets, headwalls and endwalls, where any portion of these structures is within 3 feet of the grading plane in excavation areas, or within one foot of original ground in embankment areas, or where shown on the plans to be removed, shall be completely removed and disposed of.

REMOVE ROADSIDE SIGN

Existing roadside signs, at those locations shown on the plans to be removed, shall be removed and disposed of.

Existing roadside signs shall not be removed until replacement signs have been installed or until the existing signs are no longer required for the direction of public traffic, unless otherwise directed by the Engineer.

ADJUST INLET

Existing pipe inlets and concrete drainage inlets shall be adjusted as shown on the plans.

Concrete shall be minor concrete conforming to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications. The concrete shall contain not less than 590 pounds of cementitious material per cubic yard.

Adjustment of inlets shall be performed before paving and shall be limited to the area to be paved or surfaced during the working day in which the adjustment is performed. The top of the inlet grate or cover shall be protected from the hot mix asphalt during paving operations by means of heavy plywood covers, steel plate covers or by other methods approved by the Engineer. Excess paving material shall be removed before rolling.

Where inlets are located in areas to be paved or surfaced, no individual structure shall be constructed to final grade until the paving or surfacing has been completed immediately adjacent to the structure.

Adjust inlets will be measured by the linear foot. The quantity to be paid for will be the difference in linear foot between the top of the existing inlet and the top of the adjusted inlet.

The contract price paid per linear foot for adjust inlet shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in adjusting inlets, including removing portions of inlets, bar reinforcing steel, concrete and structure excavation and structure backfill, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

COLD PLANE ASPHALT CONCRETE PAVEMENT

GENERAL

Summary

This work includes cold planing existing asphalt concrete pavement.

Sequencing and Scheduling

Schedule cold planing activities to ensure hot mix asphalt (HMA) is placed over cold planed area during the same work shift before opening to traffic. If you cannot place HMA over the entire cold planed area before opening it to traffic:

1. Construct a temporary HMA taper to the level of the existing pavement.
2. Place HMA during the next lane or shoulder closure for that area.
3. Submit a corrective action plan that shows that you are able to cold plane and place HMA in the same work shift. Do not perform cold planing work until the Engineer approves the corrective action plan.

Schedule cold planing activities so that not more than 24 hours elapses between the time the pavement is cold planed and the HMA is placed.

MATERIALS

HMA for temporary tapers must be of the same quality as the HMA used elsewhere on the project or comply with "Minor Hot Mix Asphalt" of these special provisions.

CONSTRUCTION

General

Perform planing of asphalt concrete pavement without the use of a heating device to soften the pavement.

Cold Planing Equipment

Cold planing machine must be:

1. Equipped with a cutter head width that matches the planing width. If the only available cutter head width is wider than the cold plane area shown, submit to the Engineer a request for using a wider cutter head. Do not cold plane until the Engineer approves your request.
2. Equipped with automatic controls to control the longitudinal grade and transverse slope of the cutter head and:

    2.1. If a ski device is used, it must be at least 30 feet long, rigid, and 1 piece unit. The entire length must be used in activating the sensor.
    2.2. If referencing from existing pavement, the cold planing machine must be controlled by a self-contained grade reference system. The system must be used at or near the centerline of the roadway. On the adjacent pass with the cold planing machine, a joint matching shoe may be used.

3. Equipped to effectively control dust generated by the planing operation.
4. Operated so that no fumes or smoke is produced.

Replace broken, missing, or worn machine teeth.

Grade Control and Surface Smoothness

Furnish, install, and maintain grade and transverse slope references.

The depth, length, width, and shape of the cut must be as shown or as ordered. The final cut must result in a neat and uniform surface. Do not damage remaining surface.

The completed surface of the planed asphalt concrete pavement must not vary more than 0.02 foot when measured with a 12-foot straightedge parallel with the centerline. The transverse slope of the planed surface must not vary more than 0.03 foot from the straightedge when placed at right angles to the centerline.

A drop-off of more than 0.15 foot is not allowed between adjacent lanes open to public traffic.

Temporary HMA Tapers

If a drop-off between the existing pavement and the planed area at transverse joints cannot be avoided before opening to traffic, construct a temporary HMA taper. HMA for temporary taper must be:

1. Placed to the level of the existing pavement and tapered on a slope of 30:1 (Horizontal: Vertical) or flatter to the level of the planed area
2. Compacted by any method that will produce a smooth riding surface
3. Completely removed before placing the permanent surfacing. The removed material must be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Disposal of Planed Material

Remove cold planed material concurrent with planing activities, within 50 feet of the planer or as ordered.

Dispose of planed material and under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Cold plane asphalt concrete pavement is measured by the square yard.

The contract price paid per square yard for cold plane asphalt concrete pavement includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in cold planing asphalt concrete surfacing and disposing of planed material, including constructing, maintaining, removing temporary HMA tapers if applicable, as specified in the Standard Specifications and these special provisions and as directed by the Engineer.

Full compensation for removal of thermoplastic traffic stripe, painted traffic stripe, and pavement marking in areas of cold plane asphalt concrete is included in the contract price paid for cold plane asphalt concrete and no separate payment will be made therefor.

CAP INLET AND MANHOLE

Existing manholes and concrete drainage inlets, where shown on the plans to be capped, shall be capped and the bottoms of the inlets or manholes shall be rounded with portland cement concrete as shown on the plans.

Concrete shall be minor concrete conforming to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications. The concrete shall contain not less than 590 pounds of cementitious material per cubic yard.

Inlets and manholes shall be removed to a depth of at least one foot below the grading plane.

Concrete removal shall be performed without damage to portions of the inlet or manhole that are to remain in place. Damage to existing concrete, which is to remain in place, shall be repaired by the Contractor to a condition equal to that existing prior to the beginning of removal operations. The repair of existing concrete damaged by the Contractor's operations shall be at the Contractor's expense.

Existing reinforcement that is to be incorporated in the new work shall be protected from damage and shall be thoroughly cleaned of adhering material before being embedded in the new concrete.

The quantity of capping inlets or manhole will be determined as units from actual count.

The contract unit price paid for cap inlet shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in capping inlets, including removing portions of inlets, rounding bottoms of inlets, bar reinforcing steel, and structure excavation and structure backfill, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract unit price paid for cap manhole shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in capping manholes, including removing portions of manholes, rounding bottoms of manholes, bar reinforcing steel, and structure excavation and structure backfill, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

BRIDGE REMOVAL

Removing bridges shall conform to the provisions in Section 15-4, "Bridge Removal," of the Standard Specifications and these special provisions.

The following bridge structure shall be removed in two stages in conformance with the limits shown on the plans:

MARINA VIADUCT
(Bridge No. 34-0014)

A multi-span main structure with ramps consisting of reinforced concrete T-beam superstructures supported on spread footings. Portions of the structure underneath the temporary detour shall remain in place and will be removed in future contracts.

Removed materials that are not to be salvaged or used in the reconstruction shall become the property of the Contractor and shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

The Contractor shall submit a complete bridge removal plan to the Engineer for each stage of bridge removal shown on the plans, detailing procedures, sequences, and all features required to perform the removal in a safe and controlled manner.

The bridge removal plan shall include, but not be limited to, the following:

A. The removal sequence, including staging of removal operations.
B. Equipment locations on the structure during removal operations.
C. Temporary support shoring or temporary bracing.

D. Locations where work is to be performed over traffic or utilities.
E. Details, locations, and types of protective covers to be used.
F. Measures to assure that people, property, utilities, and improvements will not be endangered.
G. Details and measures for preventing material, equipment, and debris from falling onto public traffic.

When protective covers are required for removal of portions of a bridge or when superstructure removal work on bridges is involved, the Contractor shall submit working drawings with design calculations to the Engineer for the proposed bridge removal plan, and the bridge removal plan shall be prepared and signed by an engineer who is registered as a Civil Engineer in the State of California. The design calculations shall be adequate to demonstrate the stability of the structure during all stages of the removal operations. Calculations shall be provided for each stage of bridge removal and shall include dead and live load values assumed in the design of protective covers. At a minimum, a stage will be considered to be removal of the deck, or the girders, in any span; or walls, bent caps, or columns at support locations.

Temporary support shoring, temporary bracing, and protective covers, as required, shall be designed and constructed in conformance with the provisions in Section 51-1.06, "Falsework," of the Standard Specifications and these special provisions.

The assumed horizontal load to be resisted by the temporary support shoring and temporary bracing, for removal operations only, shall be the sum of the actual horizontal loads due to equipment, construction sequence, or other causes and an allowance for wind, but in no case shall the assumed horizontal load to be resisted in any direction be less than 5 percent of the total dead load of the structure to be removed.

The bridge removal plan shall conform to the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The number of sets of drawings, design calculations, and unless otherwise specified in the following table, the time for reviewing bridge removal plans shall be the same as specified for falsework working drawings in Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications.

The time to be provided for the Engineer's review of the bridge removal plans for removing specific structures, or portions thereof, shall be as follows:

Structure or Portion of Structure	Review Time - Weeks
Stage 1 Removal	6
Stage 2 Removal	6

For bridge removal work that requires the Contractor's registered engineer to prepare and sign the bridge removal plan, the Contractor's registered engineer shall be present at all times when bridge removal operations are in progress. The Contractor's registered engineer shall inspect the bridge removal operation and report in writing on a daily basis the progress of the operation and the status of the remaining structure. A copy of the daily report shall be available at the site of the work at all times. Should an unplanned event occur or the bridge operation deviate from the approved bridge removal plan, the Contractor's registered engineer shall submit immediately to the Engineer for approval the procedure of operation proposed to correct or remedy the occurrence.

10-1.47 CLEARING AND GRUBBING

Clearing and grubbing shall conform to the provisions in Section 16, "Clearing and Grubbing," of the Standard Specifications and these special provisions.

Vegetation shall be cleared and grubbed only within the excavation and embankment slope lines.

10-1.48 WATERING

Developing a water supply and applying watering shall conform to the provisions in Section 17, "Watering," of the Standard Specifications and these special provisions.

Attention is directed to "Beginning of Work, Time of Completion and Liquidated Damages" of these special provisions regarding availability of water.

10-1.49 EARTHWORK

Earthwork shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications and these special provisions.

Rock excavation shall conform to the requirements specified in "Rock Excavation (Controlled Blasting)," of these special provisions.

At the Contractor's option, controlled blasting methods may be used for structure excavation (rock) at Southbound Battery Tunnel (Bridge No. 34-0161L). If used, controlled blasting methods shall conform to "Rock Excavation (Controlled Blasting)" of these special provisions.

Quantities of slurry cement to be paid as structure backfill (slurry cement) will be determined from the limits shown on the plans with the deduction of volumes taken by the utility conduits.

Where shoring and temporary wall bracing system design and construction are required as shown on the plans, the Contractor shall design and construct the shoring system in conformance with the provisions in Section 19-1.02, "Preservation of Property," of the Standard Specifications.

When a layer of specified material is not to be placed on the basement material, the finished grading plane shall not vary more than 0.10-foot above or below the grade established by the Engineer. The requirements for obtaining a relative compaction of 95 percent, as provided in the first 2 paragraphs in Section 19-5.03, "Relative Compaction (95 Percent)," of the Standard Specifications shall not apply when a layer of specified material is not to be placed on the basement material.

When concrete pavement is to be placed on the grading plane, the grading plane shall not extend above the grade established by the Engineer.

The grading plane of embankments beneath structure approach slabs and beneath the thickened portion of sleeper slabs shall not project above the grade established by the Engineer.

Surplus excavated material shall become the property of the Contractor and shall be handled and disposed of in conformance with the provisions in "Earth Material Containing Lead" of these special provisions.

All excavated materials shall be surplus materials.

Where a portion of the existing surfacing is to be removed, the outline of the area to be removed shall be cut on a neat line with a power-driven saw to a minimum depth of 0.17-foot before removing the surfacing. Full compensation for cutting the existing surfacing shall be considered as included in the contract price paid per cubic yard for roadway excavation and no additional compensation will be allowed therefor.

The portion of imported borrow placed within 4 feet of the finished grade shall have a Resistance (R-Value) of not less than 15.

Reinforcement or metal attached to reinforced concrete rubble placed in embankments shall not protrude above the grading plane. Prior to placement within 2 feet below the grading plane of embankments, reinforcement or metal shall be trimmed to no greater than 3/4 inch from the face of reinforced concrete rubble. Full compensation for trimming reinforcement or metal shall be considered as included in the contract prices paid per cubic yard for the types of excavation shown in the Engineer's estimate, or the contract prices paid for furnishing and placing imported borrow or embankment material, as the case may be, and no additional compensation will be allowed therefor.

Imported borrow shall be mineral material including rock, sand, gravel, or earth. The Contractor shall not use man-made refuse in imported borrow including:

A. Portland cement concrete
B. Asphalt concrete
C. Hot mix asphalt
D. Material planed from roadway surfaces
E. Residue from grooving or grinding operations
F. Metal
G. Rubber
H. Mixed debris
I. Rubble

The Contractor shall construct geocomposite drain at the following locations:

A. Southbound Battery Tunnel, the geocomposite drain shall include geocomposite drain panels between the soldier piles, filter fabric, drain pipes, and drain connectors, and above the lean concrete base at the tunnel roof slab as shown on the plans.
B. Retaining Wall A and B, the geocomposite drain shall include geocomposite drain filter fabric, and 4" perforated PVC pipes that are wrapped with geocomposite drains with end caps and elbows.
C. Retaining Wall No. 8: the geocomposite drain system shall include geocomposite drain, 3" slotted and unslotted plastic pipes, cement treated permeable base, polyethylene sheet bonded to geocomposite drain, and 4" weepholes.
D. Battery Substation (Bridge): the geocomposite drain system shall include geocomposite drain, 3" slotted plastic pipes, filter fabric, and treated permeable base.

The geocomposite drain shall conform to the details shown on the plans and the following except that treated permeable base will not be required for Southbound Battery Tunnel subdrain system:

A. Geocomposite wall drain shall consist of a manufactured core not less than 7/16-inch thick nor more than 2 inches thick with one or both sides covered with a layer of filter fabric that will provide a drainage void. The drain shall produce a flow rate through the drainage void of at least 10 gallons per minute per foot of width at a hydraulic gradient of 1.0 and a minimum externally applied pressure of 10,000 psf.
B. A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications shall be furnished for the geocomposite drain certifying that the drain produces the required flow rate and complies with these special provisions. The Certificate of Compliance shall be accompanied by a flow capability graph for the geocomposite drain showing flow rates for externally applied pressures and hydraulic gradients. The flow capability graph shall be stamped with the verification of an independent testing laboratory.
C. Filter fabric for geocomposite wall drain shall conform to the provisions in Section 88-1.02, "Filtration," of the Standard Specifications. Filter fabric shall be Class A.
D. The manufactured core shall be either a preformed grid of embossed plastic, a mat of random shapes of plastic fibers, a drainage net consisting of a uniform pattern of polymeric strands forming 2 sets of continuous flow channels, or a system of plastic pillars and interconnections forming a semirigid mat.
E. The core material and filter fabric shall be capable of maintaining the drainage void for the entire height of geocomposite drain. Filter fabric shall be integrally bonded to the side of the core material with the drainage void. Core material manufactured from impermeable plastic sheeting having nonconnecting corrugations shall be placed with the corrugations approximately perpendicular to the drainage collection system. The minimum compressive strength of the core material shall be 10,000 psf.
F. The geocomposite drain shall be installed with the drainage void and the filter fabric facing the embankment. The fabric facing the embankment side shall overlap a minimum of 3 inches at all joints and wrap around the exterior edges a minimum of 3 inches beyond the exterior edge. If additional fabric is needed to provide overlap at joints and wrap-around at edges, the added fabric shall overlap the fabric on the geocomposite drain at least 6 inches and be attached thereto.
G. Should the fabric on the geocomposite drain be torn or punctured, the damaged section shall be replaced completely or repaired by placing a piece of fabric that is large enough to cover the damaged area and provide a minimum 6-inch overlap.
H. High Density Polyethylene perforated pipe for the subdrain piping shall conform to AASHTO M252.
I. Treated permeable base to be placed around the slotted plastic pipe at the bottom of the geocomposite drain shall be cement treated permeable base conforming to the provisions for cement treated permeable base in Section 29, "Treated Permeable Bases," of the Standard Specifications and these special provisions.
J. The treated permeable base shall be enclosed with a high density polyethylene sheet or PVC geomembrane, not less than 10 mils thick, that is bonded with a suitable adhesive to the concrete and geocomposite drain. Surfaces to receive the polyethylene sheet shall be cleaned before applying the adhesive. The treated permeable base shall be compacted with a vibrating shoe type compactor.

SOLDIER PILE WALL EARTHWORK

General

The Contractor shall submit to the Engineer working drawings, including design calculations, and a construction sequence for the proposed method of soldier pile wall construction for the site in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The drawings and calculations shall be signed by an engineer who is registered as a Civil Engineer in the State of California. One set of the drawings and construction sequence, and one copy of the design calculations, shall be furnished to the Engineer. The working drawings and construction sequence shall include, but not be limited to, defining order of work, traffic control, method of installation of soldier piles, method of placing lagging, limits of structure excavation lifts, and type of drilling and excavation equipment to be used. The Contractor shall allow 7 days after complete drawings and support data are submitted for the review and approval of the proposed method of soldier pile wall construction.

Structure Excavation (Soldier Pile Wall)

Excavation and construction of the soldier pile wall shall proceed in lifts from the top down.

Care shall be taken in performing structure excavation (soldier pile wall) for placement of lagging such that a minimal void behind the lagging is required to be backfilled.

Excavation in front of the soldier pile wall shall not extend more than 3 feet below any level of tiebacks that has not been stressed and grouted or any level of bracing that has not been installed.

At the end of the work shift, lagging shall be in place the full height of the exposed excavation face.

Structure Backfill (Soldier Pile Wall)

Material for structure backfill behind lagging shall conform to the provisions in Section 19-3, "Structure Excavation and Backfill," of the Standard Specifications. Structure backfill behind lagging shall be compacted by hand tamping, mechanical compaction, or other means approved by the Engineer.

Structure backfill in fill areas behind the lagging shall be keyed into the existing or excavated back slope.

Backfill behind the lagging shall be in place and compacted to at least 4 ft above the level of the tiebacks prior to drilling for the tiebacks. The remainder of the backfill behind the lagging shall be placed and compacted after tiebacks are drilled, stressed, and grouted.

Lean Concrete Backfill

Lean concrete backfill shall conform to the provisions for slurry cement backfill in Section 19-3.062, "Slurry Cement Backfill," of the Standard Specifications, except that aggregate shall be sand suitable for making commercial quality concrete.

Lean concrete backfill in the portions of the drilled holes occupied by lagging and in front of the soldier pile flanges shall be removed as necessary to install lagging.

Concrete Backfill

Concrete backfill encasing the steel soldier piles shall contain not less than 505 pounds of cementitious material per cubic yard and shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and these special provisions.

TIEBACK WALL EARTHWORK

General

The Contractor shall submit to the Engineer working drawings, including design calculations, and a construction sequence for the proposed method of tieback wall construction for the site in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The drawings and calculations shall be signed by an engineer who is registered as a Civil Engineer in the State of California. One set of the drawings and construction sequence, and one copy of the design calculations, shall be furnished to the Engineer. The working drawings and construction sequence shall include, but not be limited to, defining order of work, traffic control, method of installation of CIDH concrete piles, limits of structure excavation lifts, and type of drilling and excavation equipment to be used. The Contractor shall allow 7 days after complete drawings and support data are submitted for the review and approval of the proposed method of soldier pile wall construction.

Structure Excavation (Tieback Wall)

Excavation and construction of the tieback wall shall proceed in lifts from the top down.

Excavation in front of the tieback wall shall not extend more than 3 feet below any level of tiebacks that has not been stressed and grouted.

MEASUREMENT AND PAYMENT

If structure excavation or structure backfill for tunnel and retaining walls is not otherwise designated by type and payment for the structure excavation or structure backfill has not otherwise been provided for in the Standard Specifications or these special provisions, the structure excavation or structure backfill will be measured and paid for as structure excavation (retaining wall) or structure backfill (retaining wall), respectively.

If structure excavation or structure backfill for bridges is not otherwise designated by type and payment for the structure excavation or structure backfill has not otherwise been provided for in the Standard Specifications or these special provisions, the structure excavation or structure backfill will be measured and paid for as structure excavation (bridge) or structure backfill (bridge), respectively.

If the Contractor chooses to use controlled blasting methods for structure excavation (rock) at Southbound Battery Tunnel (Bridge No. 34-0161L), then full compensation for all the work involved shall be considered as included in the contract price paid per cubic yard for structure excavation (rock) and no additional compensation will be allowed therefor.

Lean concrete backfill at Retaining Wall A and B will be measured and paid for by the cubic yard as lean concrete backfill in the same manner specified for structure backfill in Section 19-3.07, "Measurement," and Section 19-3.08, "Payment," of the Standard Specifications.

Full compensation for lean concrete backfill at Retaining No. 8 is included in the contract price paid per linear foot for steel soldier piles of the sizes as listed in the Engineer's Estimate and no separate payment will be made therefor.

Concrete backfill encasing steel soldier piles will be measured and paid for by the cubic yard as concrete backfill in the same manner specified for structure backfill in Section 19-3.07, "Measurement," and Section 19-3.08, "Payment," of the Standard Specifications.

Full compensation for removing lean concrete backfill and concrete backfill shall be considered as included in the contract price paid per cubic yard for structure excavation (soldier pile wall) and no additional compensation will be allowed therefor.

Full compensation for working drawings and construction sequence, and temporary supports and shoring, if required, for soldier pile wall construction shall be considered as included in the contract price paid per cubic yard for structure excavation (soldier pile wall) and no additional compensation will be allowed therefor.

Full compensation for shoring and temporary wall bracing system design and construction is included in the contract prices paid per cubic yard for structure excavation of types listed in the Engineer's Estimate, and no separate payment will be made therefor.

The contract price paid per square foot for geocomposite drain includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in geocomposite drain in all locations, complete in place, including filter fabric, drain pipes, drain connectors, PVC pipes that are wrapped with geocomposite drains, end caps and elbows, plastic pipes, cement treated permeable base, polyethylene sheet bonded to geocomposite drain, and weepholes, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for furnishing and installing the geocomposite drainage system at Battery Substation (Bridge) is included in the contract price paid per cubic yard for structure backfill (bridge), and no additional compensation will be allowed therefor.

10-1.50 ROCK EXCAVATION (CONTROLLED BLASTING)

GENERAL

Summary

This work includes using hydraulic splitters, pneumatic hammers, controlled blasting, or other roadway excavation techniques approved by the Engineer to fracture rock and construct stable final rock cut faces.

Comply with Section 19, "Earthwork," of the Standard Specifications and "Traffic Control," "Vibration Monitoring," and "Survey of Existing Non-Highway Facilities" of these special provisions.

Blasting to perform rock excavation must be controlled blasting. Comply with Federal, State, and local blasting regulations. Regulations containing specific Cal-OSHA requirements for blasting activities include 8 CA Code of Regs, Ch 4, Subchapter 7, Group 18, "Explosive Materials." Regulations for explosives containing percholate materials include 22 CA Code of Regs, Division 4.5, Ch 33, "Best Management Practices for Percholate Materials."

Do not perform any drilling or other preparation work for blasting before the Engineer approves all submittals and personnel assignments. Comply with Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. If, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in completing the submittal review within the specified time, you will be compensated for resulting losses and an extension of time will be granted in the same manner as provided for in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

You are liable for damages resulting from blasting activities.

Definitions

controlled blasting: The use of explosives and blasting accessories in predetermined spaced and aligned drill holes to limit blast vibrations, noise (airblast overpressure), and flyrock.

flyrock: Rock that becomes airborne due to blasting.

near field blasting: Blasting within 30 feet of a critical structure.

Submittals

Blasting Safety Plan

Submit 3 copies of a blasting safety plan for review. The plan must include:

1. References to applicable Federal, State, and local codes and regulations
2. Copies of permits required for blasting activities
3. Business name, contractor license number, address, and telephone number of the blasting subcontractor
4. Proof of current liability insurance and bonding
5. Name, address, telephone number, copies of applicable licenses, and resume of:

5.1. Blaster-in-charge
5.2. Personnel responsible for controlled blast design, loading, and conducting the blasting operation
5.3. Safety officer for blasting subcontractor
5.4. Blast monitoring consultant
5.5. Blasting consultant

6. Name, address, and telephone number of the local fire station and law enforcement agencies
7. Detailed description of:

7.1. Location where explosives will be stored
7.2. Security measures to protect and limit access to the explosives
7.3. Transportation means for explosives
7.4. List of personnel permitted to handle the explosives

8. Exclusion zone and limited entry zone for nonblast related operations and personnel surrounding loading and blasting operations
9. Details of warning signals used to alert employees on the job site of an impending blast and to indicate the blast is completed and the area is safe to enter
10. How blasting operations will be conducted
11. Measures to protect blasting operations and personnel from lightning
12. Emergency evacuation procedures for areas where explosives may be present
13. How misfires will be recognized, handled, and resolved including:

13.1. Who will be notified
13.2. How blast zone will be secured until misfire is resolved
13.3. Identification of equipment that may be needed to resolve misfires

14. Details of signs to be used around blasting zones including:

14.1. Timing of when signs will be posted relative to a specific blast
14.2. Name and telephone number of person responsible for placing signs
14.3. Roadway signs for compliance with Chapter 6, Typical Application 2, of the California MUTCD.

15. Traffic control details for:

15.1. Loading and blasting operations
15.2. Misfire event or other blast related phenomenon that causes a transportation corridor to remain closed to the public

16. Description of possible noxious gas generation and details of safeguards to be used to protect employees, work zones adjacent to the shot, private property, and the public
17. Procedure to report and resolve complaints for blast related accidents
18. Copies of the Material Safety Data Sheets and manufacturer data sheets of explosives, caps, primers, initiators, and other compounds

Allow 15 days for the Engineer's review of the blasting safety plan. If revisions are needed, you must revise and resubmit the plan. After the plan has been approved by the Engineer, submit 3 additional copies of the plan.

Controlled Blasting Plan

For each blast submit 3 copies of a controlled blasting plan for review. Each plan must include details on how each blast will be controlled and the following:

1. Blast identification by numerical and chronological sequence
2. Location, referenced to stationing, offset distance, date, and time of blast
3. Drawings showing drill hole pattern, spacing, burden, and initiation sequence
4. Typical cross-sections through zone to be blasted
5. Groundwater level if present within the prism to be blasted
5. Initiation-sequence diagram showing the actual firing time of each delay
6. Type of material to be blasted

7. Number of drill holes
8. Diameter, depth, and spacing of holes
9. Height or length of stemming
10. Types and characteristics of explosives used, including explosive's density, relative strength, and date of manufacture
11. Type of caps and delay periods used and their date of manufacture
12. Total amount of explosives used
13. The total amount of explosives detonating within any 8 millisecond period
14. Powder factor (pounds of explosive per cubic yard of material blasted)
15. Method of firing
16. Direction and distance to nearest buildings or structures listed elsewhere in these special provisions.
17. Type and method of instrumentation
18. Location and placement of instruments
19. Measures to limit air noise and flyrock
20. Measures to limit overbreak
21. Name of blasting subcontractor
22. Name and signature of blaster-in-charge
23. Drawings showing spacing and proximity of shot guards to blast location

Allow 15 days for the Engineer's review of the controlled blasting plan. If revisions are needed, revise and resubmit the plan. After the plan has been approved by the Engineer, submit 3 additional copies of the approved plan.

If changes to the controlled blasting plan are made to adjust for site conditions, these must be submitted for review before implementing.

Quality Control and Assurance

Blaster-In-Charge

Assign a blaster-in-charge responsible for supervising all blasting activities. The blaster-in-charge must have 10 years of experience in performing or supervising similar blasting activities and must be a licensed blaster.

Blast Monitoring Consultant

Assign a blast monitoring consultant to monitor blasting generated vibrations and noise near buildings and structures that may be subject to damage. The monitoring consultant will be responsible for collecting and interpreting vibration and noise data. The blast monitoring consultant must:

1. Not be employed by the blasting contractor or other subcontractor on this project
2. Have a minimum of a 2-year Associate's Degree in science or engineering
3. Have at least 5 years of documented experience in collecting and interpreting ground vibrations and noise data

Blasting Consultant

Assign a blasting consultant to oversee near field blasting activities. The blasting consultant must:

1. Be a licensed engineer or geologist
2. Have 10 years experience providing specialized blasting services in near field blasting
3. Not be employed by the blasting contractor, explosive manufacturer, or explosive distributor
4. Submit a resume of credentials and a list of projects worked on

Preblast Surveys

Provide the Engineer with written verification that all buildings or structures within 330 feet of blasting has been surveyed, listed elsewhere in these special provisions.

Along with the above, provide the Engineer with:

1. Detailed listing of highway sign posts, light fixtures, and overhead power lines
2. Survey of wells or other private water supplies including total depth and existing water surface levels

Vibration and Noise (Airblast Overpressure) Monitoring

Vibration levels must be kept below peak particle velocity of 0.3 inches per second at the nearest buildings or structures listed elsewhere in these special provisions.

Noise (airblast overpressure) levels must comply with "Sound Control and Monitoring Requirements," elsewhere in these special provisions at all locations listed in these special provisions.

Ground vibrations and noise created from blasting shall be controlled by using properly designed delay sequencing and charge weights for shots.

Seismographs must be installed at all buildings, listed elsewhere in these special provisions, within 330 feet of each blast. The seismograph should be placed within 3 feet of the building on the side facing the blast. The seismographs must be:

1. Appropriate for controlled blasting activities
2. Capable of:

    2.1. Recording particle velocities for 3 mutually perpendicular components of vibration and instantaneous resultant peak vector sum in the range generally found with controlled blasting
    2.2. Continuously measuring, recording, and reporting vibrations along 3 primary axes
    2.3. Measuring and recording vibration frequencies ranging from 2 to 300 Hz
    2.4. Providing a printed record of each event showing a plot of peak particle velocity versus vibration frequencies
    2.5. Measuring and recording airblast noise levels.

Record each blast shot using approved seismographs and prepare a vibration and noise monitoring report. The report must include:

1. Identification of instruments used
2. Name of blast monitoring consultant
3. Distance and direction of recording stations from blast area
4. Maximum particle velocity in each component and resultant peak particle velocity of each shot
5. Copy of seismograph readings with date and signature of blast monitoring consultant
6. Noise levels recorded in Decibels (C-network or Linear network) units

Video Recording of Blasts

Video-record each blast. The video-recording must be taken from a safe location with a clear view of the blast area, activities, and progression. Identify each video or section of video with an index to properly identify each blast. Submit a copy of each video in DVD-Video format to the Engineer.

Blasting Complaints

Accurately document complaints. Notify the Engineer immediately of complaints received or at the start of the next day's work shift. Complaint documentation must include:

1. Name and address of complainant
2. Date, time, and nature of complaint
3. Dated photo or videotape of physical damage
4. Name of person receiving complaint
5. Record of complaint investigation conducted
6. Resolution of complaint

Postblast Reports

Document each shot in a postblast report. The postblast report must include all data required in the controlled blasting plan for that shot and the following:

1. Description of site conditions, loading, and time of blast
2. Description of weather conditions at time of blast including wind direction and cloud cover
3. Drillers boring record
4. Copy of vibration and noise monitoring report
5. Copy of document complaints arising from blast

Submit the postblast report within 48 hours of the blast.

CONSTRUCTION

At least 7 days before starting or resuming blasting activities, notify in writing occupants of the local buildings within 330 feet of the blasting area. Also, verbally notify occupants of pending blasting activities on the day of blasting.

Do not perform blasts within 1200 feet of concrete that has been placed within 72 hours.

Before firing any blast, confirm that groundwater conditions are consistent with shot design and explosive type to be used.

Before firing any blast in areas where flyrock may result in personal injury or damage to property or the work, cover the rock to be blasted with blasting mats, soil, or other equally serviceable material to prevent flyrock.

If blasting causes flyrock, suspend blasting activities. The blasting consultant must review the site to determine the cause of the flyrock problem and provide an amendment to the controlled blasting plan that prevents flyrock.

Do not use drill cuttings as stemming in controlled blasting operations.

MEASUREMENT AND PAYMENT

Full compensation for rock excavation (controlled blasting) shall be considered as included in the contract price paid per cubic yard for the various types of excavation involved and no separate payment will be made therefor.

10-1.51 STRUCTURE BACKFILL (LIGHTWEIGHT AGGREGATE)

Structure backfill (lightweight aggregate) shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications and these special provisions.

Structure backfill (lightweight aggregate) shall consist of a rotary kiln expanded shale aggregate of the extruded type or a processed, naturally-occurring volcanic aggregate.

Structure backfill (lightweight aggregate) material, when deposited in place, shall conform to the following requirements:

Grading Requirements

Sieve Sizes	Percentage Passing
1.5 in	100
1 in	95 - 100
0.75 in	90 - 100
0.375 in	15 - 85
#200	0 - 9

Grading will be determined in conformance with the requirements of California Test 202, except shaking in the sieves shall be limited to 5 minutes.

Quality Requirements

Test	Requirement
Resistance (R-Value)	50 min
Durability Index	35 min

At locations directed by the Engineer, the structure backfill placed within 2 feet of finished ground around structures shall be a compacted impervious material, conforming to the provisions in Section 19-3.06, "Structure Backfill," of the Standard Specifications. If the minimum resistivity of the native soil is less than 1,000 ohm-cm, then the structure backfill (lightweight aggregate) shall have a chloride content less than or equal to 300 parts per million and a sulfate content less than or equal to 2,000 parts per million.

Structure backfill shall have a maximum calculated saturated surface dry unit weight of 60 pcf. The saturated surface dry unit weight shall be calculated using the dry loose unit weight and the absorption of the coarse and fine aggregates. Dry loose unit weight shall be determined in conformance with the requirements in California Test Method 212, using test procedure (b) Compaction Method (by jigging). Absorption of the coarse and fine aggregates shall be determined in conformance with the requirements in California Test Methods 206 and 207, except that the samples shall be oven dry before soaking and shall be soaked for 24 hours plus or minus 30 minutes. Saturated surface dry unit weight shall be calculated as follows:

1. multiply the percent coarse aggregate by the absorption of the coarse aggregate;
2. multiply the percent fine aggregate by the absorption of the fine aggregate;
3. add the two values from 1. and 2. and divide by 10000;
4. add one (1) to the result from 3. and multiply by the dry loose unit weight.

Structure backfill (lightweight aggregate) shall be placed and compacted to the designated dimensions in conformance with the provisions in Sections 19-1.03, "Grade Tolerance," and 19-6, "Embankment Construction," of the Standard Specifications. The provisions in Section 19-5, "Compaction," of the Standard Specifications shall not apply.

Initial layers of structure backfill (lightweight aggregate) may be placed by end dumping from trucks, or by any other method approved by the Engineer.

Structure backfill (lightweight aggregate) shall be spread or placed in such manner that will prevent bulking of the material and minimize particle breakdown. Structure backfill (lightweight aggregate) shall be compacted in uniform layers not to exceed 8-inch thickness before compaction. Compaction shall be obtained by a minimum of 3 complete coverage passes using smooth drum steel roller compaction equipment imposing contact force of 672 pounds per-foot-width of the roller face. Track type equipment which imposes the equivalent contact pressure as that specified for steel drum rollers, as determined by the Engineer, may be used provided the 3 complete coverages of the tracks of the track type equipment are achieved. Sufficient moisture treatment shall be made to aid the compactive effort. Compaction using pneumatic-tired equipment or compaction within trenches or other limited-access areas, or compaction in areas of low confining pressure, shall be by a method approved by the Engineer.

When alternative compaction equipment and methods of compaction (including use of pneumatic-tired equipment in trenches, in limited-access areas, and areas of low confining pressure) are proposed by the Contractor, a test site placing and compacting lightweight aggregate material shall be constructed. The alternative compaction equipment and methods of compaction shall not be used until, evaluation of the test site by the Engineer and the alternative methods and equipment have been approved by the Engineer.

Quantities of structure backfill (lightweight aggregate) shall be paid for by the cubic yard calculated on the basis of the mass, measured in place in conformance with the provisions in Section 9-1.01, "Measurement of Quantities," of the Standard Specifications divided by the 95 percent of the dry unit weight measured in conformance with the requirements in California Test Method 212, using test procedure (b) Compaction Method (by jigging).

The contract price paid per cubic yard for structure backfill (lightweight aggregate) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing structure backfill (lightweight aggregate), complete in place (including constructing and removing any test sites required, and furnishing and placing geotextile), as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

10-1.52 TUNNEL EXCAVATION MONITORING

This work shall consist of furnishing and installing inclinometer casing behind or in the Retaining Wall A of the Southbound Battery Tunnel; furnishing and installing reflective targets on soldier piles; and performing monitoring of the tunnel excavation using the inclinometers and reflective targets in conformance with the details shown on the plans and the requirements specified in these special provisions.

WORKING DRAWINGS

The Contractor shall submit working drawings to the Engineer, in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. Working drawings shall include complete details, information, drawings, and substantiating calculations of proposed instruments, materials, facilities, equipment to be used, methods of installing and monitoring instrumentation. The working drawings shall include the survey control layout with survey bench marks and baselines; exact locations and elevations for reflective targets; location of inclinometer and installation schedule, sequence, and procedures; details for inclinometer casing and reflective targets; details of protecting well cap for inclinometer casing; measures to protect reflective targets; and the format of monitoring data. The working drawings and calculations shall be signed by a surveyor who is registered as a Land Surveyor in the State of California.

The Contractor shall allow 2 weeks after complete drawings and all support data are submitted for the review and approval of the proposed wall monitoring. No instrumentation and monitoring work shall begin until complete working drawings are reviewed and approved, in writing, by the Engineer.

In the event the Engineer fails to complete the review and approval within the time allowed, and if, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss, and an extension of time will be granted, in the same manner as provided in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

DOCUMENTATION

The Contractor shall submit to the Engineer as-built drawings, including drawings showing exact location of instruments, date and time of installation, and elevations and locations of instruments, within one week of completing the installation of the instrumentation.

REPORT SUBMITTALS

The Contractor shall submit to the Engineer monitoring data collected from instrumentation readings in the form and timeframe specified herein. Plots processed shall be in the form and size as specified herein. Monitoring data collection and reports shall be performed and stamped by a surveyor who is registered as a Land Surveyor in the State of California. The monitoring data shall be presented on a spreadsheet showing the data readings, northing, easting, and elevation on each observation, and any delta from the previous reading and the original baseline reading.

The submittal of the monitoring data and results shall conform to the following requirements: data from retaining wall monitoring points, including data plots and the Contractor's interpreted instrumentation monitoring data results shall be submitted to the Engineer within 24 hours after the readings are taken.

The Contractor shall submit to the Engineer a report documenting damaged or otherwise non-functioning instrumentation immediately upon identifying damage or loss of function.

MONITORING DATA

After the monitoring data is collected, processed, plotted, and interpreted, the Contractor shall submit to the Engineer all the monitoring data and results to the Engineer.

Monitoring data and results shall be in the form of files stored in compact discs (CDs) with a corresponding hard copy. The data format shall conform to the approved working drawings and supplement. Each set of data shall clearly indicate the instrument identification number and location, reference elevation for the readings, directions of movement, and the date and time that the readings were taken. Data shall be summarized in tables and graphs showing the date of installation and measured movements recorded at each reading.

INCLINOMETER CASING

Installation of the inclinometer casing shall be performed in the presence of the Engineer by personnel with experience from at least five previous projects that included inclinometer installation.

The inclinometer casing shall have a diameter of 2.87 inches, and shall be installed in accordance with the manufacturer's recommendations.

The inclinometer casing couplings shall be sealable and shall preclude soldier pile backfill or other fluids from entering the casing at any joint. Casing termination shall preclude intrusion of soldier pile backfill material or other fluids at the down-hole end and shall be 2 inches below the top of the well cap at the top-of-casing end.

The inclinometer casing shall be installed to prevent damage from vehicles, equipment, debris, or intentional acts of vandalism. Installations shall also be protected from becoming filled by sedimentation. Protection shall include locking well caps. Well caps and inclinometer casing shall be installed flush with top of the ground surface behind the shoring wall.

Locking well caps shall be those typical to the water well industry, and shall have a minimum of 10 inches outside diameter. The well cap shall be installed around the slope inclinometer casing so as not to interfere with accessing the casing. Installation of the well cap shall in no way compromise the integrity or use of the inclinometer installation.

The inclinometer casing shall be located so that it clears tieback and lagging installations. Casing shall be installed to within one degree of vertical and this alignment shall be maintained until such time that the soldier pile backfill attains sufficient strength to maintain the casing alignment. Casing groove orientation shall be aligned perpendicular and parallel to the Retaining Wall A alignment. The Engineer will verify the referenced groove orientation at the time of installation.

Casing shall be weighted with a steel rod during installation to resist effects of buoyancy. Installations lost due to intrusion of material or out of plumb beyond specified maximum shall be at the Contractor's expense.

The casing installed behind Retaining Wall A shall be grouted in-place using a cement-water-bentonite grout. The grout mixture shall be 94 pounds Type II Portland cement, 40 gallons of potable water, and 25 pounds of bentonite. The grout shall be placed using a tremie method with side discharge ports on the tremie pipe.

Casing shall be installed to the specified depth as shown on the plans. The inside of the casing shall be free of obstructions that cause the probe to jump out of the slots or impede insertion of the probe. At the time of the first reading, the casing integrity shall be intact to the specified depth for the installation and the casing spiral shall be within the specified tolerance.

The Contractor shall provide the probe, cable, readout unit, and software for processing data. The probe, cable, readout unit, and software shall all be compatible.

Tunnel excavation shall not commence until inclinometer casing is installed and the installation has been accepted by the Engineer.

The monitoring frequency for the inclinometers shall be weekly from commencement of the tunnel excavation until four weeks after the shored excavation is braced, and then monthly until the tunnel is constructed and backfilled.

REFLECTIVE MONITORING TARGETS

The reflective targets shall have an adhesive backing for direct attachment to the soldier pile beam. Measurements shall be made by optical survey methods weekly.

Reflective monitoring targets shall be installed as close as practicable to the locations shown on the plans and as approved by the Engineer. The initial readings shall be taken no more than 6 hours following installation and before the next lift of excavation.

The Contractor shall clearly mark and protect all survey reference and control points, instruments, and appurtenant fixtures, and other instrumentation system components from damage due to construction operations, weather, and traffic. Damaged or missing instrumentation and components shall be repaired or replaced within 24 hours. Access shall be maintained to permit reading of instruments.

MAXIMUM ALLOWABLE MOVEMENT

The maximum allowable movement measured from the inclinometers or reflective targets shall be one-inch. Corrective action shall be triggered at 1/2-inch measured movements. The corrective actions shall consist of stopping excavation, evaluating data, and providing additional bracing, as necessary to limit new movement to less than 1/2-inch.

PAYMENT

The contract lump sum price paid for tunnel excavation monitoring includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing, installing, performing monitoring for tunnel excavation, and taking necessary corrective actions to control the movement as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.53 CONTROLLED LOW STRENGTH MATERIAL

Controlled low strength material shall consist of a workable mixture of aggregate, cementitious materials, and water and shall conform to the provisions for slurry cement backfill in Section 19-3.062, "Slurry Cement Backfill," of the Standard Specifications and these special provisions.

At the option of the Contractor, controlled low strength material may be used as structure backfill for pipe culverts, except that controlled low strength material shall not be used as structure backfill for culverts having a diameter or span greater than 20 feet.

When controlled low strength material is used for structure backfill, the width of the excavation shown on the plans may be reduced so that the clear distance between the outside of the pipe and the side of the excavation, on each side of the pipe, is a minimum of 12 inches. This minimum may be reduced to 6 inches when the height of cover is less than or equal to 20 feet or the pipe diameter or span is less than 42 inches.

Controlled low strength material in new construction shall not be permanently placed higher than the basement soil. For trenches in existing pavements, permanent placement shall be no higher than the bottom of the existing pavement permeable drainage layer. If a drainage layer does not exist, permanent placement in existing pavements shall be no higher than one inch below the bottom of the existing asphalt concrete surfacing or no higher than the top of base below the existing portland cement concrete pavement. The minimum height that controlled low strength material shall be placed, relative to the culvert invert, is 0.5 diameter or 0.5 height for rigid culverts and 0.7 diameter or 0.7 height for flexible culverts.

When controlled low strength material is proposed for use, the Contractor shall submit a mix design and test data to the Engineer for approval prior to excavating the trench for which controlled low strength material is proposed for use. The test data and mix design shall provide for the following:

A. A 28-day compressive strength between 50 pounds per square inch and 100 pounds per square inch for pipe culverts having a height of cover of 20 feet or less and a minimum 28-day compressive strength of 100 pounds per square inch for pipe culverts having a height of cover greater than 20 feet. Compressive strength shall be determined in conformance with the requirements in ASTM Designation: D 4832.
B. Cement shall be any type of portland cement conforming to the requirements in ASTM Designation: C 150; or any type of blended hydraulic cement conforming to the requirements in ASTM Designation: C 595M or the physical requirements in ASTM Designation: C 1157M. Testing of cement will not be required.
C. Admixtures may be used in conformance with the provisions in Section 90-4, "Admixtures," of the Standard Specifications. Chemical admixtures containing chlorides as Cl in excess of one percent by weight of admixture, as determined in conformance with the requirements of California Test 415, shall not be used. If an air-entraining admixture is used, the maximum air content shall be limited to 20 percent. Mineral admixtures shall be used at the Contractor's option.

Materials for controlled low strength material shall be thoroughly machine-mixed in a pugmill, rotary drum or other approved mixer. Mixing shall continue until the cementitious material and water are thoroughly dispersed throughout the material. Controlled low strength material shall be placed in the work within 3 hours after introduction of the cement to the aggregates.

When controlled low strength material is to be placed within the traveled way or otherwise to be covered by paving or embankment materials, the material shall achieve a maximum indentation diameter of 3 inches prior to covering and opening to public traffic. Penetration resistance shall be measured in conformance with the requirements in ASTM Designation: D 6024.

Controlled low strength material used as structure backfill for pipe culverts will be considered structure backfill for compensation purposes.

10-1.54 MATERIAL CONTAINING NATURALLY OCCURRING ASBESTOS

This work includes handling, stockpiling, transporting, and disposing of material containing naturally occurring asbestos (NOA). The State regulates material containing NOA and material from areas where serpentine or ultramafic rock is present. Material containing NOA is material containing 0.25 percent or greater concentration of asbestos. Naturally occurring asbestos (NOA) is present within the job site limits. The tested levels of NOA range from 0.75 percent asbestos to 2.5 percent asbestos in serpentine rock as analyzed by California Air Resources Board (CARB) Test Method 435. Use of excavated material containing NOA in the proposed construction is not approved.

Perform earthwork in areas containing NOA under Section 19, "Earthwork," of the Standard Specifications and these special provisions. A copy of the asbestos testing report is available as specified in "Supplemental Project Information" of these special provisions.

Notify the Bay Area Air Quality Management District (BAAQMD) at least 14 days before starting work in areas containing NOA and comply with the California Air Resources Board (CARB), Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying and Surface Mining Operations (ATCM) under California Code of Regulations (CCR), Title 17, Section 93105 (d)(1)(A).

Material containing NOA at concentrations equal to or greater than 1 percent exists from Station "SB" 78+00 to "SB" 86+10 within the excavations for:

1. Retaining walls A and B to the bottom of the soldier piles
2. Southbound Battery Tunnel

Refer to the Log of Test Borings for the elevation of the serpentine rock.

Material containing NOA may be temporarily stockpiled until it is transported and disposed of in accordance with these specifications. Limit stockpile locations to areas that contain NOA within the job site limits. Cover temporary stockpiles with polyethylene sheeting of 10-mil minimum thickness or stabilize stockpiles by other methods permitted by the ATCM under CCR Title 17, Section 93105(d)(1)(3). Temporarily stockpiled material containing NOA is not selected material under Section 19-2.07, "Selected Material," of the Standard Specifications.

Do not leave NOA surface areas exposed unless these areas are stabilized by being kept wetted or by being treated with a chemical dust palliative. Cover disturbed material containing NOA that is open to public traffic with a 3-inch minimum layer of material that contains less than 0.25 percent asbestos and has been accepted by the Engineer.

Material with 1 percent or higher concentration of NOA is hazardous material and for removing, managing, hauling, and disposing of the material outside the right-of-way, comply with Federal, State, and local laws and ordinances.

SUBMITTALS

Submit an asbestos compliance plan (ACP) signed by a Certified Industrial Hygienist (CIH) certified in Comprehensive Practice by the American Board of Industrial Hygiene to the Engineer for acceptance at least 15 days before starting work in areas containing NOA.

Submit a dust control plan (DCP) approved by the APCD or AQMD to the Engineer for acceptance at least 15 days before starting work in areas containing NOA.

ASBESTOS COMPLIANCE PLAN

Prepare and implement a job site specific asbestos compliance plan (ACP) to prevent or minimize worker exposure to asbestos. The ACP must comply with:

1. CCR, Title 8, Section 1529, (Asbestos) and Section 5192, (Hazardous Waste Operations and Emergency Response)
2. Occupational Safety and Health Guidance Manual published by the National Institute of Occupational Safety and Health (NIOSH)

3. Occupational Safety and Health Administration (OSHA), including addenda to it issued up to and including the date of advertisement of the contract

Include in the ACP:

1. Identification of personnel designated to be on site
2. Job hazard analysis for work assignments
3. Summary of potential risks
4. Worker exposure air monitoring plan
5. Description of personal protective equipment
6. Delineation of work zones on the job site
7. Decontamination procedures
8. General safe work practices
9. Site security measures
10. Emergency response plans
11. Description of worker training

Before performing work in areas with material containing NOA, personnel who have not had the worker training must complete a safety training program that meets the requirements of the ACP. The safety training program must meet the requirements of CCR, Title 8, Section 1529, (Asbestos), and Section 5192 (b)(4)(B), (Hazardous Waste Operations and Emergency Response). Provide the Engineer written certification of completion of safety training for each trainee before performing work in areas containing NOA.

Provide training, personal protective equipment, and washing facilities for 10 Department employees.

When required by local APCD or AQMD, perform daily ambient air monitoring on this job site. If daily ambient monitoring is required, submit a written air monitoring report to the Engineer every month. The report must include:

1. Air monitoring results
2. An analysis of results from the prior month
3. The name and location of the laboratory where the analysis was performed
4. An assessment of exposures of workers or the public
5. Descriptions of the type of air monitoring equipment
6. Sampling frequency

DUST CONTROL PLAN

Prepare and implement a job site specific dust control plan (DCP). Prevent visible dust from leaving the project boundaries during excavation, stockpiling, or transportation of material containing NOA under Section 10, "Dust Control," of the Standard Specifications, these special provisions, and with the requirements in the Asbestos ATCM CCR Title 17, Section 93105(d)(1)(B).

Control dust in areas with material containing NOA using measures that include the following:

1. Stabilize unpaved areas subject to vehicular traffic by keeping adequately wetted, treated with a chemical dust palliative, or covered with material that contains less than 0.25 percent asbestos
2. The speed of vehicles and equipment traveling across unpaved areas must not be more than 15 mph unless the road surface and surrounding area is sufficiently stabilized to prevent vehicles and equipment going faster from causing dust that is visible from crossing job site limits
3. Stockpiles and disturbed areas not subject to vehicular traffic must be located in the plan and stabilized by being kept adequately wetted, treated with a chemical dust palliative, or covered with material that contains less than 0.25 percent asbestos
4. Conduct activities so that no dirt or mud tracking is visible on any paved roadway open to the public

On job sites that require blasting, minimize the emission of material containing NOA with the use of blasting mats or cover material not containing NOA. Sample and analyze cover material after blasting to determine if it contains NOA. Cover material not containing NOA after blasting is the property of the Contractor. Dispose of cover material containing NOA in accordance with these special provisions.

MATERIAL TRANSPORTATION AND DISPOSAL

During transport of material containing NOA to a disposal location:

1. Prevent spillage from holes or other openings in the cargo compartment,
2. Ensure each load is adequately wetted, and use either of the following:

    2.1. Cover the load with tarps
    2.2. Keep the top of the load below the top of the cargo compartment and do not allow the material to touch the front, back, or sides of the cargo compartment at any point less than six inches from the top

3. Prevent tracking of material containing NOA onto roads open to the public.

Dispose of material containing NOA with concentrations equal to or greater than 1 percent as hazardous waste at a landfill facility under permit issued by the California Environmental Protection Agency. You are responsible for identifying the appropriately permitted landfill to receive the material.

Material containing NOA excavated from outside the limits of payment for contract items is the property of the Contractor and must be disposed of in accordance with these special provisions.

Provide the Engineer copies of manifests, landfill receipts and certified weight tickets showing the amount of disposal material containing NOA and the concentration of asbestos that was sent to the facility. Provide the Engineer a copy of additional test results if required by the owner of the landfill facility.

The Engineer obtains the Environmental Protection Agency Generator Identification Number for any disposal of Department of Toxic Substance Control regulated hazardous material and will sign all manifests. Notify the Engineer 5 days before the manifests are to be signed. Ensure that the Engineer has full access to the disposal facility during construction.

MEASUREMENT AND PAYMENT

Structure excavation (serpentine) will be measured and paid for by the cubic yard in the same manner as structure excavation specified for the construction of foundations for structures in Section 19-3, "Structure Excavation and Backfill."

The contract lump sum price paid for asbestos compliance plan (naturally occurring asbestos) must include full compensation for preparing and implementing the ACP and no additional compensation will be allowed therefor.

The contract lump sum price paid for dust control plan (naturally occurring asbestos) includes full compensation for preparing and implementing the DCP and providing notification and payment of fees to the APCD and no additional compensation will be allowed therefor.

Full compensation for handling, transporting and disposing of material containing greater than or equal to 1 percent of NOA to an appropriately permitted landfill facility, including providing copies of disposal documents to the Engineer, is included in the contract items of work involved, and no additional compensation will be allowed therefor.

Full compensation for cover material used for blasting is included in the contract price paid per cubic yard for the type of excavation (naturally occurring asbestos) involved and no separate payment will be made therefor.

Sampling of cover material after blasting for NOA as directed by the Engineer will be paid for as extra work under Section 4-1.03D, "Extra Work", of the Standard Specifications.

Air monitoring and reporting results will be paid for as extra work under Section 4-1.03D, "Extra Work," of the Standard Specifications.

The Department does not pay for sampling, analyzing, transporting, and disposing of material containing NOA from outside the limits of payment for contract items.

10-1.55 IMPORTED BORROW (LIGHTWEIGHT AGGREGATE)

Imported borrow (lightweight aggregate) shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications and these special provisions.

Imported borrow (lightweight aggregate) shall consist of a rotary kiln expanded shale aggregate of the extruded type or a processed, naturally-occurring volcanic aggregate.

Imported borrow (lightweight aggregate) material, when deposited in place, shall conform to the following requirements:

Grading Requirements

Sieve Sizes	Percentage Passing
1.500-inch	100
1.000-inch	95 - 100
0.750-inch	90 - 100
0.375-inch	15 - 85
0.003-inch	0 - 9

Grading will be determined in conformance with the requirements of California Test 202, except shaking in the sieves shall be limited to 5 minutes.

Quality Requirements

Test	Requirement
Resistance (R-Value)	50 min
Durability Index	35 min

The imported borrow (lightweight aggregate) shall have a chloride content less than or equal to 500 parts per million and a sulfate content less than or equal to 1500 parts per million.

When imported borrow (lightweight aggregate) is used as structure backfill for galvanized steel or reinforced concrete pipe culverts, the imported borrow (lightweight aggregate) shall have a minimum resistivity greater than or equal to 1500 ohm-cm and a pH greater than or equal to 5.5. For aluminum or aluminum-coated steel culverts, imported borrow (lightweight aggregate) used for structure backfill shall have a minimum resistivity greater than 1,500 ohm-cm and a pH between 5.5 and 8.5. Minimum resistivity and pH shall be determined in conformance with the requirements of California Test Method 643, chloride content shall be determined in conformance with the requirements of California Test Method 422, and sulfate content shall be determined in conformance with the requirements of California Test Method 417.

At locations directed by the Engineer, the material used to backfill the outer 2-foot portion of structure backfill adjacent to pipe and culvert inlets and outlets shall be a compacted impervious material, conforming to the provisions in Section 19-3.06, "Structure Backfill," of the Standard Specifications.

At locations directed by the Engineer, the structure backfill placed within 2-foot of finished ground around abutments, abutment wingwalls, retaining walls, and other portions of structures shall be a compacted impervious material, conforming to the provisions in Section 19-3.06, "Structure Backfill," of the Standard Specifications.

Imported borrow (lightweight aggregate) shall have a maximum calculated saturated surface dry unit weight of 60 lb/ft^3. The saturated surface dry unit weight shall be calculated using the dry loose unit weight and the absorption of the coarse and fine aggregates. Dry loose unit weight shall be determined in conformance with the requirements in California Test Method 212, using test procedure (b) Compaction Method (by jigging). Absorption of the coarse and fine aggregates shall be determined in conformance with the requirements in California Test Methods 206 and 207, except that the samples shall be oven dry before soaking and shall be soaked for 24 hours plus or minus 30 minutes. Saturated surface dry unit weight shall be calculated as follows:

1. multiply the percent coarse aggregate by the absorption of the coarse aggregate;
2. multiply the percent fine aggregate by the absorption of the fine aggregate;
3. add the two values from 1. and 2. and divide by 10000;
4. add one (1) to the result from 3. and multiply by the dry loose unit weight.

Imported borrow (lightweight aggregate) shall be placed and compacted to the designated dimensions in conformance with the provisions in Sections 19-1.03, "Grade Tolerance," and 19-6, "Embankment Construction," of the Standard Specifications. The provisions in Section 19-5, "Compaction," of the Standard Specifications shall not apply.

Initial layers of imported borrow (lightweight aggregate) may be placed by end dumping from trucks, or by any other method approved by the Engineer.

Imported borrow (lightweight aggregate) shall be spread or placed in such manner that will prevent bulking of the material and minimize particle breakdown. Imported borrow (lightweight aggregate) shall be compacted in uniform layers not to exceed 0.66-ft thickness before compaction. Compaction shall be obtained by a minimum of 3 complete coverage passes using smooth drum steel roller compaction equipment imposing contact force of 672 lb per-foot-width of the roller face. Track type equipment which imposes the equivalent contact pressure as that specified for steel drum rollers, as determined by the Engineer, may be used provided the 3 complete coverages of the tracks of the track type equipment are achieved. Sufficient moisture treatment shall be made to aid the compactive effort. Compaction using pneumatic-tired equipment or compaction within trenches or other limited-access areas, or compaction in areas of low confining pressure, shall be by a method approved by the Engineer.

When alternative compaction equipment and methods of compaction (including use of pneumatic-tired equipment in trenches, in limited-access areas, and areas of low confining pressure) are proposed by the Contractor, a test site placing and compacting lightweight aggregate material shall be constructed. The alternative compaction equipment and methods of compaction shall not be used until, evaluation of the test site by the Engineer and the alternative methods and equipment have been approved by the Engineer.

Quantities of imported borrow (lightweight aggregate) shall be paid for by the cubic yard calculated on the basis of the mass, measured in place in conformance with the provisions in Section 9-1.01, "Measurement of Quantities," of the Standard Specifications divided by the 95 percent of the dry unit weight measured in conformance with the requirements in California Test Method 212, using test procedure (b) Compaction Method (by jigging).

The contract price paid per cubic yard for imported borrow (lightweight aggregate) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing imported borrow (lightweight aggregate), complete in place (including constructing and removing any test sites required), as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

10-1.56 LIGHTWEIGHT FILL (EPS BLOCK)

Lightweight fill (EPS block) shall be expanded polystyrene (EPS) material. Lightweight fill (EPS block) shall be fabricated as blocks measuring approximately 2 ft x 4 ft x 8 ft. Manufacturer's standard size blocks will be acceptable. Special-size blocks will be required at the edges of the lightweight fill section to fill the volume shown on the plans.

Lightweight fill (EPS block) shall have the following properties:

Physical Property	ASTM Designation	Acceptance Value
Density	C 303	1.5 lb/ft^3 Minimum 2 lb/ft^3 Maximum
Compressive Strength (at 5% deformation)	D 1621	14.5 psi Minimum
Flexural Strength	C 203	43.5 psi Minimum
Tensile Strength	D 1623	20 psi Minimum
Water Absorption	C 272	2.0% Maximum by Volume

A Certificate of Compliance from the manufacturer of the lightweight fill (EPS block) shall be furnished in accordance with the provisions of Section 6-1.07 "Certificates of Compliance" of the Standard Specifications. Shop drawings showing special size blocks and the layout of lightweight fill (EPS block) blocks in each layer shall be submitted to the Engineer for approval prior to fabrication of the blocks. The long axis of blocks in adjacent layers shall be rotated horizontally 90 degrees and the edges of blocks in adjacent layers shall be offset as shown on the plans to minimize continuous joints.

The Contractor shall prevent damage to the lightweight fill (EPS block) during delivery, storage, and construction. Lightweight fill (EPS block) shall be protected from petroleum products, ultraviolet light, and/or mechanical damage. Any lightweight fill (EPS block) damaged by the Contractor's equipment or operations shall be replaced by the Contractor at his expense. It shall be the Contractor's responsibility to ensure that the EPS blocks are not exposed to hydrocarbons contamination during the life of the contract.

Between stages, and as shown on the plans, the lightweight embankment fill (EPS block) shall be protected with temporary geomembrane (Type A-gasoline resistant) and weighted down with sufficient sand bags to keep it in place. Temporary geomembrane shall conform to the provisions in the Section "Geomembrane (Gasoline Resistant)" elsewhere in these special provisions. Sand bags shall conform to the provisions in Section 19-3.025B, "Sand Bedding," of the Standard Specifications. The sacks for sand bags shall be made of at least 10 ounce burlap or an equivalent strength woven geotextile and shall be approximately 18 inch by 36 inch measured inside the seams when the sack is laid flat. The capacity of each sack shall be approximately 0.05 cubic yards. The sacks shall be filled with approximately 0.04 cubic yards of sand loosely placed so as to leave room for folding at the top. The fold shall be just enough to retain the sand at the time of placing.

Lightweight fill (EPS block) shall be placed to the lines and grades shown in the plans and as directed by the Engineer. Surfaces to receive lightweight fill (EPS block) shall be finished such that there is no more than a 5/8 inch variation in vertical grade over any 10 ft interval, and are within 2.5 inches of the grade shown on the contract plans. The surface of a layer of lightweight fill (EPS block) blocks on which additional blocks are to placed shall be plane, with no more than a 5/8 inch variation in vertical grade over any 10 ft interval. All blocks shall fit accurately against adjacent blocks, without voids wider than 5/8 inch at any vertical joint. The finished surface of the lightweight fill (EPS block) fill shall be constructed to a tolerance of plus or minus 4 inch from the grade shown on the contract plans. Lightweight fill (EPS block) shall not be less than 6 inch in thickness. This may require saw cutting the lower blocks to achieve a minimum 6 inch thickness for the top most EPS blocks in order to meet roadway super-elevations and grades. All excess EPS block cuttings and debris resulting from saw cutting and other construction related activity shall be contained, collected and hauled offsite for disposal by the Contractor.

Sliding of lightweight fill (EPS block) blocks along horizontal joints shall be prevented by timber fasteners placed as shown on the plans or by gluing. Timber fasteners shall have 16 prongs approximately 1 inch on-center which penetrate a minimum of ½ inch into the foam block above and below or as approved by the Engineer. Timber fasteners shall be placed a minimum of 9 inches from block edges. Glue shall be as recommended by the manufacturer of the lightweight fill (EPS block). Glue joints shall be capable of developing a minimum of 12.3 psi of shear strength when tested in accordance with ASTM D 732 test procedures.

MEASUREMENT

Lightweight fill (EPS block) shall be measured by the cubic yard of material placed as shown on the plans or as directed by the Engineer. No additional compensation will be made for material placed outside these limits.

PAYMENT

The contract price paid per cubic yard for lightweight fill (EPS block) shall include full compensation for furnishing all labor, materials, equipment, tools, and incidentals necessary to construct the lightweight fill (EPS block) as shown on the plans and for disposal of EPS cuttings and debris, as specified in these special provisions and as directed by the Engineer.

10-1.57 GEOMEMBRANE (GASOLINE RESISTANT)

Geomembrane (gasoline resistant) shall consist of reinforced or unreinforced tri-polymer membrane consisting of polyvinyl chloride (PVC), ethylene interpolymer alloy, and polyurethane or a comparable polymer combination. The geomembrane shall be suitable for the containment of spilled liquid hydrocarbons, including gasoline, diesel fuel, kerosene, hydraulic fluid, methanol, ethanol, mineral spirits, and naptha. The geomembrane shall be sufficiently flexible to cover and closely conform to 90 degree edges and corners of lightweight fill (EPS block) subgrade material at ambient temperatures as low as 44.6°F without application of heat.

Geomembrane (gasoline resistant) shall have the following properties, specified as minimum or maximum, not average roll properties:

Physical Property	ASTM Designation	Acceptance Value
Unleaded Gasoline Permeability	D 814	0.025lb/ft^2 Maximum per 24 hours
Thickness	D 751 *	0.18 in Minimum
Grab Tensile Strength (1 in grip, 4 in x 8 in sample	D 751 *	0.6 kip Minimum in each direction
Tensile Strength	D 1623	19 psi Minimum
Elongation at break	D 4632 *	20 Percent Minimum
Toughness (Percent elongation times Grab Tensile Strength **)	N/A	14 kip Minimum
Puncture Resistance (ball tip)	D 751 ***	0.8 kip Minimum
Cold Crack Resistance (1 in mandrel, 4 hours)	D 2138 *	Pass at 1.4°F

* or ASTM test method appropriate for specific polymer
** for example, 0.67 kip x 30% = 20 kip
*** or FTMS 101C, Method 2065

All factory-produced seams shall have a minimum bonded width of 1.18 in, and shall have a minimum shear strength of 0.32 kip when tested in accordance with ASTM D 751 (Modified per NSF Standard No. 54). Failure shall occur in the base geomembrane material.

A Certificate of Compliance from the manufacturer of the geomembrane shall be furnished in accordance with the provisions of Section 6-1.07, "Certificates of Compliance" of the Standard Specifications.

INSTALLATION

Geomembrane (gasoline resistant) shall be placed directly on the surface of the lightweight fill (EPS block) fill, which shall be clean and free of sharp objects. Field seams shall be bonded with an electrically-heated hot-wedge device as recommended by the manufacturer. Hot air extrusion welding devices or solvent bonding chemicals shall not be used. The temperature of the bonded geomembrane shall not exceed 165.2°F immediately before contacting the lightweight fill (EPS block) fill. Before installation of geomembrane, the Contractor shall demonstrate to the Engineer that the equipment, techniques, and personnel proposed for the bonding of field seams can produce vapor-tight seams under similar weather and work conditions near the job site. Field seams shall be inspected and, when ordered by the Engineer, shall be tested and pass the Vacuum Box Test. Construction equipment shall not be operated directly on the geomembrane. Any material damaged by the Contractor's equipment or operations shall be replaced or repaired to the satisfaction of the Engineer by the Contractor at his expense.

MEASUREMENT

Geomembrane (gasoline resistant) shall be measured by the square yard of area covered as shown on the plans or as directed by the Engineer.

PAYMENT

The contract price paid per square yard for geomembrane (gasoline resistant) shall include full compensation for furnishing all labor, materials, equipment, tools, and incidentals necessary to install the geomembrane as shown on the plans, as specified in these special provisions and as directed by the Engineer.

10-1.58 EROSION CONTROL (SEQUENCING)

Place erosion control treatments in the following sequence for each erosion control type identified:

Erosion Control (Type 1)

Erosion Control (Compost Blanket)

Rolled Erosion Control Product (Netting)

Fiber Rolls

Erosion Control (Hydroseed)

10-1.59 ROLLED EROSION CONTROL PRODUCT (NETTING)

GENERAL

Summary

This work includes installing rolled erosion control product (netting).

Definitions

Rolled erosion control product (RECP): A long-term degradable material manufactured or fabricated into rolls designed to reduce soil erosion and assist in the growth, establishment and protection of vegetation.

Open weave textile (OWT): A degradable RECP composed of processed natural yarns woven into a matrix, used to provide erosion control and vegetation establishment.

Submittals

Submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for:

1. Netting
2. Fastener

MATERIALS

Netting

Netting must comply with the following:

1. Netting must be a OWT RECP.
2. Netting Type: A.
3. Machine-made mats provided in rolled strips.
4. Minimum thickness: 0.30 inch.
5. Minimum width: 72 inches.
6. U.V. Stability under ASTM D 4355 (500 hours exposure): 80%
7. Physical properties in Table A:

Table A

Type	Number Of Nets	Net Type	Matrix	Maximum "C" Factor [1]	Minimum Sheer Stress [2]	Functional Longevity (months)	Minimum Tensile Strength [3]
A[4]	Single Net	Organic	100% Woven Coir (Coconut Fiber)	0.25	3	36	125
B[5]	Single Net	Organic	100% Woven Coir (Coconut Fiber)	0.25	4.4	36	125
C[6]	Single Net	Organic	100% Woven Coir (Coconut Fiber)	0.25	4.6	36	125

Notes:

[1] Universal Soil Loss Equation (USLE) C-Factor for a 1.5:1 (H:V) unvegetated slope.
[2] lb/ft2 under ASTM D 6460.
[3] lb/ft under ASTM D 5035.
[4] Average open area of 65%, with a tolerance of ± two percent. Minimum weight of 11.8 ounces per square yard under ASTM D 3776.
[5] Average open area of 48%, with a tolerance of ± two percent. Minimum weight of 20 ounces per square yard under ASTM D 3776.
[6] Average open area of 38%, with a tolerance of ± two percent. Minimum weight of 26 ounces per square yard under ASTM D 3776.

Fasteners

Fasteners must be 11 gauge, 6-inch U-shaped staples with 6-inch legs, and 1-inch crown.

MEASUREMENT AND PAYMENT

The quantity of rolled erosion control product (netting) will be measured by the square foot as determined from actual slope measurements of the areas covered by the rolled erosion control product (netting) excluding overlaps.

The contract price paid per square foot for rolled erosion control product (netting) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in rolled erosion control product (netting), complete in place, including fasteners, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.60 MOVE-IN/MOVE-OUT (EROSION CONTROL)

Move-in/move-out (Erosion Control) shall include moving onto the project when an area is ready to receive erosion control as determined by the Engineer, setting up all required personnel and equipment for the application of erosion control materials and moving out all personnel and equipment when erosion control in that area is completed.

When areas are ready to receive applications of erosion control (Hydroseed), as determined by the Engineer, the Contractor shall begin erosion control work in that area within 5 working days of the Engineer's notification to perform the erosion control work.

Quantities of move-in/move-out (Erosion Control) will be determined as units from actual count as determined by the Engineer. For measurement purposes, a move-in followed by a move-out will be considered as one unit.

The contract unit price paid for move-in/move-out (Erosion Control) shall include full compensation for furnishing all labor, materials (excluding erosion control materials), tools, equipment, and incidentals and for doing all the work involved in moving in and removing from the project all personnel and equipment necessary for application of erosion control (Hydroseed), as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

No adjustment of compensation will be made for any increase or decrease in the quantities of move-in/move-out (Erosion Control) required, regardless of the reason for the increase or decrease. The provisions in Section 4-1.03B, "Increased or Decreased Quantities," of the Standard Specifications shall not apply to the item of move-in/move-out (Erosion Control).

10-1.61 EROSION CONTROL (HYDROSEED)

GENERAL

Summary

This work includes removing and disposing of weeds, applying erosion control materials, seed, fiber, organic fertilizer and tackifier to erosion control (Hydroseed) areas shown on the plans.

Comply with Section 20-3, "Erosion Control," of the Standard Specifications.

Apply erosion control (Hydroseed) when an area is ready to receive erosion control as determined by the Engineer and under "Move-In/Move-Out (Erosion Control)" of these special provisions.

The Engineer will designate the ground location of all erosion control (Hydroseed) areas in increments of one acre or smaller by directing the placing of stakes or other suitable markers. Furnish all tools, labor, materials, and transportation required to adequately indicate the various erosion control (Hydroseed) locations.

MATERIALS

Seed

Seed not required to be labeled under the California Food and Agricultural Code must be tested for purity and germination by a seed laboratory certified by the Association of Official Seed Analysts or by a seed technologist certified by the Society of Commercial Seed Technologists. Measure and mix individual seed species in the presence of the Engineer.

Seed must contain at most 1.0 percent total weed seed by weight.

Deliver seed to the job site in unopened separate containers with the seed tag attached. Containers without a seed tag attached are not accepted. The Engineer takes a sample of approximately one ounce or 0.25 cup of seed for each seed lot greater than 2 pounds.

Seed must comply with the following:

Seed

Botanical Name (Common Name)	Percent Germination (Minimum)	Pounds Pure Live Seed Per Acre (Slope Measurement)
Elymus X Triticum (Hybrid Sterile Wheatgrass)	50	60
Hordeum vulgare var. UC603 (Barley (UC603))	50	40
	Total	100

Seed Sampling Supplies

At the time of seed sampling, provide the Engineer a glassine lined bag and custody seal tag for each seed lot sample.

Organic Fertilizer

Must be a pelleted or granular form and must be one of the following:

Organic Fertilizer

Products	Guaranteed Chemical Analysis (N-P-K) (%)	Company
Biosol Mix® - Granular	7-2-3	Rocky Mountains Bioproducts Edwards, CO
Fertil-Fibers™	6-4-1	Quattro Environmental Coronado, CA
Sustane®	5-2-4	Natural Fertilizer of America Cannon Falls, MN
Approved Equal[1]	(N) 5 to 7 (P) 1 to 5 (K) 2 to 10	

[1]Approved equal must be within the ranges shown for N-P-K. The cumulative (N) release rate must be no more than 70 percent the first 70 days after incubation (86° F) with 100 percent at 350 days or more.

Tackifier

Tackifier must be:

1. Polymeric Emulsion Blend

Tackifier must comply with the following:

1. Nonflammable
2. Nontoxic to aquatic organisms
3. Free from growth or germination inhibiting factors
4. Either a plant-based product or a polymeric-emulsion blend

Tackifier classified as polymeric emulsion blend must comply with the following:

1. A liquid or dry powder formulation
2. Anionic with a residual monomer content that is at most 0.05 percent by weight
3. Functional for at least 180 days
4. A prepackaged product labeled as containing one of the following as the primary active ingredient of the polymeric emulsion blend:

   4.1 Acrylic copolymers and polymers
   4.2 Polymers of methacrylates and acrylates
   4.3 Copolymers of sodium acrylates and acrylamides
   4.4 Polyacrylamide (PAM) and copolymer of acrylamide
   4.5 Hydrocolloid polymers

Fiber

Fiber must be produced from one or a combination of the following materials:

1. Newsprint or corrugated cardboard
2. Coconut or excelsior
3. Certified weed free rice straw
4. Certified weed free non-rice straw

Coloring Agent

Use a biodegradable, nontoxic coloring agent free from copper, mercury, and arsenic.

CONSTRUCTION

Site Preparation

Immediately prior to applying seed to erosion control (Hydroseed) areas, trash and debris and weeds must be removed.

Removed weeds must be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Application

Prior to applying erosion control materials, all hydroseeding equipment and vehicles must be clean and free of any seed or material that is not part of the specified mixture.

Apply erosion control (Hydroseed) materials in separate applications in the following sequence:

1. Apply the following mixture with hydroseeding equipment at the rates indicated within 60 minutes after the seed has been added to the mixture:

Material	Pounds Per Acre (Slope Measurement)
Seed	100
Fiber	320
Organic Fertilizer	1,200

2. Apply the following mixture with hydro-seeding equipment at the corresponding rates:

Material	Pounds Per Acre (Slope Measurement)
Fiber	320
Tackifier	150

The ratio of total water to total tackifier in the mixture must be as recommended by the manufacturer.

Hydraulic application of erosion control (Hydroseed) materials for rolled erosion control product (Netting) areas must be applied by hose, from the ground. Erosion control (Hydroseed) materials must be applied onto the slope face such that the materials are well integrated into the rolled erosion control product (Netting) and in contact with ground surface. Application must be perpendicular to the slope face such that rolled erosion control product (Netting) materials are not damaged or displaced.

The Engineer may change the rates of erosion control (Hydroseed) materials to meet field conditions.

For any area where erosion control (Hydroseed) materials are to be applied, the application of all erosion control (Hydroseed) materials to be applied to that area must be completed within 72 hours from when the first materials were applied.

MEASUREMENT AND PAYMENT

Erosion control (Hydroseed) will be measured by the square foot or by the acre, whichever is designated in the Engineer's Estimate. The area will be calculated on the basis of actual or computed slope measurements.

The contract price paid per square foot or acre for erosion control (Hydroseed) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in erosion control (Hydroseed) complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.62 EROSION CONTROL (COMPOST BLANKET)

GENERAL

Summary

This work includes removing and disposing of weeds, applying compost to erosion control (Compost Blanket) areas shown on the plans.

Comply with Section 20-3, "Erosion Control," of the Standard Specifications.

The Engineer will designate the ground location of all erosion control (Compost Blanket) areas in increments of one acre or smaller by directing the placing of stakes or other suitable markers. Furnish all tools, labor, materials, and transportation required to adequately indicate the various erosion control (Compost Blanket) locations.

MATERIALS

Compost

The compost producer must be fully permitted as specified under the California Integrated Waste Management Board, Local Enforcement Agencies and any other State and Local Agencies that regulate Solid Waste Facilities. If exempt from State permitting requirements, the composting facility must certify that it follows guidelines and procedures for production of compost meeting the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7.

The compost producer must be a participant in United States Composting Council's Seal of Testing Assurance program.

Compost may be derived from any single, or mixture of the following feedstock materials:

1. Green material consisting of chipped, shredded, or ground vegetation, or clean processed recycled wood products except fiber from chipboard
2. Biosolids
3. Manure
4. Mixed food waste

Compost feedstock materials to reduce weed seeds, pathogens and deleterious materials as specified under Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7, Section 17868.3.

Compost must not be derived from mixed municipal solid waste and must be reasonably free of visible contaminates. Compost must not contain paint, petroleum products, pesticides or any other chemical residues harmful to animal life or plant growth. Compost must not possess objectionable odors.

Metal concentrations in compost must not exceed the maximum metal concentrations listed under Title 14, California Code of Regulations, Division 7, Chapter 3.1, Section 17868.2.

Compost must comply with the following:

Physical/Chemical Requirements

Property	Test Method	Requirement
pH	*TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0–8.0
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0-10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- 5 deg C % Wet Weight Basis	30-60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30–65
Maturity	TMECC 05.05-A Germination and Vigor Seed Emergence Seedling Vigor % Relative to Positive Control	 80 or Above 80 or Above
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	8 or below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	100% Passing, 3 inch 90-100% Passing, 1 inch 65-100% Passing, 3/4 inch 0 - 75% Passing, 1/4 inch Maximum length 6 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	Pass
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	Pass
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps (Sewing needles, straight pins and hypodermic needles) % > 4mm fraction	None Detected

*TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

Before compost application, provide the Engineer with a copy of the compost producer's compost technical data sheet and a copy of the compost producer's Seal of Testing Assurance certification.

The compost technical data sheet must include:

1. Laboratory analytical test results
2. List of product ingredients

Before compost application, provide the Engineer with a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

CONSTRUCTION

Site Preparation

Immediately prior to applying compost to erosion control (Compost Blanket) areas remove trash, debris and weeds.

Removed weeds must be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Application

Apply compost to a uniform thickness.

Erosion control (Compost Blanket) must extend to the edge of retaining sidewalks, walls, curbs, dikes, paving, and to within 4 feet from the flow line of paved and unpaved drainage ditches.

MEASUREMENT AND PAYMENT

Erosion Control (Compost Blanket) will be measured by the cubic yard of compost in the vehicle at the point of delivery in conformance with the provisions in Section 9-1.01, "Measurement of Quantities," of the Standard Specifications.

The contract price paid per cubic yard for erosion control (Compost Blanket) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in erosion control (Compost Blanket), as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.63 FIBER ROLLS

GENERAL

Summary

This work includes installing fiber rolls.

At the option of the Contractor, fiber rolls shall be Type 1 or Type 2.

MATERIALS

Fiber Roll

Fiber roll shall be:

1. A premanufactured roll of rice straw encapsulated within a biodegradable jute, sisal, or coir fiber netting. The netting shall have a minimum durability of one year after installation. The netting shall be secured tightly at each end of the roll. Rolls shall be between 8 inches and 12 inches in diameter. Rolls between 8 inches and 10 inches in diameter shall have a minimum weight of 1 pound per linear foot and a minimum length of 20 feet. Rolls between 10 inches and 12 inches in diameter shall have a minimum weight of 3 pounds per linear foot and a minimum length of 10 feet.

Stakes

Wood stakes shall be a minimum of 1" x 1" x 24" in size for Type 1 installation, or a minimum of 1" x 2" x 24" in size for Type 2 installation. Wood stakes shall be untreated fir, redwood, cedar, or pine and cut from sound timber. They shall be straight and free of loose or unsound knots and other defects which would render them unfit for the purpose intended. Metal stakes shall not be used.

Rope

Rope shall be biodegradable, such as sisal or manila, with a minimum diameter of 1/4 inch.

CONSTRUCTION

Installation

Fiber rolls shall be installed as follows:

1. Fiber rolls (Type 1): Furrows shall be constructed to a depth between 2 inches and 4 inches, and to a sufficient width to hold the fiber roll. Stakes shall be installed 24 inches apart along the length of the fiber rolls and stopped at 12 inches from each end of the rolls. Stakes shall be driven to a maximum of 2 inches above, or flush with the top of the roll.
2. Fiber rolls (Type 2): Rope and notched stakes shall be used to restrain the fiber rolls against the slope. Stakes shall be driven into the slope until the notch is even with the top of the fiber roll. Rope shall be knotted at each stake and laced between stakes. After installation of the rope, stakes shall be driven into the slope such that the rope will hold the fiber roll tightly to the slope. Furrows will not be required.
3. Fiber rolls shall be as shown on the plans.
4. The bedding area for the fiber rolls shall be cleared of obstructions including rocks, clods, and debris greater than one inch in diameter before installation.
5. Fiber rolls shall be installed approximately parallel to the slope contour.

If the intended function of the fiber rolls to disperse concentrated water runoff and to reduce runoff velocities is impaired, the Contractor shall take action to repair or replace the fiber rolls. Split, torn, or unraveling rolls shall be repaired or replaced. Broken or split stakes shall be replaced. Sagging or slumping fiber rolls shall be repaired with additional stakes or replaced. Locations where rills and other evidence of concentrated runoff have occurred beneath the rolls shall be corrected. Fiber rolls shall be repaired or replaced within 24 hours of identifying the deficiency.

MEASUREMENT AND PAYMENT

Quantities of fiber rolls to be paid for will be determined by the linear foot measured along the centerline of the installed roll. Where fiber rolls are joined and overlapped, the overlap will be measured as a single installed roll.

The contract price paid per linear foot for fiber roll shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing fiber rolls, complete in place, including furrow excavation and backfill, repairing or replacing fiber rolls as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.64 IRRIGATION CROSSOVERS

Irrigation crossovers shall conform to the provisions in Section 20-5, "Irrigation Systems," of the Standard Specifications and these special provisions.

Conduits shall be placed in open trenches in conformance with the provisions in Section 20-5.03B, "Conduit for Irrigation Crossovers," of the Standard Specifications.

Conduits shall be corrugated high density polyethylene (CHDPE) pipe. Corrugated high density polyethylene pipe shall conform to the requirements in ASTM Designation: F 405 or F 667, or AASHTO Designation: M 252 or M 294 and shall be Type S. Couplings and fittings shall be as recommended by the pipe manufacturer.

Water line crossovers shall conform to the provisions in Section 20-5.03C, "Water Line Crossovers," of the Standard Specifications.

Fittings for water line crossovers shall be Schedule 80.

Sprinkler control crossovers shall conform to the provisions in Section 20-5.027D, "Sprinkler Control Crossovers," of the Standard Specifications.

Installation of pull boxes shall conform to the provisions in Section 20-5.027I, "Conductors, Electrical Conduit and Pull Boxes," of the Standard Specifications. When no conductors are installed in electrical conduits, pull boxes for irrigation crossovers shall be installed on a foundation of compacted soil.

10-1.65 IMPORTED TOPSOIL

GENERAL

Summary

This work includes applying and consolidating topsoil.

Imported topsoil must be furnished with a soil report and fertility analysis from a California certified soil and plant laboratory for minimum compliance with these special provisions. Submit 3 copies of the lab report for the Engineer's approval.

The Engineer will take a sample of approximately one quart to one gallon of the imported topsoil material to test for compliance with these special provisions.

MATERIAL

Comply with Section 20-2.01, "Topsoil," of the Standard Specifications, and these special provisions.

Imported topsoil must be sandy loam of an even texture with the following composition:

Soil Type	Composition Range (Percent)
Sand	10-80
Silt	0-50
Clay	5-30

Imported topsoil must have a neutral soil reaction with a pH of not less than 5.5 nor greater than 7.0. The topsoil must have a low saline alkali content-saturation extract; an electrical conductivity of not more than 4 mmhos/cm at 25 degrees centigrade, an exchangeable sodium or sodium cation content of not more than 6 percent of the total metallic cation content, and a boron content must not be greater than 1 ppm measured on the saturation extract.

CONSTRUCTION

Comply with Section 20-3.02, "Preparation," of the Standard Specifications.

Spread topsoil to a uniform thickness.

Trackwalk topsoil with tracked equipment run perpendicular to slope contours. Water may be used to assist this process but must not cause erosion.

10-1.66 CLASS 3 AGGREGATE SUBBASE

Aggregate subbase must comply with Section 25, "Aggregate Subbases," of the Standard Specifications and these special provisions.

Aggregate subbase must be Class 3.

Do not store reclaimed asphalt concrete or aggregate subbase with reclaimed asphalt concrete within 100 feet measured horizontally of any culvert, watercourse, or bridge.

10-1.67 CLASS 4 AGGREGATE SUBBASE

Aggregate subbase must comply with Section 25, "Aggregate Subbases," of the Standard Specifications and these special provisions.

Aggregate subbase must be Class 4.

Do not store reclaimed asphalt concrete or aggregate subbase with reclaimed asphalt concrete within 100 feet measured horizontally of any culvert, watercourse, or bridge.

Class 4 aggregate subbase must comply with:

Grading (Percentage Passing)

Sieve Sizes	Operating Range	Contract Compliance
$2\ ^{1}/_{2}$	100	100
No. 4	30-65	25-70
No. 200	0-15	0-18

Quality

Test	Operating Range	Contract Compliance
Sand Equivalent	21 Min.	18 Min.
Resistance (R-value)	----	50 Min.

If tests show grading or sand equivalent does not comply with the "Operating Range" specifications but complies with the "Contract Compliance" specifications, you may place aggregate subbase for the remainder of that day. Do not start another day's work until tests or other information indicate the next day's material complies with the "Operating Range" specifications.

If tests show grading or sand equivalent does not comply with the "Contract Compliance" specifications, remove the aggregate subbase represented by the tests. If you request and the Engineer approves, that aggregate subbase may remain in place and the Department reduces payment by $2.00 per cubic yard for that aggregate subbase. If both the grading and sand equivalent do not comply with "Contract Compliance" specifications and the subbase remains in place, the Department only makes one payment reduction.

No single grading or sand equivalent test may represent more than the smaller of 500 cubic yards or one day's production.

Instead of Class 4 aggregate subbase, you may place Class 2 aggregate subbase complying with the aggregate grading and quality requirements in Section 25-1.02A, "Class 1, Class 2, and Class 3 Aggregate Subbases," of the Standard Specifications. If you place Class 2 aggregate subbase, do not change back to Class 4 subbase without written approval from the Engineer.

Regardless of the aggregate subbase class supplied, the Department pays for aggregate subbase as Class 4 aggregate subbase.

10-1.68 AGGREGATE BASE

Aggregate bases must comply with Section 26, "Aggregate Bases," of the Standard Specifications and these special provisions.

Aggregate base must be Class 2 or Class 3 where specified.

Do not store reclaimed asphalt concrete or aggregate base with reclaimed asphalt concrete within 100 feet measured horizontally of any culvert, watercourse, or bridge.

For Class 2 aggregate base must be 3/4 inch maximum grading.

For Class 3 aggregate base, choose the 1-1/2 inch maximum or the 3/4 inch maximum grading.

Aggregate for Class 3 aggregate base must comply with:

Grading (Percentage Passing)

Sieve Sizes	1-1/2 inch Maximum		3/4 inch Maximum	
	Operating Range	Contract Compliance	Operating Range	Contract Compliance
2"	100	100	-------	-------
1-1/2"	90 - 100	87 - 100	-------	-------
1"	-------	-------	100	100
3/4"	50 - 90	45 - 95	90 - 100	87 - 100
No. 4	25 - 60	20 - 65	40 - 70	35 - 75
No. 30	10 - 35	6 - 39	12 - 40	7 - 45
No. 200	3 - 15	0 - 19	3 - 15	0 - 19

Quality

Tests	Operating Range	Contract Compliance
Sand Equivalent	21 min.	18 min.
Resistance (R-value)	---------	50 min.
Durability Index		35 min

Do not treat aggregate with lime, cement, or other chemical material before the Department performs the Durability Index test. The Engineer does not consider any untreated processed asphalt concrete and portland cement concrete to be treated with lime, cement, or other chemical material for purposes of performing the Durability Index test.

If tests show grading or sand equivalent does not comply with the "Operating Range" specifications but complies with the "Contract Compliance" specifications, you may place aggregate base for the remainder of that day. Do not start another day's work until tests or other information indicate the next day's material complies with the "Operating Range" specifications.

If tests show grading or sand equivalent does not comply with the "Contract Compliance" specifications, remove the aggregate base represented by the tests. If you request and the Engineer approves, that aggregate base may remain in place and the Department reduces payment by $2.25 per cubic yard for that aggregate base. If both the grading and sand equivalent do not comply with "Contract Compliance" specifications and the material is left in place, the Department only makes one payment reduction.

No single grading or sand equivalent test may represent more than the smaller of 500 cubic yards or one day's production.

If aggregate base is specified to be measured by the ton, the Engineer converts tons to cubic yards for the purpose of reducing payment for noncompliant aggregate base left in place.

10-1.69 LEAN CONCRETE BASE

Lean concrete base shall conform to the provisions in Section 28, "Lean Concrete Base," of the Standard Specifications and these special provisions.

The finished surface of lean concrete base shall not be above the grade established by the Engineer, or more than 0.05-foot below the grade established by the Engineer.

10-1.70 TREATED PERMEABLE BASE

Treated permeable base shall be asphalt treated and shall conform to the provisions in Section 29, "Treated Permeable Bases," of the Standard Specifications and these special provisions.

The type of asphalt binder to be mixed with aggregate for treated permeable base shall be Grade PG 64-10 conforming to the provisions in Section 92, "Asphalts," of the Standard Specifications.

10-1.71 HOT MIX ASPHALT

GENERAL

Summary

This work includes producing and placing hot mix asphalt (HMA) Type A using the Quality Control / Quality Assurance (QC / QA) process.

Comply with Section 39, "Hot Mix Asphalt," of the Standard Specifications.

Submittals

Quality Control / Quality Assurance Projects

With the job mix formula (JMF) submittal, submit:

1. California Test 204 plasticity index results
2. California Test 371 tensile strength ratio results for untreated HMA
3. California Test 371 tensile strength ratio results for treated HMA if untreated HMA tensile strength ratio is below 70

At project start-up and once during production, submit samples split from your HMA production sample for California Test 371 to the Engineer and the Transportation Laboratory, Attention: Moisture Test.

With the JMF submittal, at project start-up, and each 5,000 tons, submit the California Test 371 test results for mix design and production to the Engineer and electronically to:

Moisture_Tests@dot.ca.gov

Data Cores

Three business days before starting coring, submit proposed methods and materials for backfilling data core holes.

Submit to the Engineer and electronically to Coring@dot.ca.gov:

1. A summary of data cores taken
2. A photograph of each data core

For each data core, the summary must include:

1. Project identification number
2. Date cored
3. Core identification number
4. Type of materials recovered
5. Type and approximate thickness of unstabilized material not recovered
6. Total core thickness
7. Thickness of each individual material to within:

    7.1 For recovered material, 1/2 inch
    7.2 For unstabilized material, 1.0 inch

8. Location including:

    8.1. County
    8.2. Route
    8.3. Post mile
    8.4. Lane number
    8.5. Lane direction
    8.6. Station

Each data core digital photograph must include a ruler laid next to the data core. Each photograph must include:

1. The core
2. Project identification number
3. Core identification number
4. Date cored
5. County
6. Route
7. Post mile
8. Lane number
9. Lane direction

After data core summary and photograph submittal, dispose of cores under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Quality Control and Assurance

Quality Control / Quality Assurance Projects

For the mix design, determine the plasticity index of the aggregate blend under California Test 204. Choose an antistrip treatment and use the corresponding laboratory procedure for the mix design in compliance with:

Antistrip Treatment Lab Procedures for Mix Design

Antistrip Treatment	Lab Procedure
Plasticity index from 4 to 10 [a]	
Dry hydrated lime with marination	LP-6
Lime slurry with marination	LP-7
Plasticity index less than 4	
Liquid	LP-5
Dry hydrated lime without marination	LP-6
Dry hydrated lime with marination	LP-6
Lime slurry with marination	LP-7

Notes:
[a] If the plasticity index is greater than 10, do not use that aggregate blend.

For the mix design, determine tensile strength ratio under California Test 371 on untreated HMA. If the tensile strength ratio is less than 70:

1. Choose from the antistrip treatments specified based on plasticity index.
2. Test treated HMA under California Test 371.
3. Treat to a minimum tensile strength ratio of 70.

On the first production day and at least every 5,000 tons, sample HMA and test under California Test 371.

The Department does not use California Test 371 test results for JMF verification and production to determine specification compliance.

MATERIALS

Asphalt Binder

The grade of asphalt binder mixed with aggregate for HMA Type A must be PG 64-10.

Aggregate

The aggregate for HMA Type A must comply with the 3/4 inch grading.

CONSTRUCTION

Vertical Joints

If you perform half-width paving, at the end of each day's work the distance between the ends of adjacent surfaced lanes must not be greater than can be completed in the following day of normal paving.

Before opening the lane to public traffic, pave shoulders and median borders adjacent to a lane being paved.

Do not leave a vertical joint more than 0.15 foot high between adjacent lanes open to public traffic.

Conform Tapers

Place additional HMA along the pavement's edge to conform to road connections and private drives. Hand rake, if necessary, and compact the additional HMA to form a smooth conform taper.

Data Cores

Take data cores that include the completed HMA pavement, underlying base, and subbase material. Protect data cores and surrounding pavement from damage.

Take 4-inch or 6-inch diameter data cores:

1. At the beginning, end, and every 1/2 mile within the paving limits of each route on the project
2. After all paving is complete
3. From the center of the specified lane

On a 2-lane roadway, take data cores from either lane. On a 4-lane roadway, take data cores from each direction in the outermost lane. On a roadway with more than 4 lanes, take data cores from the median lane and the outermost lane in each direction.

Each core must include the stabilized materials encountered. You may choose not to recover unstabilized material but you must identify the material. Unstabilized material includes:

1. Granular material
2. Crumbled or cracked stabilized material
3. Sandy or clayey soil

PAYMENT

The contract lump sum price paid for data core includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in data coring, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.72 MINOR HOT MIX ASPHALT

GENERAL

Summary

This work includes producing hot mix asphalt (HMA) at a central mixing plant and placing it as specified.

MATERIALS

For minor HMA:

1. Do not submit a job mix formula.
2. Choose the 3/8-inch or 1/2-inch HMA Type A aggregate gradation under Section 39-1.02E, "Aggregate," of the Standard Specifications.
3. Minimum asphalt binder content must be 6.8 percent for 3/8-inch aggregate gradation and 6.0 percent for 1/2-inch aggregate gradation.
4. Choose asphalt binder Grade PG 64-10, PG 64-16, or PG 70-10 under Section 92, "Asphalts," of the Standard Specifications.

If you request and the Engineer authorizes, you may reduce the minimum asphalt binder content.

Tack coat must comply with Section 39, "Hot Mix Asphalt," of the Standard Specifications.

CONSTRUCTION

Using a self-propelled spreader, spread minor HMA ready for compacting without further shaping.

Compact minor HMA with a vibratory roller providing a minimum of 7,000 pounds centrifugal force. With the vibrator on, compact at least 3 complete coverages over each layer, overlapping to prevent displacement. The speed of the vibratory roller in miles per hour must not exceed the vibrations per minute divided by 1,000. If the HMA layer thickness is less than 0.08 foot, turn the vibrator off. Complete the first coverage before the mixture's temperature drops below 250 °F.

Minor HMA finished surface must be:

1. Textured uniformly
2. Compacted firmly
3. Without depressions, humps, and irregularities
4. Compliant with the 12-foot straightedge specifications in Section 39-1.12, "Smoothness," of the Standard Specifications

10-1.73 HOT MIX ASPHALT AGGREGATE LIME TREATMENT - SLURRY METHOD

GENERAL

Summary

This work includes treating hot mix asphalt (HMA) aggregate with lime using the slurry method and placing it in stockpiles to marinate.

Treat aggregate for HMA (Type A) with lime slurry.

Submittals

Determine the exact lime proportions for fine and coarse virgin aggregate and submit them as part of the proposed job mix formula (JMF) under Section 39, "Hot Mix Asphalt," of the Standard Specifications.

Submit the averaged aggregate quality test results to the Engineer within 24 hours of sampling.

Submit a treatment data log from the slurry proportioning device in the following order:

1. Treatment date
2. Time of day the data is captured
3. Aggregate size being treated
4. Wet aggregate flow rate collected directly from the aggregate weigh belt
5. Moisture content of the aggregate just before treatment, expressed as a percent of the dry aggregate weight
6. Dry aggregate flow rate calculated from the wet aggregate flow rate
7. Lime slurry flow rate measured by the slurry meter
8. Dry lime flow rate calculated from the slurry meter output
9. Approved lime ratio for each aggregate size being treated
10. Actual lime ratio calculated from the aggregate weigh belt and the slurry meter output, expressed as a percent of the dry aggregate weight
11. Calculated difference between the approved lime ratio and the actual lime ratio
12. Dry lime and water proportions at the slurry treatment time

Every day during lime treatment, submit the treatment data log on electronic media in tab delimited format on a removable CD-ROM storage disk. Each continuous treatment data set must be a separate record using a line feed carriage return to present the specified data on one line. The reported data must include data titles at least once per report.

Quality Control and Assurance

Your quality control plan (QCP) must include aggregate quality control sampling and testing during aggregate lime treatment. Perform sampling and testing in compliance with:

Aggregate Quality Control During Lime Treatment

Quality Characteristic	Test Method	Minimum sampling and testing frequency
Sand Equivalent	CT 217	Once per 1,000 tons of aggregate treated with lime
Percent of crushed particles	CT 205	As necessary and as designated in the QCP
Los Angeles Rattler	CT 211	
Fine aggregate angularity	AASHTO T 304, Method A	
Flat and elongated particles	ASTM D 4791	

Note: During lime treatment, sample coarse and fine aggregate from individual stockpiles. Combine aggregate in the JMF proportions. Run tests for aggregate quality in triplicate and report test results as the average of 3 tests.

The Engineer orders proportioning operations stopped for any of the following if you:

1. Do not submit the treatment data log.
2. Do not submit the aggregate quality control data.
3. Submit incomplete, untimely, or incorrectly formatted data.
4. Do not take corrective actions.
5. Take late or unsuccessful corrective actions.
6. Do not stop treatment when proportioning tolerances are exceeded.
7. Use malfunctioning or failed proportioning devices.

If you stop treatment, notify the Engineer of any corrective actions taken and conduct a successful 20-minute test run before resuming treatment.

For the aggregate to be treated, determine the moisture content at least once during each 2 hours of treatment. Calculate moisture content under California Test 226 or California Test 370 and report it as a percent of dry aggregate weight. Use the moisture content calculations as a set point for the proportioning process controller.

MATERIALS

High-calcium hydrated lime and water must comply with Section 24-1.02, "Materials," of the Standard Specifications.

Before virgin aggregate is treated, it must comply with the aggregate quality specifications. Do not test treated aggregate for quality control except for gradation. The Engineer does not test treated aggregate for acceptance except for gradation.

The Engineer determines the combined aggregate gradation during HMA production after you have treated aggregate. If reclaimed asphalt pavement (RAP) is used, the Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.

Treated aggregate must not have lime balls or clods.

CONSTRUCTION

General

Notify the Engineer at least 24 hours before the start of aggregate treatment.

Treat aggregate separate from HMA production.

Do not treat RAP.

Add lime to the aggregate as slurry consisting of mixed dry lime and water at a ratio of 1 part lime to between 2 parts and 3 parts water by weight. The slurry must completely coat the aggregate.

Lime treat and marinate coarse and fine aggregates separately.

Immediately before mixing lime slurry with aggregate, water must not visibly separate from aggregate.

Treat aggregate and stockpile for marination only once.

The lime ratio is the pounds of dry hydrated lime per 100 pounds of dry virgin aggregate expressed as a percent. Water content of slurry or untreated aggregate must not affect the lime ratio.

Lime ratio ranges are:

Aggregate Gradation	Lime Ratio
Coarse	0.4 to 1.0
Fine	1.5 to 2.0
Combined virgin aggregate	0.8 to 1.5

The lime ratio for fine and coarse aggregate must be within ±0.2 percent of the lime ratio in the accepted JMF. The lime ratio must be within ±0.2 percent of the approved lime ratio when you combine the individual aggregate sizes in the JMF proportions. The lime ratio must be determined before the addition of RAP.

If 3 consecutive sets of recorded treatment data indicate deviation more than 0.2 percent above or below the lime ratio in the accepted JMF, stop treatment.

If a set of recorded treatment data indicates a deviation of more than 0.4 percent above or below the lime ratio in the accepted JMF, stop treatment and do not use the material represented by that set of data in HMA.

If 20 percent or more of the total daily treatment indicates deviation of more than 0.2 percent above or below the lime ratio in the accepted JMF, stop treatment and do not use the day's total treatment in HMA.

If you stop treatment for noncompliance, you must implement corrective action and successfully treat aggregate for a 20-minute period. Notify the Engineer before beginning the 20-minute treatment period.

Lime Slurry Proportioning

Proportion lime and water with a continuous or batch operation.

The device controlling slurry proportioning must produce a treatment data log. The log consists of a series of data sets captured at 10-minute intervals throughout daily treatment. The data must be a treatment activity register and not a summation. The material represented by the data set is the amount produced 5 minutes before and 5 minutes after the capture time. For the contract's duration, collected data must be stored by the controller.

Proportioning and Mixing Lime Slurry Treated Aggregate

Treat HMA aggregate by proportioning lime slurry and aggregate by weight in a continuous operation.

Marinate treated aggregate in stockpiles from 24 hours to 60 days before using in HMA. Do not use aggregate marinated longer than 60 days.

MEASUREMENT AND PAYMENT

Full compensation for treating aggregates with lime slurry shall be considered as included in the contract price paid per ton for HMA as designated in the Engineer's Estimate and no separate payment will be made therefor.

10-1.74 HOT MIX ASPHALT AGGREGATE LIME TREATMENT - DRY LIME METHOD

GENERAL

Summary

This work includes treating hot mix asphalt (HMA) aggregate with lime using the dry lime method either with marination or without.

Treat aggregate for HMA (Type A) with dry lime.

Marinate aggregate if the plasticity index determined under California Test 204 is from 4 to 10.

Submittals

Determine the exact lime proportions for fine and coarse virgin aggregate and submit them as part of the proposed job mix formula (JMF) under Section 39, "Hot Mix Asphalt," of the Standard Specifications.

If marination is required, submit in writing the averaged aggregate quality test results to the Engineer within 24 hours of sampling.

Submit in writing a treatment data log from the dry lime and aggregate proportioning device in the following order:

1. Treatment date
2. Time of day the data is captured
3. Aggregate size being treated
4. HMA type and mix aggregate size
5. Wet aggregate flow rate collected directly from the aggregate weigh belt

6. Aggregate moisture content, expressed as a percent of the dry aggregate weight
7. Flow rate of dry aggregate calculated from the flow rate of wet aggregate
8. Dry lime flow rate
9. Lime ratio from the accepted JMF for each aggregate size being treated
10. Lime ratio from the accepted JMF for the combined aggregate
11. Actual lime ratio calculated from the aggregate weigh belt output, the aggregate moisture input, and the dry lime meter output, expressed as a percent of the dry aggregate weight
12. Calculated difference between the approved lime ratio and the actual lime ratio

Every day during lime treatment, submit the treatment data log on electronic media in tab delimited format on a removable CD-ROM storage disk. Each continuous treatment data set must be a separate record using a line feed carriage return to present the specified data on one line. The reported data must include data titles at least once per report.

Quality Control and Assurance

If marination is required, the quality control plan (QCP) specified in Section 39-4, "Quality Control / Quality Assurance," must include aggregate quality control sampling and testing during lime treatment. Perform sampling and testing in compliance with:

Quality Characteristic	Test Method	Minimum sampling and testing frequency
Sand Equivalent	CT 217	Once per 1,000 tons of aggregate treated with lime
Percent of crushed particles	CT 205	As necessary and as designated in the QCP
Los Angeles Rattler	CT 211	
Fine aggregate angularity	AASHTO T 304, Method A	
Flat and elongated particles	ASTM D 4791	

Note: During lime treatment, sample coarse and fine aggregate from individual stockpiles. Combine aggregate in the JMF proportions. Run tests for aggregate quality in triplicate and report test results as the average of 3 tests.

The Engineer orders proportioning operations stopped for any of the following if you:

1. Do not submit the treatment data log
2. Do not submit the aggregate quality control data for marinated aggregate
3. Submit incomplete, untimely, or incorrectly formatted data
4. Do not take corrective actions
5. Take late or unsuccessful corrective actions
6. Do not stop treatment when proportioning tolerances are exceeded
7. Use malfunctioning or failed proportioning devices

If you stop treatment, notify the Engineer of any corrective actions taken and conduct a successful 20-minute test run before resuming treatment.

MATERIALS

Lime must be high-calcium hydrated lime. Lime and water must comply with Section 24-1.02, "Materials," of the Standard Specifications.

Before virgin aggregate is treated, it must comply with the aggregate quality specifications. Do not test treated aggregate for quality control except for gradation. The Engineer does not test treated aggregate for acceptance except for gradation.

The Engineer determines the combined aggregate gradation during HMA production after you have treated aggregate. If reclaimed asphalt pavement (RAP) is used, the Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.

Treated aggregate must not have lime balls or clods.

CONSTRUCTION

General

Notify the Engineer in writing at least 24 hours before the start of aggregate treatment.
Do not treat RAP.
If marination is required:

1. Treat and marinate coarse and fine aggregates separately.
2. Treat aggregate and stockpile for marination only once.
3. Treat aggregate separate from HMA production.

The lime ratio is the pounds of dry hydrated lime per 100 pounds of dry virgin aggregate expressed as a percent. Water content of untreated aggregate must not affect the lime ratio.

Lime ratio ranges are:

Aggregate Gradation	Lime Ratio
Coarse	0.4 to 1.0
Fine	1.5 to 2.0
Combined virgin aggregate	0.8 to 1.5

The lime ratio for fine and coarse aggregate must be within ±0.2 percent of the lime ratio in the accepted JMF. The lime ratio must be within ±0.2 percent of the approved lime ratio when you combine the individual aggregate sizes in the JMF proportions. Determine the lime ratio before you add RAP.

Proportion dry lime by weight with a continuous operation.

The device controlling dry lime and aggregate proportioning must produce a treatment data log. The log consists of a series of data sets captured at 10-minute intervals throughout daily treatment. The data must be a treatment activity register and not a summation. The material represented by a data set is the amount produced 5 minutes before and 5 minutes after the capture time. For the duration of the contract, collected data must be stored by the controller.

If 3 consecutive sets of recorded treatment data indicate deviation more than 0.2 percent above or below the lime ratio in the accepted JMF, stop treatment of lime treated aggregates.

If a set of recorded treatment data indicates a deviation of more than 0.4 percent above or below the lime ratio in the accepted JMF, stop treatment of lime treated aggregates and do not use the material represented by that set of data in HMA.

If 20 percent or more of the total daily treatment indicates deviation of more than 0.2 percent above or below the lime ratio in the accepted JMF, stop treatment and do not use the day's treated aggregate in HMA.

If you stop treatment for noncompliance, you must implement corrective action and successfully treat aggregate for a 20-minute period. Notify the Engineer before beginning the 20-minute treatment period.

If you use a batch-type proportioning operation for HMA production, control proportioning in compliance with the specifications for continuous mixing plants. Use a separate dry lime aggregate treatment operation from HMA batching operations including:

1. Pugmill mixer
2. Controller
3. Weigh belt for the lime
4. Weigh belt for the aggregate

If using a continuous mixing operation for HMA without lime marinated aggregates, use a controller that measures the blended aggregate weight after any additional water is added to the mixture. The controller must determine the amount of lime added to the aggregate from the aggregate weigh belt input in connection with the manually input total aggregate moisture, the manually input target lime content, and the lime proportioning system output. Use a continuous aggregate weigh belt and pugmill mixer for the lime treatment operation in addition to the weigh belt for the aggregate proportioning to asphalt binder in the HMA plant. If you use a water meter for moisture control for lime treatment, the meter must comply with California Test 109.

At the time of mixing dry lime with aggregate, the aggregate moisture content must ensure complete lime coating. The aggregate moisture content must not cause aggregate to be lost between the point of weighing the combined aggregate continuous stream and the dryer. Add water for mixing and coating aggregate to the aggregate before dry lime addition. Immediately before mixing lime with aggregate, water must not visibly separate from aggregate.

The HMA plant must be equipped with a bag house dust system. Material collected in the dust system must be returned to the mix.

Mixing Dry Lime and Aggregate

Mix aggregate, water, and dry lime with a continuous pugmill mixer with twin shafts. Immediately before mixing lime with aggregate, water must not visibly separate from aggregate. Store dry lime in a uniform and free flowing condition. Introduce dry lime to the pugmill in a continuous operation. The introduction must occur after the aggregate cold feed and before the point of proportioning across a weigh belt and the aggregate dryer. Prevent loss of dry lime.

If marination is required, marinate treated aggregate in stockpiles between 24 hours and 60 days before using in HMA. Do not use aggregate marinated more than 60 days.

The pugmill must be equipped with paddles arranged to provide sufficient mixing action and mixture movement. The pugmill must produce a homogeneous mixture of uniformly coated aggregates at mixer discharge.

If the aggregate treatment operation is stopped longer than 1 hour, clean the equipment of partially treated aggregate and lime.

Aggregate must be completely treated before introduction into the mixing drum.

MEASUREMENT AND PAYMENT

Full compensation for dry lime treating HMA aggregate including marination shall be considered as included in the contract price paid per ton for HMA as designated in the Engineer's Estimate and no separate payment will be made therefor.

10-1.75 LIQUID ANTISTRIP TREATMENT

GENERAL

Summary

This work includes treating asphalt binder with liquid antistrip (LAS) treatment to bond the asphalt binder to aggregate in hot mix asphalt (HMA).

Submittals

For LAS, submit with the proposed job mix formula (JMF) submittal under Section 39, "Hot Mix Asphalt," of the Standard Specifications:

1. Materials Safety Data Sheet (MSDS)
2. One 1-pint sample
3. Infrared analysis including copy of absorption spectra

Submit a certified copy of test results and a MSDS for each LAS lot.

Submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each LAS shipment. With each certificate also submit:

1. Your signature and printed name
2. Shipment number
3. Material type
4. Material specific gravity
5. Refinery
6. Consignee
7. Destination
8. Quantity
9. Contact or purchase order number
10. Shipment Date

Submit proportions for LAS as part of the JMF submittal specified in Section 39-1.03, "Hot Mix Asphalt Mix Design Requirements," of the Standard Specifications. If you change the brand or type of LAS, submit a new JMF.

For each job site delivery of LAS, submit one 1/2-pint sample to the Transportation Laboratory. Submit shipping documents to the Engineer. Label each LAS sampling container with:

1. LAS type
2. Application rate
3. Sample date
4. Contract number

At the end of each day's production shift, submit production data in electronic and printed media. Present data on electronic media in tab delimited format. Use line feed carriage return with one separate record per line for each production data set. Allow sufficient fields for the specified data. Include data titles at least once per report. For each mixing operation type, submit in order:

1. Batch Mixing:

    1.1. Production date
    1.2. Time of batch completion
    1.3. Mix size and type
    1.4. Each ingredient's weight
    1.5. Asphalt binder content as percentage of dry aggregate weight
    1.6. LAS content as percentage of asphalt binder weight

2. Continuous Mixing:

    2.1. Production date
    2.2. Data capture time
    2.3. Mix size and type
    2.4. Flow rate of wet aggregate collected directly from the aggregate weigh belt
    2.5. Aggregate moisture content as percentage of dry aggregate weight
    2.6. Flow rate of asphalt binder collected from the asphalt binder meter
    2.7. Flow rate of LAS collected from the LAS meter
    2.8. Asphalt binder content as percentage of dry aggregate weight calculated from:

        2.8.1. Aggregate weigh belt output
        2.8.2. Aggregate moisture input
        2.8.3. Asphalt binder meter output

    2.9. LAS content as percentage of asphalt binder weight calculated from:

        2.9.1. Asphalt binder meter output
        2.9.2. LAS meter output

Quality Control and Assurance

For continuous mixing and batch mixing operations, sample asphalt binder before adding LAS. For continuous mixing operations, sample combined asphalt binder and LAS after the static mixer.

The Engineer orders proportioning operations stopped for any of the following if you:

1. Do not submit data
2. Submit incomplete, untimely, or incorrectly formatted data
3. Do not take corrective actions
4. Take late or unsuccessful corrective actions
5. Do not stop production when proportioning tolerances are exceeded
6. Use malfunctioning or failed proportioning devices

If you stop production, notify the Engineer of any corrective actions taken before resuming.

MATERIALS

LAS-treated asphalt binder must comply with Section 39, "Hot Mix Asphalt," of the Standard Specifications. LAS does not substitute for asphalt binder.

LAS total amine value must be 325 minimum when tested under ASTM D 2074.

Use only 1 LAS type or brand at a time. Do not mix LAS types or brands.

Store and mix LAS under the manufacturer's recommendations.

CONSTRUCTION

LAS must be between 0.5 and 1.0 percent by weight of asphalt binder.

If 3 consecutive sets of recorded production data show actual delivered LAS weight is more than ±1 percent of the approved mix design LAS weight, stop production and take corrective action.

If a set of recorded production data shows actual delivered LAS weight is more than ±2 percent of the approved mix design LAS weight, stop production. If the LAS weight exceeds 1.2 percent of the asphalt binder weight, do not use the HMA represented by that data.

The continuous mixing plant controller proportioning the HMA must produce a production data log. The log consists of a series of data sets captured at 10-minute intervals throughout daily production. The data must be a production activity register and not a summation. The material represented by the data is the amount produced 5 minutes before and 5 minutes after the capture time. For the duration of the contract, collected data must be stored by the plant controller or a computer's memory at the plant.

MEASUREMENT AND PAYMENT

Full compensation for LAS is included in the contract price paid per ton for HMA as designated in the Engineer's Estimate and no separate payment will be made therefor.

10-1.76 CONTINUOUSLY REINFORCED CONCRETE PAVEMENT

GENERAL

Summary

This work includes constructing continuously reinforced concrete pavement.

Comply with Section 40, "Concrete Pavement," of the Standard Specifications.

Submittals

If epoxy-coated steel is used in continuously reinforced concrete pavement, submit a copy of the certification for each plant used.

Submit coefficient of thermal expansion test results to the Engineer.

Quality Control and Assurance

General

Perform coefficient of thermal expansion testing under AASHTO T 336 at a frequency of 1 test for each day of paving.

Perform profilograph testing on concrete shoulders. Testing and test results for shoulders must comply with the specifications for concrete pavement smoothness, profilograph test procedure, and corrective action for traffic lanes.

Prepaving Conference

Meet with the Engineer at a prepaving conference at a mutually agreed time and place. The conference facility must be within 3 miles of the job site. Discuss methods of performing the production and paving work.

Prepaving conference attendees must sign an attendance sheet provided by the Engineer. The prepaving conference must be attended by your:

1. Project superintendent
2. Quality control manager
3. Paving construction foreman
4. Subcontractor's workers including:

    4.1. Foremen
    4.2. Concrete plant manager
    4.3. Concrete plant operator
    4.4. Personnel performing saw cutting and joint sealing

Do not start paving activities including test strips until the listed personnel have attended a prepaving conference.

Test Strips

The first paving activity must be to construct a test strip:

1. 700 to 1,000 feet long
2. Same width as the planned paving
3. With the same equipment used for the planned paving

The Engineer evaluates the test strip for compliance with the specifications for Engineer's acceptance.
The Engineer selects from 3 to 6 core locations per test strip.
Allow the Engineer 3 days to evaluate the test strip for:

1. Smoothness
2. Reinforcement alignment
3. Thickness
4. Final finishing except coefficient of friction is not evaluated

During the 3 day evaluation, the Engineer rejects a test strip if any of the following occurs:

1. Surface varies more than 0.02 feet from a straightedge's lower edge
2. Wheel path's individual high points are greater than 0.025 feet in 25 feet
3. Reinforcement does not comply with specified placement tolerances
4. Pavement thickness deficiency is greater than 0.05 feet
5. Final finishing does not comply with the specifications

Remove the test strip if the Engineer rejects it for noncompliance with the specifications for thickness or reinforcement alignment. Dispose of rejected test strip material under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

If the Engineer rejects the test strip for noncompliance with smoothness or final finishing specifications, you may grind the test strip into compliance if you intend to leave it as part of the paving.

If the Engineer accepts the test strip, you may start production paving while the Engineer continues to evaluate the test strip for compliance with the other specifications. If the Engineer rejects the test strip for noncompliance with the other specifications, stop production paving until you construct a test strip the Engineer accepts.

For rejected test strips, submit a plan for changed materials, methods, or equipment before constructing additional test strips. Construct additional test strips until the Engineer accepts one.

Construct additional test strips for any of the following:

1. You propose different paving equipment including:

    1.1. Batch plant
    1.2. Paver
    1.3. Tining
    1.4. Curing equipment

2. You change concrete mix proportions

The Engineer may allow paving to start without a test strip if you use a batch plant mixer, paving equipment, and personnel that completed a Department continuously reinforced concrete pavement project within the preceding 12 months. Submit supporting documents and previous project information to the Engineer.

Engineer's Acceptance

The Engineer accepts concrete pavement based on the Department's testing for the following additional test:

Concrete Pavement Acceptance

Test or Determination	Frequency	Test
Coefficient of Thermal Expansion	1 test per day of paving	AASHTO T 336

MATERIALS

Concrete

Concrete for terminal joints, support slabs, and pavement anchors must comply with the specifications for concrete for continuously reinforced concrete pavement.

The thermal coefficient of expansion determined under AASHTO T 336 for concrete used in continuously reinforced concrete pavement must not exceed 6 x 10^{-6} inch/inch at 68 °F.

Bar Reinforcement

Bar reinforcement may be epoxy-coated or uncoated in compliance with the following:

1. If epoxy-coated, bar reinforcement must comply with ASTM A 706/A 706M. Epoxy-coating must comply with ASTM A 934/A 934M. Epoxy-coating must be purple or gray and handled at the manufacturing plant and job site under ASTM D 3963/D 3963M and Section 52-1.02B, "Epoxy-coated Reinforcement," of the Standard Specifications.
2. If uncoated, bar reinforcement must comply with ASTM A 1035/A 1035 M.

Dowel Bars and Dowel Bar Baskets

Dowel bars and dowel bar baskets may be epoxy-coated or uncoated in compliance with the following:

1. Epoxy coating must comply with ASTM A 884/A 884M, Class A, Type 2. Epoxy coating must be purple or gray.
2. If uncoated, dowel bars must comply with the following:

    2.1. Descaled, pickled, and polished solid stainless steel bars, UNS Designation S31603 or S31803, Grade 60 under ASTM A 276/ A 276M, and ASTM A 955/ A 955M.
    2.2. If placed under the basket placing method, stainless steel baskets must comply with ASTM A 493/ A 493M, UNS S31600 or S31603.

Tie Bars

Tie bars may be epoxy-coated or uncoated in compliance with the following:

1. Epoxy coating must comply with ASTM A 934/A 934M. Epoxy-coating must be purple or gray.
2. If uncoated, tie bars must comply with ASTM A 1035/A 1035M.

Dowel Expansion Caps

Dowel expansion caps must comply with the following:

1. Made from plastic
2. Sized to provide a slip fit onto the end of dowel bars
3. With a uniform diameter of 1.5 inches
4. Include a device that maintains the end of the cap a minimum 1.5 inches from the end of the dowel bar during concrete placement
5. With a uniform thickness of 63 mils
6. Manufactured in 1 piece
7. Closed on 1 end

Transverse Bar Assembly

You may use transverse bar assemblies to support longitudinal reinforcement instead of transverse reinforcement and other support devices. Transverse bar assemblies must comply with the following:

1. Minimum W5 wire size number under ASTM A 82/A 82M for clips
2. Minimum W2 wire size number under ASTM A 82/A 82M for chairs
3. Welded under Section 7.4 of ASTM A 185/A 185M
4. Coated or uncoated in compliance with the following:

4.1 If coated, coating must comply with ASTM A 884/A 884M, Class A, Type 2 epoxy coating. Epoxy coating must be purple or gray and handled at the manufacturing plant and job site under ASTM D 3963/D 3963M and Section 52-1.02B, "Epoxy-coated Reinforcement," of the Standard Specifications.

4.2 If uncoated, transverse bar assemblies must comply with ASTM A 1035/A 1035M.

Liquid Joint Sealant

Liquid joint sealant for longitudinal contraction and transverse contraction joints must be Compression Seal.

Expansion Joints

Joint seals for transverse expansion joints and must comply with Section 51-1.12F, "Sealed Joints," of the Standard Specifications.

Expanded polystyrene for transverse expansion joints must comply with Section 51-1.12D, "Sheet Packing, Preformed Pads and Board Fillers," of the Standard Specifications.

Terminal Joints

For terminal joints (Type D) and (Type E), joint seals must be Type C.

CONSTRUCTION

Transition Joints With Asphalt Concrete

If a joint between concrete pavement and asphalt concrete is specified, apply tack coat between the concrete pavement and asphalt concrete.

Longitudinal Contraction Joints

Longitudinal contraction joints must be Type B.

Transverse Contraction Joints

Transverse contraction joints must be Type B.

If widening existing concrete pavement, do not construct transverse contraction joints to match the existing pavement's joint spacing or skew unless specified. Transverse joints in pavement on curves must be straight and aligned with the curve's radius point.

Bar Reinforcement in Curves

For transverse bar reinforcement in a curve with a radius under 2,500 feet, place the reinforcement in a single continuous straight line across the lanes and aligned with the radius point. Place tie bars on the same alignment as the transverse bar reinforcement. If the curve does not allow the specified spacing between transverse bar reinforcement and tie bars, space them a distance that is between one half the specified spacing and the specified spacing.

Repair, Removal, and Replacement

If the Engineer orders removal of continuously reinforced concrete pavement, remove it to full depth. Cut transverse saw cuts normal to the lane line. Fill saw cuts extending beyond the removal limits with grout.

Replace concrete pavement with unconsolidated concrete.

If you damage existing bar reinforcement during removal, lengthen the removal area to provide the specified splicing length. Below the reinforcement at a partial depth saw cut, leave the face of the concrete pavement inclined no more than 1:12 (horizontal:vertical) into the removal area.

You may make additional saw cuts within the removal area to facilitate concrete removal or to alleviate binding of the saw cut at the removal area's edge.

Prevent base damage and prevent spalling of the concrete remaining in place. Remove and replace base material disturbed during removal. Place a minimum 4-mil thick polyethylene sheet between the base and new continually reinforced concrete pavement. If concrete is used as base, place replacement continually reinforced concrete pavement after the concrete base has gained sufficient strength to prevent displacement.

For transverse joints, connect longitudinal bar reinforcement with lap splices in compliance with Section 52-1.08A, "Lap Splicing Requirements," of the Standard Specifications.

For longitudinal joints, drill and bond tie bars in compliance with Section 40-3.05, "Tie Bar Placement," of the Standard Specifications.

Within 18 hours after inserting tie bars into the chemical adhesive-filled holes, demonstrate the bond strength is 3/4 of the tie bar yield strength when tested under ASTM E 488. If the bond strength does not comply, increase the embedment depth and retest. Do not place replacement continuously reinforced concrete pavement until the bond strength complies with the specifications.

Sawcut and seal expansion joints in the repair area. Use preformed sponge rubber expansion joint filler for expansion joints and longitudinal joints. Preformed sponge rubber expansion joint filler must comply with ASTM D 1752.

MEASUREMENT AND PAYMENT

Continuously reinforced concrete pavement (Terminal Joint), continuously reinforced concrete pavement (Expansion Joint), and continuously reinforced concrete pavement (Pavement Anchor) of the types designated in the Verified Bid Item List are measured by the linear foot from field measurements.

If the Engineer accepts a test strip and it remains as part of the paving surface, the test strip is measured and paid for as continuously reinforced concrete pavement, seal pavement joint, and seal isolation joint as the case may be.

Full compensation for coring test strips and for back-filling core holes when the test strip remains as part of the continually reinforced concrete pavement is included in the contract price paid per cubic yard for continuously reinforced concrete pavement and no additional compensation will be allowed therefor.

The contract price paid per linear foot for continuously reinforced concrete pavement (Terminal Joint) of the type designated in the Verified Bid Item List includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the terminal joints including saw cutting, dowel bars, drill and bond dowel bars, support slab, support slab reinforcement, tack coat, and temporary hot mix asphalt, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract price paid per linear foot for continuously reinforced concrete pavement (Expansion Joint) of the type designated in the Verified Bid Item List includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in continuously reinforced concrete pavement (Expansion Joint), complete in place, including polystyrene, support slab, support slab reinforcement, dowel bars, drill and bond dowel bars, and bond breaker, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract price paid per linear foot for continuously reinforced concrete pavement (Pavement Anchor) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in continuously reinforced concrete pavement (Pavement Anchor), complete in place, including anchor reinforcement, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for providing a facility for and attending the prepaving conference is included in the contract price paid per cubic yard for continuously reinforced concrete pavement and no additional compensation will be allowed therefor.

Full compensation for epoxy coating of steel reinforcement is included in the contract price paid per cubic yard for continuously reinforced concrete pavement and no additional compensation will be allowed therefor.

10-1.77 CONCRETE PAVEMENT JUST-IN-TIME-TRAINING

GENERAL

Summary

Your personnel required to attend the prepaving conference must also complete Just-In-Time-Training (JITT). JITT is a formal training class for the following pavement types:

Pavement Types for JITT
Continuously Reinforced Concrete Pavement (CRCP)

Submittals

At least 7 business days before JITT, submit the instructor's name and listed experience, the JITT facility's location, and 1 copy each of the course syllabus, handouts, and presentation materials.

The Engineer provides training evaluation forms and each attendee must complete them. Five business days after JITT, submit completed training evaluation forms to the Engineer and to:

Construction_Engineering_HQ@dot.ca.gov

Just-In-Time-Training

JITT must be:

1. At least 4 hours long
2. At your option, an extension of the prepaving conference
3. Conducted within 3 miles of the job site
4. Completed at least 20 days before you start paving activities
5. Conducted during normal working hours

Provide a JITT instructor who is experienced with the specified pavement construction methods, materials, and tests. The instructor must be neither your employee nor a Department field staff member. Upon JITT completion, the instructor must issue a certificate of completion to each participant.

The Engineer may waive training for personnel who have completed equivalent training within the 12 months preceding JITT. Submit certificates of completion for the equivalent training.

MEASUREMENT AND PAYMENT

The Engineer determines the costs for providing JITT under Section 9-1.03, "Force Account Payment," of the Standard Specifications, except no markups are added and you are paid for one half of the JITT cost. Costs for providing JITT include training materials, class site, and the JITT instructor including the JITT instructor's travel, lodging, meals and presentation materials.

10-1.78 GRIND EXISTING CONCRETE PAVEMENT

Grinding existing portland cement concrete and asphalt concrete pavement shall conform to the provisions in Section 42-2, "Grinding," of the Standard Specifications and these special provisions.

Grinding shall be performed at the locations as shown on the plans.

The finished ground surface of the concrete pavement will not be profiled and the Profile Index requirements shall not apply.

The ground surface will be tested with a 12-foot ±2-1/2 inches long straightedge at locations determined by the Engineer. When the straightedge is laid on the finished pavement in a direction parallel with centerline, or perpendicular to centerline, the surface shall not vary more than 1/8 inch from the lower edge of the straightedge. Additional grinding shall be performed, if necessary, to meet the straightedge requirements.

Fog seal coat shall be furnished and applied to ground asphalt concrete pavement in conformance with the provisions in Section 37-1, "Seal Coats," of the Standard Specifications, except for payment.

Full compensation for additional grinding necessary to conform to the straightedge requirements shall be considered as included in the contract price paid per square yard for grind existing concrete pavement and no additional compensation will be allowed therefor.

10-1.79 DISPOSAL OF PORTLAND CEMENT CONCRETE (PCC) PAVEMENT GROOVING AND GRINDING RESIDUES

Disposal of portland cement concrete (PCC) pavement grooving and grinding residues shall be in conformance with the provisions in Section 42, "Groove and Grind Pavement," of the Standard Specifications and these special provisions.

The Contractor shall include water pollution control measures to address the handling of the grinding pavement residue within the Storm Water Pollution Prevention Plan or Water Pollution Control Program, as specified in "Water Pollution Control" of these special provisions.

Temporary storage of PCC pavement grooving and grinding residues shall not be allowed within the highway right of way. The Contractor may transport liquid PCC pavement grooving and grinding residues to an offsite drying location if the Engineer provides written approval. The offsite drying location shall be identified and protected in conformance with "Water Pollution Control" of these special provisions.

Temporary storage locations shown on the plans for PCC pavement grooving and grinding residues within the highway right of way may be used to dry the material before disposal outside the highway right of way. Temporary storage facilities for PCC pavement grooving and grinding residues shall be in conformance with WM-8, Concrete Waste Management in the Construction Site BMPs Manual or "Temporary Concrete Washout Facility" of these special provisions.

A Materials Information Handout is not available for disposal of PCC pavement grooving or grinding residues. The Contractor shall dispose of PCC pavement grooving and grinding residues in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside of the Right of Way," of the Standard Specifications. The facilities listed below were permitted by Regional Water Quality Control Board (RWQCB) or other agencies that may accept PCC pavement grinding and grooving residues as of July 1, 2004. If the Contractor is planning to use one of these sites, the Contractor shall determine if the facility has a current permit to accept PCC pavement grooving and grinding residues and if the facility can accept the waste at the time of generation.

Site Name	Location	Telephone	Waste Types / Restrictions
Clean Harbors Environmental Services Buttonwillow	2500 West Lokern Road Buttonwillow, CA	(562) 432-5445	Hazardous Solids and Non-Hazardous Liquids and Solids
Clean Harbors Environmental Services San Jose	1021 Berryessa San Jose, CA	(408) 451-5000	Hazardous and Non-Hazardous Liquids
Crosby & Overton, Inc.	1610 W. 17th Street Long Beach, CA	(562) 432-5445	Hazardous and Non-Hazardous Liquids
D/K Environmental	3650 East 26th Street Vernon, CA	(323) 268-5056	Hazardous and Non-Hazardous Liquids and Solids
DeMenno-Kerdoon	200 N. Alameda Street Compton, CA	(323) 268-5057 (310) 537-7100	Hazardous and Non-Hazardous Liquids and Solids
Filter Recycling Services, Inc.	180 West Monte Avenue Rialto, CA	(909) 424-1630	Hazardous and Non-Hazardous Liquids
K-Pure Water Works	8910 Rochester Ave Rancho Cucamonga, CA	(909) 476-2308	Non-Hazardous Liquids
Liquid Waste Management McKittrick	56533 Highway 58 McKittrick, CA	(559) 386-6104	Non-Hazardous Liquids and Solids
Onyx Environmental Services LLC	1704 W. First Street Azusa, CA	(626) 334-5117	Hazardous and Non-Hazardous Liquids and Solids
Phibro-Tech, Inc.	8851 Dice Road Santa Fe Springs, CA	(562) 698-8036	Hazardous and Non-Hazardous Liquids and Solids
Romic Environmental Technologies Corporation	2081 Bay Road East Palo Alto, CA	(650) 324-1638	Hazardous and Non-Hazardous Liquids
Seaport Environmental	700 Seaport Boulevard Redwood City, CA	(650) 364-8154	Non-Hazardous Liquids
Southwest Treatment Systems, Inc.	4120 Bandini Boulevard Los Angeles, CA	(800) 900-3366	Non-Hazardous Liquids
US Filter Recovery Services, Inc.	5375 S. Boyle Avenue Vernon, CA	(323) 277-1495	Hazardous and Non-Hazardous Liquids and Solids
Waste Management Kettleman City	35251 Old Skyline Road Kettleman City, CA	(559) 386-6104	Hazardous and Non-Hazardous Liquids and Solids

If the Contractor disposes of PCC pavement grooving and grinding residues at locations not listed above, the disposal shall be in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications, and the following:

A. If the disposal facility is located within the State of California, the facility must be permitted by the RWQCB or other applicable agency, or the Contractor must obtain written approval from the RWQCB or other applicable agency.
B. If located outside of the State of California, the facility must be permitted by the applicable local, state, or federal agencies, or the Contractor must obtain written approval from the applicable local, state, or federal agencies.

The following shall be delivered to the Engineer at least 5 days before disposal of PCC pavement grooving and grinding residues:

A. The name, address, and telephone number of the disposal facility.
B. If the facility is not listed above:

1. Copy of the facility's RWQCB or other applicable agency permit, or
2. RWQCB's or other applicable agency's approval, or
3. Copy of the applicable agency permit if the final disposal location is located outside of the State of California.

The Contractor shall deliver landfill receipts and weight ticket of disposal of residues from PCC pavement grooving and grinding to the Engineer within 5 days of completing of PCC pavement grooving and grinding activities.

The Contractor shall make all arrangements and agreements for the disposal at the time of bidding. Costs related to obtaining approval for disposal within the State of California from the RWQCB or other applicable agency, or the applicable agency if the disposal location is located outside of the State of California, shall be borne by the Contractor and no additional payment shall be made therefore. Full compensation for all costs involved in disposing of PCC pavement grooving or grinding residues as specified in this section, including all costs of handling, temporary storage, hauling and disposal fees, shall be considered as included in the price paid for the contract item of work involving PCC pavement grooving or grinding residues and no additional compensation will be allowed therefore.

10-1.80 PILING

GENERAL

Piling shall conform to the provisions in Section 49, "Piling," of the Standard Specifications, and these special provisions.

Unless otherwise specified, welding of any work performed in conformance with the provisions in Section 49, "Piling," of the Standard Specifications, shall be in conformance with the requirements in AWS D1.1.

Attention is directed to "Project Information" and "Welding" of these special provisions.

Difficult pile installation is anticipated due to the presence of caving soils, serpentine materials at Southbound Battery Tunnel and Retaining Wall A and B, high ground water, cobbles and boulders, underground utilities, the requirements of pile embedment into rock, sound control, and traffic control.

Difficult pile installation at Battery Substation (Bridge) (Bridge No. 34-0157W) is anticipated due to the presence of variable rock formations ranging from very hard to very soft, caving soils, high ground water, the requirements of pile embedment into rock, and sound control.

The Contractor shall not have adjacent drilled holes open simultaneously during construction of the cast-in-drilled-hole concrete piles at Bents 2 and 3 of Battery Substation (Bridge) (Bridge No. 34-0157W).

CAST-IN-DRILLED-HOLE CONCRETE PILES

GENERAL

Summary

Cast-in-drilled-hole (CIDH) concrete piling shall conform to the provisions in Section 49-4, "Cast-In-Place Concrete Piles," of the Standard Specifications and these special provisions.

The provisions of "Welding" of these special provisions shall not apply to temporary steel casings.

SUBMITTALS

Pile Installation Plan

The Contractor shall submit a pile installation plan to the Engineer for approval for all CIDH concrete piling. The pile installation plan shall be submitted at least 15 days before constructing CIDH concrete piling and shall include complete descriptions, details, and supporting calculations for the following:

A. Concrete mix design, certified test data, and trial batch reports.
B. Drilling or coring methods and equipment.
C. Proposed method for casing installation and removal when necessary.
D. Plan view drawing of pile showing reinforcement. Include inspection pipes on the drawing if inspection pipes are required.
E. Methods for placing, positioning, and supporting bar reinforcement.
F. Methods and equipment for determining the depth of concrete and actual and theoretical volume placed, including effects on volume of concrete when any casings are withdrawn.
G. Methods and equipment for verifying that the bottom of the drilled hole is clean before placing concrete.
H. Methods and equipment for preventing upward movement of reinforcement, including the Contractor's means of detecting and measuring upward movement during concrete placement operations.

For concrete placed under slurry, the pile installation plan shall also include complete descriptions, details, and supporting calculations for the following:

A. Concrete batching, delivery, and placing systems, including time schedules and capacities. Time schedules shall include the time required for each concrete placing operation at each pile.
B. Concrete placing rate calculations. When requested by the Engineer, calculations shall be based on the initial pump pressures or static head on the concrete and losses throughout the placing system, including anticipated head of slurry and concrete to be displaced.
C. Suppliers' test reports on the physical and chemical properties of the slurry and any proposed slurry chemical additives, including Material Safety Data Sheet.
D. Slurry testing equipment and procedures.
E. Methods of removal and disposal of excavation, slurry, and contaminated concrete, including removal rates.
F. Methods and equipment for slurry agitating, recirculating, and cleaning.

QUALITY ASSURANCE

Concrete Test Batch

Before concrete is deposited under slurry, a concrete test batch shall be produced and delivered to the project under conditions and in time periods similar to those expected during placement of concrete in the piles. Concrete shall be placed in an excavated hole or suitable container of adequate size to allow for testing as specified herein. Depositing of concrete under slurry will not be required. In addition to meeting the specified nominal slump, the concrete test batch shall meet the following requirements:

A. For piles where the time required for each concrete placing operation, as submitted in the placing plan, will be 2 hours or less, the concrete test batch shall demonstrate that the proposed concrete mix design achieves a slump of at least 7 inches after twice that time has elapsed.
B. For piles where the time required for each concrete placing operation, as submitted in the placing plan, will be more than 2 hours, the concrete test batch shall demonstrate that the proposed concrete mix design achieves a slump of at least 7 inches after that time plus 2 hours has elapsed.

The time period shall begin at the start of placement. Concrete shall not be vibrated or agitated during the test period. Slump tests will be performed in conformance with the requirements in California Test 556.

Upon completion of testing, concrete shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

MATERIALS

Concrete

Concrete deposited under slurry shall have a nominal slump equal to or greater than 7 inches, contain not less than 675 pounds of cementitious material per cubic yard, and be proportioned to prevent excessive bleed water and segregation. The nominal and maximum slump and penetration requirements in Section 90-6.06, "Amount of Water and Penetration," of the Standard Specifications shall not apply.

Aggregate Grading

The combined aggregate grading shall be either the 1-inch maximum grading, the 1/2-inch maximum grading, or the 3/8-inch maximum grading and shall conform to the requirements in Section 90-3, "Aggregate Gradings," of the Standard Specifications.

When concrete is placed under slurry, the combined aggregate grading shall be either the 1/2-inch maximum grading or the 3/8-inch maximum grading and shall conform to the requirements in Section 90-3, "Aggregate Gradings," of the Standard Specifications.

Permanent Steel Casings

Permanent steel casings shall conform to the provisions of "Steel Pipe Piling" of these special provisions.

Mineral Slurry

Mineral slurry shall be mixed and thoroughly hydrated in slurry tanks, and slurry shall be sampled from the slurry tanks and tested before placement in the drilled hole.

Slurry shall be recirculated or continuously agitated in the drilled hole to maintain the specified properties.

Recirculation shall include removal of drill cuttings from the slurry before discharging the slurry back into the drilled hole. When recirculation is used, the slurry shall be sampled and tested at least every 2 hours after beginning its use until tests show that the samples taken from the slurry tank and from near the bottom of the hole have consistent specified properties. Subsequently, slurry shall be sampled at least twice per shift as long as the specified properties remain consistent.

Slurry that is not recirculated in the drilled hole shall be sampled and tested at least every 2 hours after beginning its use. The slurry shall be sampled mid-height and near the bottom of the hole. Slurry shall be recirculated when tests show that the samples taken from mid-height and near the bottom of the hole do not have consistent specified properties.

Slurry shall also be sampled and tested before final cleaning of the bottom of the hole and again just before placing concrete. Samples shall be taken from mid-height and near the bottom of the hole. Cleaning of the bottom of the hole and placement of the concrete shall not start until tests show that the samples taken from mid-height and near the bottom of the hole have consistent specified properties.

Mineral slurry shall be tested for conformance to the requirements shown in the following table:

MINERAL SLURRY		
PROPERTY	REQUIREMENT	TEST
Density (pcf) - before placement in the drilled hole - during drilling - before final cleaning - immediately before placing concrete	64.3* to 69.1* 64.3* to 75.0*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/quart) bentonite attapulgite	28 to 50 28 to 40	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 to 10.5	Glass Electrode pH Meter or pH Paper
Sand Content (percent) - before final cleaning - immediately before placing concrete	less than or equal to 4.0	Sand API 13B-1 Section 5
*When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40°F when tested.		

Any caked slurry on the sides or bottom of hole shall be removed before placing reinforcement. If concrete is not placed immediately after placing reinforcement, the reinforcement shall be removed and cleaned of slurry, the sides of the drilled hole cleaned of caked slurry, and the reinforcement again placed in the hole for concrete placement.

Synthetic Slurry

Synthetic slurries shall be used in conformance with the manufacturer's recommendations and these special provisions. The following synthetic slurries may be used:

PRODUCT	MANUFACTURER
SlurryPro CDP	KB Technologies Ltd. 3648 FM 1960 West Suite 107 Houston, TX 77068 (800) 525-5237
Super Mud	PDS Company c/o Champion Equipment Company 8140 East Rosecrans Ave. Paramount, CA 90723 (562) 634-8180
Shore Pac GCV	CETCO Drilling Products Group 1350 West Shure Drive Arlington Heights, IL 60004 (847) 392-5800
Novagel Polymer	Geo-Tech Drilling Fluids 220 N. Zapata Hwy, Suite 11A Laredo, TX 78043 (210) 587-4758

Inclusion of a synthetic slurry on the above list may be obtained by meeting the Department's requirements for synthetic slurries. The requirements can be obtained from the Offices of Structures Design, P.O. Box 168041, MS# 9-4/11G, Sacramento, CA 95816-8041.

Synthetic slurries listed may not be appropriate for a given site.

Synthetic slurries shall not be used in holes drilled in primarily soft or very soft cohesive soils as determined by the Engineer.

A manufacturer's representative, as approved by the Engineer, shall provide technical assistance for the use of their product, shall be at the site before introduction of the synthetic slurry into a drilled hole, and shall remain at the site until released by the Engineer.

Synthetic slurries shall be sampled and tested at both mid-height and near the bottom of the drilled hole. Samples shall be taken and tested during drilling as necessary to verify the control of the properties of the slurry. Samples shall be taken and tested when drilling is complete, but before final cleaning of the bottom of the hole. When samples are in conformance with the requirements shown in the following tables for each slurry product, the bottom of the hole shall be cleaned and any loose or settled material removed. Samples shall be obtained and tested after final cleaning and immediately before placing concrete.

SlurryPro CDP synthetic slurries shall be tested for conformance to the requirements shown in the following table:

SLURRYPRO CDP KB Technologies Ltd.		
PROPERTY	REQUIREMENT	TEST
Density (pcf) - during drilling - before final cleaning - just before placing concrete	 less than or equal to 67.0* less than or equal to 64.0*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/quart) - during drilling -before final cleaning - just before placing concrete	 50 to 120 less than or equal to 70	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	6 to 11.5	Glass Electrode pH Meter or pH Paper
Sand Content (percent) - before final cleaning - just before placing concrete	 less than or equal to 0.5	Sand API 13B-1 Section 5
*When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40°F when tested.		

Super Mud synthetic slurries shall be tested for conformance to the requirements shown in the following table:

SUPER MUD PDS Company		
PROPERTY	REQUIREMENT	TEST
Density (pcf) - before final cleaning - just before placing concrete	less than or equal to 64.0*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/quart) - during drilling - before final cleaning - just before placing concrete	32 to 60 less than or equal to 60	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 to 10.0	Glass Electrode pH Meter or pH Paper
Sand Content (percent) - before final cleaning -just before placing concrete	less than or equal to 0.5	Sand API 13B-1 Section 5
*When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40°F when tested.		

Shore Pac GCV synthetic slurries shall be tested for conformance to the requirements shown in the following table:

Shore Pac GCV CETCO Drilling Products Group		
PROPERTY	REQUIREMENT	TEST
Density (pcf) - before final cleaning - just before placing concrete	less than or equal to 64.0*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/quart) - during drilling - before final cleaning - just before placing concrete	33 to 74 less than or equal to 57	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8.0 to 11.0	Glass Electrode pH Meter or pH Paper
Sand Content (percent) - before final cleaning -just before placing concrete	less than or equal to 0.5	Sand API 13B-1 Section 5
*When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40°F when tested.		

Novagel Polymer synthetic slurries shall be tested for conformance to the requirements shown in the following table:

NOVAGEL POLYMER Geo-Tech Drilling Fluids		
PROPERTY	REQUIREMENT	TEST
Density (pcf) - during drilling - before final cleaning - just before placing concrete	 less than or equal to 67.0* less than or equal to 64.0*	Mud Weight (Density) API 13B-1 Section 1
Viscosity (seconds/quart) - during drilling - before final cleaning - just before placing concrete	 45 to 104 less than or equal to 104	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	6.0 to 11.5	Glass Electrode pH Meter or pH Paper
Sand Content (percent) - before final cleaning -just before placing concrete	 less than or equal to 0.5	Sand API 13B-1 Section 5
*When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pcf. Slurry temperature shall be at least 40°F when tested.		

Water Slurry

At the option of the Contractor, water may be used as slurry when casing is used for the entire length of the drilled hole. Water slurry shall be tested for conformance to the requirements shown in the following table:

WATER SLURRY		
PROPERTY	REQUIREMENT	TEST
Density (pcf) - before final cleaning - just before placing concrete	63.5*	Mud Weight (Density) API 13B-1 Section 1
Sand Content (percent) - before final cleaning -just before placing concrete	less than or equal to 0.5	Sand API 13B-1 Section 5
*When approved by the Engineer, salt water slurry may be used and the allowable densities may be increased up to 2 pcf.		

CONSTRUCTION

General

CIDH concrete piling 24 inches in diameter or larger may be constructed by excavation and depositing concrete under slurry.

Disposal of drill cuttings shall conform to the provisions in "Earthwork" of these special provisions.

Portions of CIDH concrete piling shown on the plans to be formed shall be formed and finished in conformance with the provisions for concrete structures in Section 51, "Concrete Structures," of the Standard Specifications.

Reinforcement shall extend to 3 inches clear of the bottom of the drilled hole when the hole is drilled below the specified tip elevation.

Placing Concrete

Concrete deposited under slurry shall be carefully placed in a compact, monolithic mass and by a method that will prevent washing of the concrete. Concrete deposited under slurry need not be vibrated. Placing concrete shall be a continuous operation lasting not more than the time required for each concrete placing operation at each pile, as submitted in the placing plan, unless otherwise approved in writing by the Engineer. Concrete shall be placed with concrete pumps and delivery tube system of adequate number and size to complete the placing of concrete in the time specified. The delivery tube system shall consist of one of the following:

A. A tremie tube or tubes, each of which are at least 10 inches in diameter, fed by one or more concrete pumps.
B. One or more concrete pump tubes, each fed by a single concrete pump.

The delivery tube system shall consist of watertight tubes with sufficient rigidity to keep the ends always in the mass of concrete placed. If only one delivery tube is utilized to place the concrete, the tube shall be placed near the center of the drilled hole. Multiple tubes shall be uniformly spaced in the hole. Internal bracing for the steel reinforcing cage shall accommodate the delivery tube system. Tremies shall not be used for piles without space for a 10-inch tube.

Spillage of concrete into the slurry during concrete placing operations shall not be allowed. Delivery tubes shall be capped with a watertight cap, or plugged above the slurry level with a good quality, tight fitting, moving plug that will expel the slurry from the tube as the tube is charged with concrete. The cap or plug shall be designed to be released as the tube is charged. The pump discharge or tremie tube shall extend to the bottom of the hole before charging the tube with concrete. After charging the delivery tube system with concrete, the flow of concrete through a tube shall be induced by slightly raising the discharge end. During concrete placement, the tip of the delivery tube shall be maintained as follows to prevent reentry of the slurry into the tube. Until at least 10 feet of concrete has been placed, the tip of the delivery tube shall be within 6 inches of the bottom of the drilled hole, and then the embedment of the tip shall be maintained at least 10 feet below the top surface of the concrete. Rapid raising or lowering of the delivery tube shall not be permitted. If the seal is lost or the delivery tube becomes plugged and must be removed, the tube shall be withdrawn, the tube cleaned, the tip of the tube

capped to prevent entrance of the slurry, and the operation restarted by pushing the capped tube 10 feet into the concrete and then reinitiating the flow of concrete.

When slurry is used, a fully operational standby concrete pump, adequate to complete the work in the time specified, shall be provided at the site during concrete placement. The slurry level shall be maintained 10 feet above the piezometric head or within 12 inches of the top of the drilled hole, whichever is higher.

A log of concrete placement for each drilled hole shall be maintained by the Contractor when concrete is deposited under slurry. The log shall show the pile location, tip elevation, dates of excavation and concrete placement, total quantity of concrete deposited, length and tip elevation of any casing, and details of any hole stabilization method and materials used. The log shall include a 8-1/2" x 11" sized graph of the concrete placed versus depth of hole filled. The graph shall be plotted continuously throughout placing of concrete. The depth of drilled hole filled shall be plotted vertically with the pile tip oriented at the bottom and the quantity of concrete shall be plotted horizontally. Readings shall be made at least at each 5 feet of pile depth, and the time of the reading shall be indicated. The graph shall be labeled with the pile location, tip elevation, cutoff elevation, and the dates of excavation and concrete placement. The log shall be delivered to the Engineer within 1 working day of completion of placing concrete in the pile.

After placing reinforcement and before placing concrete in the drilled hole, if drill cuttings settle out of the slurry, the bottom of the drilled hole shall be cleaned. The Contractor shall verify that the bottom of the drilled hole is clean.

If a temporary casing is used, concrete placed under slurry shall be maintained at a level at least 5 feet above the bottom of the casing. The withdrawal of the casing shall not cause contamination of the concrete with slurry. If slurry is not used, the temporary casing shall not be withdrawn until the concrete head in the casing is greater than the groundwater outside of the casing. This positive concrete head shall be maintained during the withdrawal of the casing.

Material resulting from using slurry shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Disposal of material resulting from using slurry shall conform to the provisions in "Earthwork" of these special provisions.

Acceptance Testing and Mitigation

Vertical inspection pipes for acceptance testing shall be provided in all CIDH concrete piling 24 inches in diameter or larger, except when the holes are dry or when the holes are dewatered without the use of temporary casing in a manner that controls ground water. Vertical inspection pipes at Retaining Wall No. 8 will not be required.

The furnishing and placing of inspection pipes shall conform to the following:

A. Inspection pipes shall be Schedule 40 PVC pipe with a nominal inside diameter of 2 inches. Watertight PVC couplers are permitted to facilitate pipe lengths in excess of those which are commercially available. The Contractor shall log the location of the inspection pipe couplers with respect to the plane of pile cut off, and these logs shall be delivered to the Engineer upon completion of the placement of concrete in the drilled hole.
B. Each inspection pipe shall be capped at the bottom and shall extend from 3 feet above the pile cutoff down to the bottom of the reinforcing cage. A temporary top cap or similar means shall be provided to keep the pipes clean before testing. If pile cutoff is below the ground surface or working platform, inspection pipes shall be extended to 3 feet above the ground surface or working platform. Approved covers or railings shall be provided and inspection pipes shall be located as necessary to minimize exposure of testing personnel to potential falling hazards.
C. Inspection pipes shall be completely clean, dry, and unobstructed at the time of testing providing a 2-inch diameter clear opening.
D. The inspection pipes shall be installed in straight alignment, parallel to the main reinforcement, and securely fastened in place to prevent misalignment during installation of the reinforcement and placing of concrete in the hole. The CIDH concrete piling shall be constructed so that the relative distance of inspection pipes to vertical steel reinforcement shall remain constant.
E. When any changes are made to the tip of CIDH concrete piling, the Contractor shall also extend the inspection pipes to the bottom of the reinforcing cage.

The following additional requirements apply if inspection pipes are not shown on the plans:

A. Inspection pipes shall be placed radially around the pile, inside the outermost spiral or hoop reinforcement and no more than 1 inch clear of the outermost spiral or hoop reinforcement.
B. Inspection pipes shall be placed around the pile at a uniform spacing not exceeding 33 inches measured along the circle passing through the centers of inspection pipes. A minimum of 2 inspection pipes per pile shall be used. Inspection pipes shall be placed to provide the maximum diameter circle that passes through the centers of the inspection pipes while maintaining the spacing required herein.

C. Inspection pipes shall be placed a minimum of 3 inches clear of the vertical reinforcement. When the vertical reinforcement configuration does not permit this clearance while achieving radial location requirements, distance to vertical rebar shall be maximized while still maintaining the requirement for radial location.
D. Where the dimensions of the pile reinforcement do not permit inspection pipes to be placed per these requirements, a plan for tube placement shall be submitted to the Engineer for approval in the Pile Placement Plan with a request for deviation before fabricating pile reinforcement.

After placing concrete and before requesting acceptance tests, each inspection pipe shall be tested by the Contractor in the presence of the Engineer by passing a 1-1/4-inch-diameter rigid cylinder 4.5 feet long through the length of pipe. If an inspection pipe fails to pass the 1-1/4-inch-diameter cylinder, the Contractor shall immediately fill all inspection pipes in the pile with water.

For each inspection pipe that does not pass the 1-1/4-inch-diameter cylinder, the Contractor shall core a nominal 2-inch diameter hole through the concrete for the entire length of the pile. Cored holes shall be located as close as possible to the inspection pipes they are replacing and shall be no more than 5 inches clear from the reinforcement.

Coring shall not damage the pile reinforcement. Cored holes shall be made with a double wall core barrel system utilizing a split tube type inner barrel. Coring with a solid type inner barrel will not be allowed. Coring methods and equipment shall provide intact cores for the entire length of the pile. The coring operation shall be logged by an Engineering Geologist or Civil Engineer licensed in the State of California and experienced in core logging. Coring logs shall be in conformance with the Department's "Soil and Rock Logging, Classification, and Presentation Manual." Coring logs shall include Core Recovery (REC), Rock Quality Designation (RQD), locations of breaks, and complete descriptions of inclusions and voids encountered during coring, and shall be delivered to the Engineer upon completion. Concrete cores shall be preserved, identified with the exact location the core was recovered from within the pile, and delivered to the Engineer upon completion. The Engineer will evaluate the portion of the pile represented by the cored hole based on the submitted core logs.

Acceptance tests of the concrete will be made by the Engineer, without cost to the Contractor. Acceptance tests will evaluate the homogeneity of the placed concrete. Tests will include gamma-gamma logging conducted in conformance with California Test 233. The Contractor shall not conduct operations within 25 feet of the gamma-gamma logging operations. The Contractor shall separate reinforcing steel as necessary to allow the Engineer access to the inspection pipes to perform gamma-gamma logging or other acceptance testing. After requesting acceptance tests and providing access to the piles, the Contractor shall allow 20 days for the Engineer to conduct these tests and make determination of acceptance. Should the Engineer fail to complete these tests within the time allowance, and if in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in inspection, the delay will be considered a right of way delay as specified in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

The Engineer may elect to perform additional tests to further evaluate a pile. These tests may include crosshole sonic logging and other means of inspection selected by the Engineer. When the Engineer elects to perform additional tests to further evaluate anomalies for a rejected pile, no time requirement exists for performing these tests. The Contractor may progress with the mitigation plan process without waiting for these supplemental results.

Inspection pipes and cored holes shall be dewatered and filled with grout after notification by the Engineer that the pile is acceptable. Grout shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications. Inspection pipes and holes shall be filled using grout tubes that extend to the bottom of the pipe or hole or into the grout already placed.

If acceptance testing performed by the Engineer determines that a pile does not meet the requirements of the specifications and California Test 233, Part 5C, then that pile will be rejected and all depositing of concrete under slurry or concrete placed using temporary casing for the purpose of controlling groundwater shall be suspended until written changes to the methods of pile construction are approved in writing by the Engineer.

The Engineer will determine whether the rejected pile requires mitigation due to structural, geotechnical, or corrosion concerns. The Engineer will consider the estimated size and location of the anomaly and potential effects upon the design. The Engineer will provide the conclusions of this analysis to the Contractor for development of a mitigation plan, if required. The Contractor shall allow 35 days for the Engineer to determine whether the pile requires mitigation and provide information to the Contractor. Day 1 of the 35 days shall be the 1st day after access has been provided to the Engineer to perform acceptance testing. If additional information is submitted to the Engineer that modifies the size, shape, or nature of the anomaly, the Contractor shall allow 15 additional days for the subsequent analysis.

If the Engineer determines that a rejected pile does not require mitigation, the Contractor may elect to (1) repair the pile per the approved mitigation plan or (2) not repair anomalies found during acceptance testing of that pile. For such unrepaired piles, the Contractor shall pay to the State, $300 per cubic yard for the portion of the pile affected by the anomalies. The volume, in cubic yards, of the portion of the pile affected by the anomalies, shall be calculated as the area of the cross section of the pile affected by each anomaly, in square yards, as determined by the Engineer, multiplied by the distance, in yards, from the top of each anomaly to the specified tip of the pile. If the volume calculated for one anomaly overlaps the volume calculated for additional anomalies within the pile, the calculated volume for the overlap shall only be counted once. In no case shall the amount of the payment to the State for any such pile be less than $300. The Department may deduct the amount from any moneys due, or that may become due the Contractor under the contract.

If the Engineer determines that a rejected pile requires mitigation, the Contractor shall submit to the Engineer for approval a mitigation plan for repair, supplementation, or replacement for each rejected CIDH concrete pile conforming to the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. If the Engineer determines that it is not feasible to repair the rejected pile, the Contractor shall not include repair as a means of mitigation and shall proceed with the submittal of a mitigation plan for replacement or supplementation of the rejected pile.

Pile mitigation plans shall include the following:

A. The designation and location of the pile addressed by the mitigation plan.
B. A review of the structural, geotechnical, and corrosion design requirements of the rejected pile.
C. A step by step description of the mitigation work to be performed, including drawings if necessary.
D. An assessment of how the proposed mitigation work will address the structural, geotechnical, and corrosion design requirements of the rejected pile.
E. Methods for preservation or restoration of existing earthen materials.
F. A list of affected facilities, if any, with methods and equipment for protection of these facilities during mitigation.
G. The State assigned contract number, bridge number, full name of the structure as shown on the contract plans, District-County-Route-Post Mile, and the Contractor's (and Subcontractor's if applicable) name on each sheet.
H. A list of materials, with quantity estimates, and personnel, with qualifications, to be used to perform the mitigation work.
I. The seal and signature of an engineer who is licensed as a Civil Engineer by the State of California. This requirement is waived for approved mitigation plans when either of the following conditions are present:

    1. The proposed mitigation will be performed in conformance with the most recent Department approved version of "ADSC Standard Mitigation Plan 'A' - Basic Repair" without exception or modification.
    2. The Engineer has determined that the rejected pile does not require mitigation due to structural, geotechnical, or corrosion concerns, and the Contractor elects to repair the pile using most recent Department approved version of "ADSC Standard Mitigation Plan 'B' - Grouting Repair" without exception or modification.

The most recent Department approved version of the "ADSC Standard Mitigation Plan" is available at:

http://www.dot.ca.gov/hq/esc/geotech/ft/adscmitplan.htm

For rejected piles to be repaired, the Contractor shall submit a pile mitigation plan that contains the following additional information:

A. An assessment of the nature and size of the anomalies in the rejected pile.
B. Provisions for access for additional pile testing if required by the Engineer.

For rejected piles to be replaced or supplemented, the Contractor shall submit a pile mitigation plan that contains the following additional information:

A. The proposed location and size of additional piles.
B. Structural details and calculations for any modification to the structure to accommodate the replacement or supplemental piles.

All provisions for CIDH concrete piling shall apply to replacement piles.

The Contractor shall allow the Engineer 20 days to review the mitigation plan after a complete submittal has been received.

Should the Engineer fail to review the complete pile mitigation submittal within the time specified, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in reviewing the pile mitigation plan, an extension of time commensurate with the delay in completion of the work thus caused will be granted in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

When repairs are performed, the Contractor shall submit a mitigation report to the Engineer within 10 days of completion of the repair. This report shall state exactly what repair work was performed and quantify the success of the repairs relative to the submitted mitigation plan. The mitigation report shall be stamped and signed by an engineer that is licensed as a Civil Engineer by the State of California. The mitigation report shall show the State assigned contract number, bridge number, full name of the structure as shown on the contract plans, District-County-Route-Post Mile, and the Contractor (and subcontractor if applicable) name on each sheet. The Engineer will be the sole judge as to whether a mitigation proposal is acceptable, the mitigation efforts are successful, and to whether additional repairs, removal and replacement, or construction of a supplemental foundation is required.

STEEL PIPE PILING

GENERAL

Summary

Steel pipe piling shall consist of permanent steel casing for cast-in-drilled-hole concrete piling. Steel pipe piling shall conform to the provisions in Section 49-5, "Steel Piles," of the Standard Specifications and these special provisions.

All steel pipe piling for this project shall be designated as Class R steel pipe piling.

Submittals

Steel pipe piling qualification audits shall be submitted in conformance with the provisions in "Steel Pipe Piling Qualification Audit" of these special provisions.

A Certificate of Compliance demonstrating material traceability shall be furnished in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications, and shall be signed by the facility's authorized Quality Control Representative. The Quality Control Representative shall be on record with the Department's Office of Structural Materials. The Certificate of Compliance shall include:

1. A statement that all materials and workmanship incorporated in the work and all required tests and inspections of this work have been performed in conformance with the details shown on the plans and these special provisions.
2. An attached certified mill test report (MTR) for each heat number of steel pipe piles being furnished.
3. The carbon equivalency (CE) calculated as $CE=C + (Mn+Si)/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15$. The CE shall be 0.45% maximum and may be shown on the MTR.

The Contractor shall submit a TL-38 Inspection Request form at least:

1. 48 hours before performing any field welding of steel pipe piling.

The TL-38 Inspection Request form is available at:

http://www.dot.ca.gov/hq/esc/Translab/OSM/smbforms.htm

Working drawings shall be submitted to the Engineer before attaching handling devices to steel pipe piling. Working drawings shall include locations, handling and fitting device details, and connection details. Attachments shall not be made to steel pipe piling until the working drawings are approved in writing by the Engineer. The Contractor shall allow the Engineer 7 days for review.

MATERIALS

General

The provisions of "Welding Quality Control" of these special provisions shall not apply to longitudinal, skelp end, or spiral seam welds in steel pipe piling.

Circumferential welds shall conform to "Welding Quality Control" of these special provisions and the following:

1. Circumferential welds shall be complete joint penetration welds conforming to AWS D1.1.
2. Welds shall be located at least 12 inches away from a skelp end weld.
3. Backing rings shall conform to the following:

3.1. The minimum thickness shall be 1/4 inch and the backing ring shall be continuous.
3.2. Splices in the backing ring shall be made by complete joint penetration welds. These welds shall be completed and inspected, including any required nondestructive testing, before final insertion into a pipe end.
3.3. The attachment of backing rings to pipe ends shall be done using the minimum size and spacing of tack welds that will securely hold the backing ring in place. Tack welding shall be done in the root area of the weld splice. Cracked tack welds shall be removed and replaced before subsequent weld passes.
3.4. The gap between the backing ring and the steel pipe piling wall shall not be greater than 5/64 inch. One localized portion of the backing ring fit-up, that is equal to or less than a length that is 20 percent of the outside circumference of the pipe, as determined by the Engineer, may be offset by a gap equal to or less than 1/4 inch, provided that this localized portion is first seal welded using shielded metal arc E7016 or E7018 electrodes. This localized portion shall be marked so that it can be referenced during any required NDT.
3.5. Backing rings shall have sufficient width so that the backing ring will not interfere with the interpretation of the NDT.

4. For steel pipe with an outside diameter greater than 42 inches and with a wall thickness greater than 1 inch, the root opening tolerances may be increased to a maximum of 3/16 inch.
5. For welding limited to fit-up and attaching backing rings and handling devices, the preheat and interpass temperature shall be in conformance with the requirements in AWS D1.1, Section 3.5, "Minimum Preheat and Interpass Temperature Requirements," and with Table 3.2, Category C.

All steel pipe piling shall be capable of meeting the fit-up requirements of AWS D1.1, Section 5.22.3.1, "Girth Weld Alignment (Tubular)," when the material is spliced utilizing a girth weld.

For the purposes of welding and prequalification of base metal, steel pipe piling designated as ASTM A 252 shall be treated as ASTM A 572, Grade 50, or ASTM A 709, Grade 50, in conformance with the requirements in AWS D1.1, Table 3.1.

Butt welded seams subsequently formed, including skelp end welds, shall be 100 percent ultrasonically tested in the final formed and welded condition. The acceptance criteria for UT shall conform to API 5L for API-licensed facilities or AWS D1.1 for cyclically loaded nontubular connections for welds subject to tensile stress.

Except for tack welding, gas metal arc welding (GMAW) shall not be used for the welding of steel pipe piling. When GMAW is used for tack welding, the filler metal shall not be deposited by short circuiting transfer.

The dimensional tolerances of steel pipe piling shall conform to the following:

1. Outside diameter: ± 0.75% of the specified outside diameter
2. Wall thickness: -5%, +10% of the specified nominal wall thickness
3. Straightness: ± 1.0% over the length of the pipe

Except for steel pipe piling marked with the API monogram, each length of steel pipe piling shall be marked as follows:

1. Name and location of the piling manufacturer
2. State Contract number
3. Heat number
4. Welding process
5. Outer diameter, nominal wall thickness, minimum wall thickness, and length
6. Year piling was produced
7. Marked as specified below for each class of steel pipe piling. Only Caltrans audited facilities are approved to mark piling for use on this project.

Class R Steel Pipe Piling

Class R steel pipe piling shall conform to one of the following:

1. Manufactured, welded, tested, and inspected in conformance with API 5L, minimum Grade X52, PSL1, and the following:

1.1. Steel pipe piling shall be manufactured by a facility licensed to apply the API monogram.
1.2. Hydrostatic testing, flattening tests, and the API monogram will not be required.
1.3. Each length shall be marked "Caltrans Class R - API."

2. Manufactured in conformance with ASTM A 252, Grade 3, and the following:

   2.1. Arc welding processes shall conform to AWS D1.1.
   2.2. Groove welds using submerged arc welding from both sides without backgouging will require a procedure qualification record witnessed by the Engineer.
   2.3. Underfill will not be allowed.
   2.4. For electric resistance welded pipe, the outer diameter flash shall be removed to a maximum of 1/32 inch.
   2.5. The weld reinforcement shall not exceed 1/8 inch.
   2.6. The weighing of individual pipe will not be required as specified in ASTM A 252.
   2.7. Each length shall be marked "Caltrans Class R - A 252."

CONSTRUCTION

General

Steel pipe piling may be re-tapped to prevent pile set-up provided the field welded splice remains at least 3 feet above the work platform until that splice is approved in writing by the Engineer.

Welds used to attach handling devices to steel pipe piling shall be aligned parallel to the axis of the pile and shall conform to the requirements for field welding specified herein. Permanent bolted connections shall be corrosion resistant.

Field Welding

Field welding of steel pipe piling is defined as welding performed after the material has been transported from an audited facility.

Field welding shall conform to the requirements for circumferential welds as specified in "Materials" of this section and the following:

1. Welds made in the horizontal position where the longitudinal pipe axis is vertical shall be single-bevel groove welds.
2. The minimum preheat and interpass temperature for splice welding and for making repairs shall be 150 °F, regardless of the pipe pile wall thickness or steel grade. In the event welding is disrupted, preheating to 150 °F shall occur before welding is resumed.
3. Welds shall not be water quenched. Welds shall be allowed to cool unassisted to ambient temperature.

STEEL SOLDIER PILING

This work at Retaining Wall No. 8 and Retaining Walls A and B shall consist of furnishing, fabricating with steel plates, and installing steel piling; cleaning and preparing portions of the pile for splicing; splicing steel piles; securing the piling prior to and during concrete encasement; shaping the tops of the piles; removing concrete at the face of steel soldier piles, cleaning and preparing portions of the pile for welding concrete anchors; and furnishing, cleaning and welding concrete anchors to piling, and removing portions of soldier piles in accordance with the details shown on the plans, and these special provisions.

Removed portions of soldier piles shall become the property of the Contractor and shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Materials

Concrete anchors shall conform to the provisions for stud connectors in Section 55, "Steel Structures," of the Standard Specifications and these special provisions.

Stud connectors shall be Type B as defined in AWS D1.5, Section 7.

Construction

Steel soldier piles shall be placed in a drilled hole and shall be plumbed and aligned before placing concrete backfill and lean concrete backfill. Alignment shall be maintained while placing backfill material in the drilled holes.

Cleaning and preparing the pile shall be performed in heat affected areas before splicing steel piles or welding stud type shear connectors.

MEASUREMENT AND PAYMENT (PILING)

Measurement and payment for the various types and classes of piles shall conform to the provisions in Sections 49-6.01, "Measurement," and 49-6.02, "Payment," of the Standard Specifications and these special provisions.

Payment for cast-in-place concrete piling (except for sign foundation piling) shall conform to the provisions in Section 49-6.02, "Payment," of the Standard Specifications and these special provisions except that when the diameter of cast-in-place concrete piling is shown on the plans as 24 inches or larger, reinforcement in the piling for bridges will be paid for by the pound as bar reinforcing steel (bridge) and reinforcement in the piling for retaining walls will be paid for by the pound as bar reinforcing steel (retaining wall).

Full compensation for slurry, depositing concrete under slurry, test batches, inspection pipes, filling inspection holes and pipes with grout, drilling oversized cast-in-drilled-hole concrete piling, filling cave-ins and oversized piles with concrete, and redrilling through concrete shall be considered as included in the contract prices paid per linear foot for cast-in-drilled-hole concrete piling of the types and sizes listed in the Engineer's Estimate, and no additional compensation will be allowed therefor.

The contract price paid per linear foot for steel soldier pile of the types shown in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing the steel soldier piles at the site to the required depth, including fabricating and welding steel plates to soldier pile, securing the piling to maintain accurate alignment prior to and during encasing the pile with concrete, shaping pile tops, cutting holes for pile anchors, removing concrete at the face of steel soldier piles for welding studs, removing and disposed of portions of soldier piles, cleaning and preparing heat affected areas of piles for splicing and welding concrete anchors to the piles, splicing steel soldier piles, furnishing pile anchors, and furnishing, cleaning, and welding concrete anchors to the piles as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for handling serpentine materials is considered in the contract paid per linear foot for 30" cast-in-drilled-hole concrete piling, and no separate payment will be made therefor.

Full compensation for removing portions of the CIDH concrete piles is considered in the contract paid per linear foot for 30" cast-in-drilled-hole concrete piling, and no additional compensation will be allowed therefor.

10-1.81 DRILLED HOLES

Holes for steel soldier piles shall be drilled into natural foundation materials at the location shown on the plans and shall conform to Section 49, "Piling," of the Standard Specifications and these special provisions.

Drilled holes shall be accurately located and shall be straight and true. When the piles are plumbed and aligned, the steel piles shall be at least one inch clear of the sides of the hole for the full length of the hole to be filled with concrete backfill and lean concrete backfill. Holes that do not provide the clearance around steel piles shall be reamed or enlarged at the Contractor's expense.

Temporary casings or tremie seals shall be furnished and placed where necessary to control water or to prevent caving of the hole.

Difficult pile installation is anticipated due to the presence of caving soils, serpentine materials at Retaining Wall A and B, high ground water, cobbles and boulders, underground utilities, the requirements of pile embedment into rock, sound control, and traffic control.

Attention is directed to rock subsurface foundation material at the soldier pile retaining wall site. Conventional drilling equipment for drilling in soils may not be suitable for drilling piling for the soldier pile retaining wall.

Loose materials existing at the bottom of the hole after drilling operations have been completed shall be removed before placing the pile.

Materials resulting from drilling holes shall be disposed of in conformance with the provisions in "Earthwork" of these special provisions.

Drilling mud or chemical stabilizers shall not be used. Surface water shall not be permitted to enter the hole and all water in the hole shall be removed before placing concrete therein.

Casing, if used in drilling operations, shall be removed from the hole as concrete is placed therein. The bottom of the casing shall be maintained not more than 5 feet nor less than one foot below the top of the concrete during casing withdrawal and concrete placing operations. Separation of the concrete during withdrawal operations shall be avoided by hammering or otherwise vibrating the casing. The methods used to withdraw temporary casings shall preclude contamination of the concrete and commingling of the soil and concrete or of any ground water and concrete.

The contract price paid per linear foot for drilled hole of the diameter shown on the plans shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in drilling holes for soldier piles, including disposing of the material resulting from drilled holes, dewatering, casing holes and removing casing, handling serpentine materials, and providing tremie seals, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.82 TIEBACK ANCHORS

Anchors at the Retaining Wall No. 8 and the Retaining Wall A and B, consisting of holes drilled in foundation material, grouted steel bars or strands, and anchorage assemblies, and testing of installed anchors shall conform to the details shown on the plans, the provisions in Section 50, "Prestressing Concrete," of the Standard Specifications, and these special provisions.

All drilled materials shall be removed from the site of the work and shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Difficult tieback installation is anticipated due to the presence of caving soils, serpentine materials at Retaining Wall A and B, high ground water, cobbles and boulders, and underground utilities.

The Contractor shall determine the bond length necessary to meet acceptance criteria specified herein.

The submittal of reduced prints of corrected original tracings will not be required for tieback anchor installations.

In fabricating, handling, shipping, and placing tieback anchors, adequate care shall be taken to avoid damage to the sheathing. Damage to the sheathing caused by handling and fabrication prior to tieback anchor installation shall be repaired or replaced as determined by the Engineer. Repair procedure for the sheathing shall be included in the working drawings.

MATERIALS

Whenever "member" is referred to in Section 50, "Prestressing Concrete," of the Standard Specifications, it shall be considered to mean tieback anchor.

Structural steel for the tieback retaining wall shall conform to the provisions in Section 55, "Steel Structures," of the Standard Specifications and these special provisions. Structural steel shall consist of the anchorage assembly and, where shown on the plans, the anchorage enclosure. The anchorage assembly and the anchorage enclosure shall be galvanized as indicated on the plans. The provisions of "Welding Quality Control" of these special provisions shall not apply to the anchorage enclosure or to the weld between the steel tube and the bearing plate of the anchorage assembly for tiebacks. Those provisions shall apply to all other welds of structural steel for tieback retaining walls.

When permanent bearing plate bears against concrete, the permanent bearing plate of the tieback anchor shall effectively distribute the design force (T) to the concrete, such that the concrete bearing stress does not exceed 1600 pounds per square inch and the bending stress does not exceed 0.55 f_y for steel nor 0.36 f_y for cast steel or cast iron.

Grout shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications. Fine aggregate may be added to the grout mixture of cement and water used outside of the grouted sheathing in drilled holes which are 8 inches or greater in diameter, but only to the extent that the cement content of the grout is not less than 845 pounds per cubic yard of grout. Fine aggregate, if used, shall conform to the provisions in Section 90-2, "Materials," and Section 90-3, "Aggregate Gradings," of the Standard Specifications.

The plastic sheathing for tieback anchors shall conform to one of the following: polyvinyl chloride (PVC) sheathing, high density polyethylene (HDPE) sheathing, or polypropylene sheathing.

Corrugated plastic sheathing shall be PVC or HDPE. The width of corrugations, the distance between corrugations, and the height of corrugations of corrugated plastic sheathing shall be approximately the same.

PVC sheathing may be used for smooth sheathing for bar tendons, and may be used for corrugated sheathing for either strand or bar tendons. PVC sheathing shall conform to ASTM Designation: D 1784, Class 13464-B. Corrugated PVC sheathing shall have a nominal wall thickness of 40 mils. HDPE sheathing may be used for smooth sheathing for bar tendons, and may be used for corrugated sheathing for either strand or bar tendons. HDPE sheathing shall have a density between 940 kg/m^3 and 960 kg/m^3 as measured in accordance with ASTM Designation: D 792, A-2. Corrugated HDPE sheathing shall have a nominal wall thickness of 60 mils for sheathing with an outside diameter of 3 inches or greater, and a nominal thickness of 40 mils for sheathing with an outside diameter less than 3 inches, with a tolerance of minus 10 mils.

HDPE sheathing may be used for the smooth sheathing encapsulating individual strands of strand type tendons. Smooth HDPE sheathing for encapsulating strands shall have a minimum wall thickness of 40 mils. Polypropylene sheathing may be used for the smooth plastic sheathing encapsulating individual strands of strand type tendons. Polypropylene sheathing shall have a density between 900 kg/m^3 and 910 kg/m^3. Smooth polypropylene sheathing shall have a minimum wall thickness of 40 mils.

The smooth sheathing for the unbonded length of the individual strands, including joints, shall have sufficient strength to prevent damage during construction operations and shall be watertight, chemically stable without embrittlement or softening, and nonreactive with concrete, steel, or corrosion inhibiting grease.

The corrugated sheathing, including joints, shall have sufficient strength to prevent damage during construction operations and shall be grout-tight and watertight, chemically stable without embrittlement or softening, and nonreactive with concrete, steel, or corrosion inhibiting grease.

The transition between the corrugated plastic sheathing and the anchorage assembly shall be an approved detail that allows stressing to the design force without evidence of distress in the corrugated plastic sheathing.

Additional requirements for tiebacks with strand type tendons are as follows:

A. The individual strands of a tendon, except for the bonded length, shall be fully coated with corrosion inhibiting grease and then encapsulated by a smooth HDPE or polypropylene sheath. The corrosion inhibiting grease shall fill all space between strand wires and shall encapsulate the strand giving an encasement diameter at least 5 mils greater than the diameter of the bare strand. The sheath shall be hot melt extruded onto the strand or shall be shop applied by an approved method that assures that all spaces between the sheath and the strand and between the strand wires are filled with corrosion inhibiting grease.
B. The corrosion inhibiting grease shall provide a continuous nonbrittle film of corrosion protection to the prestressing steel and lubrication between the strand and the sheathing, shall resist flow from the sheathing, shall be chemically stable and nonreactive with the prestressing steel, sheathing material, and concrete, and shall be organic with appropriate polar, moisture displacing, and corrosion inhibiting additives.
C. The corrosion inhibiting grease shall have the physical properties listed in Table 3.2.1 of the Post Tensioning Manual, Fifth Edition, by the Post Tensioning Institute with the following revisions:

1. Test 5., Corrosion Test. The environment shall always be considered as corrosive for the purposes of determining the proper test criterion.
2. Test 6.b., Water Soluble Ions, Nitrates, ppm maximum. The test method shall be ASTM D 3867.
3. Test 8.a., C[o]mpatibility with Sheathing, Hardness and volume change of polymer exposure to grease, 40 days @ 150°F. The test method shall be ASTM D 4289, except that ASTM D 792 shall be used to determine density.

D. At least 40 days before use, a sample from the lot to be used and test results shall be provided for the corrosion inhibiting grease.

CONSTRUCTION

Tieback anchors shall be installed in accordance with the manufacturer's recommendations. In case of a conflict between the manufacturer's recommendations and these special provisions, these special provisions shall prevail.

Water and grout from tieback anchor construction operations shall not fall on public traffic, flow across shoulders or lanes occupied by public traffic, or flow into landscaping, gutters, or other drainage facilities. Excessive amounts of water shall not be used in any of the drilling and the tieback anchor installation procedures.

Tieback anchor steel shall be protected prior to completion of all grouting against rust, corrosion, and physical damage in conformance with the provisions in Section 50, "Prestressing Concrete," of the Standard Specifications. In addition, there shall be no evidence of distress in the plastic sheathing or crushing of the grout within the pregrouted sheathing.

The tieback anchorage assembly shall be protected against rust, corrosion, and physical damage prior to completion of all grouting of enclosure or encasement in concrete.

The tieback anchor installation method selected by the Contractor shall be sufficient to achieve the loadings specified herein. Holes for tieback anchors shall be drilled in the foundation to a depth sufficient to provide the necessary bond length beyond the minimum unbonded length shown on the plans.

Tieback anchorage holes shall be drilled by either the rotary or rotary percussion drilling method.

The diameter of the drilled hole shall be large enough to provide a minimum of one inch grout cover within the bonded length of the tendon. Centralizers shall be used within the bonded length of the tendon.

Pregrouting shall occur at least 48 hours before placing the tendon in the drilled hole.

Prior to installing each anchor assembly into the drilled hole, the anchor assembly shall be clean and free of oil, grease, or other extraneous substances, and any damage to the sheathing shall be repaired or replaced.

Grout for all stages of tieback construction shall be injected at the low end of the void being filled and shall be expelled at the high end until there is no evidence of entrapped air, water, or diluted grout. The grout shall be placed using grout tubes, unless another method is approved by the Engineer. The quantity of the grout and the grout pressures shall be recorded.

After placing initial grout, the anchor shall remain undisturbed until the grout has reached a strength sufficient to provide anchorage during testing operations.

Additional requirements for tiebacks with bar type tendons are as follows:

A. The bar tendons in the unbonded area shall be sheathed with smooth sheathing that extends into the steel tube of the permanent tieback anchorage assembly, as shown on the plans. For this portion of smooth sheathing there is no minimum wall thickness and the sheathing shall be either PVC or HDPE.
B. In addition, bar tendons shall be sheathed full-length with corrugated sheathing. The annular space between the bar and the corrugated sheathing shall be pregrouted prior to placing the tendons in the drilled hole. The bar shall be centered in the sheathing.

C. There shall be a seal between the smooth sheathing and the corrugated sheathing at the top and bottom of the length of smooth sheathing.
D. For bar tendons, the initial grout in the drilled hole may be placed before or after insertion of the bar tendon.
E. For drilled holes 6 inches in diameter or less, the initial grout outside of the corrugated sheathing shall extend to within 6 inches of the end of the steel tube of the anchorage assembly. Grout in the unbonded length shall not be placed under pressure. For drilled holes greater than 6 inches in diameter, the initial grout outside of the corrugated sheathing shall be within the limits of the bonded length. After placing the initial grout, the anchor shall remain undisturbed until the grout has reached a strength sufficient to provide anchorage during testing operations.

Additional requirements for tiebacks with strand type tendons are as follows:

A. The Contractor shall have the option of using Alternative A or Alternative B as shown on the plans for tieback tendons.
B. For Alternative A and Alternative B, strand tendons shall be sheathed with corrugated sheathing. The individual strands within the bonded length shall be separated by spaces so that the entire surface of each strand is bonded in the grout. The maximum spacing of strand spacers shall be 5 feet. The strand spacers shall be plastic and of a construction and strength that will provide support for the individual strands during construction operations.
C. For Alternative A, the bonded length of the tendon shall be sheathed with corrugated sheathing and pregrouted full length of the corrugated sheathing before placing the tendon in the hole. The corrugated sheathing shall lap the smooth sheathing on the strands 2 feet. For this alternative, the initial grout in the drilled hole may be placed before or after insertion of the strand tendon.
D. For Alternative B, the tendon shall be sheathed full length with corrugated sheathing and pregrouted a minimum length of 2 feet before placing the tendon in the hole. After placing the tendon into the drilled hole and before placing initial grout in the drilled hole, the grout shall be injected at the low end of the corrugated sheathing and the grout shall be expelled at the high end until there is no evidence of entrapped air, water, or diluted grout.
E. For Alternative A and Alternative B, anchors in holes of 6 inches in diameter and smaller shall be initially grouted to within 6 inches of the end of the steel tube. Grout in the unbonded length shall not be placed under pressure. After placing the initial grout, the anchor shall remain undisturbed until the grout has reached a strength sufficient to provide anchorage during testing operations.
F. For Alternative A and Alternative B, anchors in holes of greater than 6 inches in diameter shall be initially grouted within the bond length. After placing the initial grout, the anchor shall remain undisturbed until the grout has reached a strength sufficient to provide anchorage during testing operations.

Testing

All tiebacks shall be load tested by either a performance test or a proof test. Load testing shall be performed against a temporary waler that bears against CIDH concrete piles or soldier piles. Bearing pads shall be kept a minimum of one foot away from the edges of the drilled hole. Temporary yokes and walers shall remain the property of the Contractor. The magnitude of applied test loads shall be determined with a calibrated pressure gauge or a load cell. Movements of the end of the tieback, relative to an independent fixed reference point, shall be measured and recorded to the nearest 0.001—inch at each load increment during the load tests. The Contractor shall perform the measuring and recording and shall furnish the Engineer copies of the recorded movements.

A minimum of 5% of total tiebacks shall be performance tested. The Engineer will determine the location of the tiebacks to be performance tested.

The performance test or proof test shall be conducted by measuring the test load applied to the tieback and the tieback end movement during incremental loading and unloading of the anchor in accordance with the loading schedule. The test load shall be held constant for 10 minutes. During the test load hold, the movement of the end of the tendon shall be measured at 1, 2, 3, 4, 5, 6, and 10 minutes. If the total movement between one minute and 10 minutes exceeds 0.04—inch, the test load shall be held for an additional 50 minutes. Total movement shall be measured at 15, 20, 25, 30, 45, and 60 minutes. If the test load is held for 60 minutes, a creep curve showing the creep movement between one minute and 60 minutes shall be plotted as a function of the logarithm of time. The proof test load shall be up to 1.30T at Retaining Wall A and B.

LOADING SCHEDULES		
PERFORMANCE TEST		PROOF TEST
	(CONT'D)	
AL	AL	AL
0.25T	0.25T	0.25T
AL	0.50T	0.50T
0.25T	0.75T	0.75T
0.50T	1.00T	1.00T
AL	1.25T	1.25T
0.25T	AL	1.50T (TEST LOAD)
0.50T	0.25T	AL
0.75T	0.50T	
AL	0.75T	
0.25T	1.00T	
0.50T	1.25T	
0.75T	1.50T (TEST LOAD)	
1.00T (CONT'D)	AL	
T = Design force for the anchor shown on the plans		
AL = Alignment load		

For performance and proof tests, each increment of load shall be applied in less than one minute and held for at least one minute but not more than 2 minutes or as specified above. The observation period for the load hold shall start when the pump begins to apply the last increment of load.

The jacking equipment, including the tendon movement measuring system, shall be stable during all phases of the tieback loading operations.

All tiebacks not performance tested shall be proof tested. If 1.5 times the design force cannot be obtained, the tieback shall be redesigned and replaced. Tieback anchors shall not be retested, unless the tieback bond length is post-grouted after the unacceptable test.

A performance tested tieback is acceptable if:

A. The measured elastic movement exceeds 0.80 of the theoretical elongation of the unbonded length plus the jacking length at the maximum test load; and
B. The creep movement between one and 10 minutes is less than 0.04—inch.

A proof tested tieback is acceptable if:

A. The pattern of movements is similar to that of adjacent performance tested tiebacks; and
B. The creep movement between one and 10 minutes is less than 0.04—inch.

Performance tested or proof tested tiebacks which fail to meet acceptance criterion B will be acceptable if the maximum load is held for 60 minutes and the creep curve plotted from the movement data indicates a creep rate of less than 0.08—inch for the last log cycle of time.

Lock-off

After successful testing of the tiebacks, the tiebacks shall be tensioned against the structure and locked off at a load equal to 1.0T. The lock-off force is the load on the jacks that is maintained while the anchor head or anchor nuts on the tieback are permanently set. Immediately after lock-off, a lift-off test shall be performed to demonstrate that the specified lock-off force was obtained. Adjustments in the shim thickness shall be made if required to maintain the specified lock-off force.

For strand tendons, the permanent wedges shall be fully set in the anchor head while the tendon is stressed to the test load of 1.50 T, and then locked off at the lock-off force by removal of the shims or other appropriate means.

Grouting to the level of secondary grouting to the dimensions shown on the plans shall be completed only after successful testing and lock-off has been completed. At least 24 hours after the secondary grout has set, the remaining void in the steel tube and bearing plate shall be filled with grout. Grout shall be injected at the low end and expelled at the high end until there is no evidence of entrapped air or water. A minimum grout head of 2 feet shall be maintained until the grout has set.

The tieback anchor head or anchor nuts shall be enclosed with a grouted anchorage enclosure device. After grouting the steel tube, the bearing plate surface shall be cleaned, sealant placed, and the anchorage enclosure bolted in place. After bolting the anchorage enclosure in place the void in the anchorage enclosure shall be filled with grout by injecting grout at the low end of the void and venting at the high end. Any holes in the top of the anchorage enclosure used for grout placement shall be cleaned and sealed with sealant. Sealant shall be a non-sag polysulfide or polyurethane sealing compound conforming requirements in ASTM Designation: C 920.

MEASUREMENT AND PAYMENT

No payment will be made for tiebacks which do not pass the specified testing requirements.

Tieback anchors will be measured and paid for by the unit, and the number for payment will be determined by the requirements of the details shown on the plans.

The contract unit price paid for tieback anchor shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the tieback anchors, including special measures taken to contain grout in the drilled hole, testing, and furnishing and installing anchorage assemblies, complete in place, including repair or replacement of sheathing as shown on the plans, and handling serpentine materials, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.83 CONCRETE STRUCTURES

Portland cement concrete structures shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications and these special provisions.

Monofilament micro polypropylene fibers shall be uniformly added in tunnel wall and tunnel roof slab concrete in conformance with ASTM C1116, "Standard Specification for Fiber-Reinforced Concrete," and the following requirements:

A. Material: 100 percent virgin polypropylene
B. Tensile strength: 58 ksi average
C. Modulus of elasticity: 580 ksi
D. Thickness: 6-8 denier
E. Length: 3/4-inch maximum
F. Dosage: 3 to 5 lbs/cubic yard

The Contractor shall furnish a Certificate of Compliance to the Engineer in conformance with the provisions in Section 6-1.07, "Certificate of Compliance," of the Standard Specifications for monofilament micro polypropylene fibers.

Tunnel wall and tunnel roof slab shall be Class 1 surface finish in conformance with the requirements specified in Section 51-1.18B, "Class 1 Surface Finish," of the Standard Specifications.

Shotcrete shall not be used as an alternative construction method for reinforced concrete members unless otherwise specified.

The joint between the reinforced concrete bridge slab and the Type 1 closure walls shall be sealed with commercial quality paintable elastomeric latex caulking suitable for use with concrete. After curing the caulk shall be painted to closely match the adjacent concrete surfaces.

SWELLING RUBBER WATERSTOP

Swelling rubber waterstop shall be provided where shown on the plans for sealing permanent cold and construction joints between structural elements against the penetrations of water from wet-face of structure under medium of high hydrostatic pressure. Also for the protection of migratory water between horizontal floor and deck slabs, or loose laid waterproofing membranes under low hydrostatic pressure.

Working Drawings

The Contractor shall submit working drawings for swelling rubber waterstop in conformance with the provisions in Section 55-1.02, "Drawings," of the Standard Specifications and the requirements specified herein.

The working drawings shall include all procedures, sequences, and details of fabrication, installation, anchorage, and interface with bar reinforcing steel and other structural elements, and all other operations that are required to construct swelling rubber waterstop.

Working drawings shall be signed by an engineer who is registered as a Civil Engineer in the State of California.

The Contractor shall allow 3 weeks after complete working drawings and all support data are submitted for the review and approval. No swelling rubber waterstop work shall begin until complete working drawings are reviewed and approved, in writing, by the Engineer.

Materials

The swelling rubber waterstop shall have the minimum performance standards as follows:

Property	ASTM	Values
Tensile Strength (psi)	D412	142
Elongation (%)	D412	550
Hardness (Hs)	D2240 Duror Type A	30

The material for swelling rubber waterstop may be used either in strip form or gun grade as shown on the plans. The gun grade product's physical properties shall conform to the following:

Property	Gun Grade
Hardness (Hs)	28
Tensile Strength (psi)	356

The Contractor shall furnish a Certificate of Compliance to the Engineer in conformance with the provisions in Section 6-1.07, "Certificate of Compliance," of the Standard Specifications for swelling rubber waterstop.

Installation

Prior to installation of the swelling rubber waterstop, the surface shall be evened, dry, clean and free of oil, dust and laitance. Joint may be glued to surface using gun grade cartridges or nailed with nails. The glue shall be applied both on the concrete and the swelling rubber waterstop joint surface. Allow the glue to become tacky to the touch in order to obtain maximum adhesion and ease in application.

The swelling rubber waterstop shall be applied with the even side towards the existing concrete surface and shall be then pressed into the tacky glue. The minimum concrete coverage over the swelling rubber waterstop shall be 6". The swelling rubber waterstop shall be placed no closer than 2 inches from the edge of the concrete pour to prevent the concrete edge from spalling. The swelling rubber waterstop ends shall be butted together tightly. Pipe penetrations shall be sealed by the use of swelling rubber waterstop gun grade cartridges by placing two beads of the material around the entire circumference of the pipe penetration as shown on the plans.

FALSEWORK

Falsework shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications and these special provisions.

In addition to the provisions in Section 51-1.06A, "Falsework Design and Drawings," of the Standard Specifications, the time to be provided for the Engineer's review of the working drawings for specific structures, or portions thereof, shall be as follows:

Structure or Portion of Structure	Total Review Time - Weeks
Southbound Battery Tunnel Roof Slab	6

The Contractor's engineer who signs the falsework drawings shall also certify in writing that the falsework is constructed in conformance with the approved drawings and the contract specifications prior to placing concrete. This certification shall include performing any testing necessary to verify the ability of the falsework members to sustain the stresses required by the falsework design. The engineer who signs the drawings may designate a representative to perform this certification. Where falsework contains openings for railroads, vehicular traffic, or pedestrians, the designated representative shall be qualified to perform this work, shall have at least 3 years of combined experience in falsework design or supervising falsework construction, and shall be registered as a Civil Engineer in the State of California. For other falsework, the designated representative shall be qualified to perform this work and shall have at least 3 years of combined experience in falsework design or supervising falsework construction. The Contractor shall certify the experience of the designated representative in writing and provide supporting documentation demonstrating the required experience if requested by the Engineer.

Welding and Nondestructive Testing

Welding of steel members, except for previously welded splices and except for when fillet welds are used where load demands are less than or equal to 1,000 pounds per inch for each 1/8 inch of fillet weld, shall conform to AWS D1.1 or other recognized welding standard. The welding standard to be utilized shall be specified by the Contractor on the working drawings. Previously welded splices for falsework members are defined as splices made prior to the member being shipped to the project site.

Splices made by field welding of steel beams at the project site shall undergo nondestructive testing (NDT). At the option of the Contractor, either ultrasonic testing (UT) or radiographic testing (RT) shall be used as the method of NDT for each field weld and any repair made to a previously welded splice in a steel beam. Testing shall be performed at locations selected by the Contractor. The length of a splice weld where NDT is to be performed, shall be a cumulative weld length equal to 25 percent of the original splice weld length. The cover pass shall be ground smooth at the locations to be tested. The acceptance criteria shall conform to the requirements of AWS D1.1, Section 6, for cyclically loaded nontubular connections subject to tensile stress. If repairs are required in a portion of the weld, additional NDT shall be performed on the repaired sections. The NDT method chosen shall be used for an entire splice evaluation including any required repairs.

For all field welded splices, the Contractor shall furnish to the Engineer a letter of certification which certifies that all welding and NDT, including visual inspection, are in conformance with the specifications and the welding standard shown on the approved working drawings. This letter of certification shall be signed by an engineer who is registered as a Civil Engineer in the State of California and shall be provided prior to placing any concrete for which the falsework is being erected to support.

For previously welded splices, the Contractor shall determine and perform all necessary testing and inspection required to certify the ability of the falsework members to sustain the stresses required by the falsework design. This welding certification shall (1) itemize the testing and inspection methods used, (2) include the tracking and identifying documents for previously welded members, (3) be signed by an engineer who is registered as a Civil Engineer in the State of California, (4) and shall be provided prior to erecting the members.

MEASUREMENT AND PAYMENT

Measurement and payment for concrete in structures shall conform to the provisions in Section 51-1.22, "Measurement," and Section 51-1.23, "Payment," of the Standard Specifications and these special provisions.

Structural concrete for Retaining Wall C will be measured and paid for as structural concrete, tunnel roof slab.

Full compensation for sealing the joint between the reinforced concrete bridge slab and the Type 1 closure walls with commercial quality paintable elastomeric latex caulking suitable for use with concrete and painting to closely match the adjacent concrete surfaces shall be considered as included in the contract price paid per cubic yard for structural concrete, bridge and no separate payment will be made therefor.

Full compensation for furnishing and installing swelling rubber waterstop shall be considered as included in the contract price paid per cubic yard for the various items of structural concrete work involved and no separate payment will be made therefor.

Full compensation for furnishing and installing monofilament micro polypropylene fibers in tunnel wall and tunnel roof slab concrete shall be considered as included in the contract price paid per cubic yard for the various items of structural concrete work involved and no separate payment will be made therefor.

Full compensation for furnishing and installing plastic pipe including horizontal or sloping drains down slopes and across sidewalk areas, including excavation and backfill involved in placing the plastic pipe, shall be considered as included in the contract price paid per cubic yard for the various items of concrete work involved and no separate payment will be made therefor.

10-1.84 DRILL AND BOND DOWELS

Drilling and bonding dowels at Retaining Wall No. 8 shall conform to the details shown on the plans, the provisions in Section 83-2.02D(1), "General," of the Standard Specifications, and these special provisions.

Dowels shall conform to the provisions for bar reinforcement in "Reinforcement" of these special provisions.

If reinforcement is encountered during drilling before the specified depth is attained, the Engineer shall be notified. Unless the Engineer approves coring through the reinforcement, the hole will be rejected and a new hole, in which reinforcement is not encountered, shall be drilled adjacent to the rejected hole to the depth shown on the plans.

Unless otherwise provided, dowels to be bonded into drilled holes will be paid for as bar reinforcing steel (retaining wall).

Unless otherwise provided, drilling and bonding dowels will be measured and paid for by the linear foot determined by the number and the required depth of holes as shown on the plans or as ordered by the Engineer.

The contract price paid per linear foot for drill and bond dowel shall include full compensation for furnishing all labor, materials (except reinforcing steel dowels), tools, equipment, and incidentals, and for doing all the work involved in drilling the holes, including coring through reinforcement when approved by the Engineer, and bonding the dowels, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.85 SEALING JOINTS

Joints between concrete structures must be sealed in conformance with the details shown on the plans, the provisions in Section 51, "Concrete Structures," of the Standard Specifications, and these special provisions.

When ordered by the Engineer, a joint seal larger than called for by the Movement Rating shown on the plans must be furnished and installed. Payment to the Contractor for furnishing the larger seal and for saw cutting the increment of additional depth of groove required will be determined as provided in Section 4-1.03, "Changes," of the Standard Specifications.

10-1.86 ARCHITECTURAL SURFACE (TEXTURED CONCRETE)

Architectural texture for concrete surfaces shall conform to the details shown on the plans, the provisions in Section 51, "Concrete Structures," of the Standard Specifications, and these special provisions.

Architectural textures listed below are required at concrete surfaces shown on the plans:

A. Fluted fin texture
B. Light board finish texture

TEST PANEL

A test panel at least 4' x 4' in size shall be successfully completed at a location approved by the Engineer before beginning work on architectural textures. The test panel shall be constructed and finished with the materials, tools, equipment, and methods to be used in constructing the architectural texture. If ordered by the Engineer, additional test panels shall be constructed and finished until the specified finish, texture, and color are obtained, as determined by the Engineer.

The test panel approved by the Engineer shall be used as the standard of comparison in determining acceptability of architectural texture for concrete-surfaces.

FORM LINERS

Form liners shall be used for textured concrete surfaces and shall be installed in conformance with the manufacturer's recommendations, unless other methods of forming textured concrete surfaces are approved by the Engineer. Form liners shall be manufactured from an elastomeric material or a semi-elastomeric polyurethane material by a manufacturer of commercially available concrete form liners. No substitution of other types of formliner material will be allowed. Form liners shall leave crisp, sharp definition of the architectural surface. Recurring textural configurations exhibited by repeating, recognizable shadow patterns shall be prevented by proper casting of form liner patterns. Textured concrete surfaces with such recurring textural configurations shall be reworked to remove such patterns as approved by the Engineer or the concrete shall be replaced.

Form liners shall have the following properties:

Description	ASTM Designation:	Range
Elastomeric material		
Shore A hardness	D 2240	20 to 65
Tensile strength (psi)	D 412	130 to 900
Semi-elastomeric polyurethane		
Shore D hardness	D 2240	55 to 65
Tensile strength (psi)	D 2370	2600 minimum

Cuts and tears in form liners shall be sealed and repaired in conformance with the manufacturer's recommendations. Form liners that are delaminated from the form shall not be used. Form liners with deformations to the manufactured surface caused by improper storage practices or any other reason shall not be used.

Form liners shall extend the full length of texturing with transverse joints at 8 foot minimum spacing. Small pieces of form liners shall not be used. Grooves shall be aligned straight and true. Grooves shall match at joints between form liners. Joints in the direction of grooves in grooved patterns shall be located only in the depressed portion of the textured concrete. Adjoining liners shall be butted together without distortion, open cracks, or offsets at the joints. Joints between liners shall be cleaned before each use to remove any mortar in the joint.

Adhesives shall be compatible with the form liner material and with concrete. Adhesives shall be approved by the liner manufacturer. Adhesives shall not cause swelling of the liner material.

RELEASING FORM LINERS

Products and application procedures for form release agents shall be approved by the form liner manufacturer. Release agents shall not cause swelling of the liner material or delamination from the forms. Release agents shall not stain the concrete or react with the liner material. For reliefs simulating fractured concrete or wood grain surfaces the application method shall include the scrubbing method using a natural bristle scrub brush in the direction of grooves or grain The release agent shall coat the liner with a thin film. Following application of form release agent, the liner surfaces shall be cleaned of excess amounts of agent using compressed air. Buildup of form release agent caused by the reuse of a liner shall be removed at least every 5 uses.

Form liners shall release without leaving particles or pieces of liner material on the concrete and without pulling or breaking concrete from the textured surface. The concrete surfaces exposed by removing forms shall be protected from damage.

CURING

Concrete surfaces with architectural texture shall be cured only by the forms-in-place or water methods. Seals and curing compounds shall not be used.

MEASUREMENT AND PAYMENT

Architectural texture will be measured and paid for by the square foot.

The contract price paid per square foot for architectural texture of the types listed in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in architectural texture, complete in place, including test panels, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.87 REINFORCEMENT

Reinforcement shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications and these special provisions.

The provisions in "Welding Quality Control" of these special provisions do not apply to resistance butt welding.

EPOXY-COATED REINFORCEMENT

All bar reinforcement in California ST-10 bridge rail at Retaining Wall No. 8 shall be epoxy coated.

MEASUREMENT AND PAYMENT

Measurement and payment for reinforcement in structures shall conform to the provisions in Section 52-1.10, "Measurement," and Section 52-1.11, "Payment," of the Standard Specifications and these special provisions.

Bar reinforcing steel for Retaining Wall C will be measured and paid for as bar reinforcing steel (tunnel).

10-1.88 SHOTCRETE

Shotcrete shall conform to the specifications in Section 51, "Concrete Structures," and Section 53, "Shotcrete," of the Standard Specifications and these special provisions.

Shotcrete shall completely encase reinforcement and other obstructions shown on the plans.

Attention is directed to the section, "Order of Work," in these special provisions regarding furnishing preconstruction shotcrete test panels.

Except for finish coats, shotcrete shall be applied by the wet-mix process only.

Finish coats, applied by the dry-mix process, may be used only when approved by the Engineer.

Shotcrete shall have a minimum compressive strength of 4000 psi at 28 days. No shotcrete work shall be performed before verification by the Engineer of the required compressive strength.

Splicing of reinforcing bars No. 7 or larger in shotcrete shall be by butt splicing only.

The Contractor shall be responsible for obtaining and testing all required preconstruction and production test cores. Coring and testing shall be performed in the presence of the Engineer. The Engineer shall be notified a minimum of 24 hours before the Contractor performs any coring or testing.

All cores shall be obtained and tested for compressive strength in conformance with the specifications in ASTM Designation: C 42/C 42M. Cores used for determining compressive strength shall be free of bar reinforcement or other obstructions. The testing shall be performed at an independent testing facility approved by the Engineer. A copy of the test results shall be furnished to the Engineer within 5 days following completion of testing. Test cylinders specified in Section 90-9 "Compressive Strength" of the Standard Specifications will not be required for shotcrete.

All test panels shall become the property of the Contractor and shall be disposed of in conformance with the specifications in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

PRECONSTRUCTION REQUIREMENTS

Before performing shotcrete work, the Contractor shall construct at least 2 preconstruction shotcrete test panels for each mixture being considered.

The nozzleperson shall have a minimum of 3000 hours experience as a nozzleperson on projects with a similar application.

At least 15 days before constructing any shotcrete test panels, the Contractor shall submit, in conformance with specifications in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, a Quality Control Plan (QCP) for the proposed method of shotcrete placement. The plan shall include:

1. The number and qualifications of nozzlepersons available to place shotcrete, the number of nozzlepersons on the project site at any time during the shotcrete placement, description of their work schedule, and the procedures for avoiding fatigue of any nozzleperson.
2. The proposed method of placing shotcrete, including, but not limited to, application rates, details of any proposed construction joints and their locations, and methods for achieving the required thickness and surface finish.
3. The procedure for curing shotcrete surfaces.
4. The description of a debris containment system, to be used during the cleaning of bar reinforcing steel and concrete and placing of shotcrete, as required to provide for public safety.

The Engineer shall have 15 days to review and approve the QCP submittal after a complete plan has been received. No construction of shotcrete test panels shall be performed until the QCP is approved by the Engineer. Should the Engineer fail to complete the review within this time allowance, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in approving the QCP, the delay will be considered a right of way delay in conformance with the specifications in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

Preconstruction shotcrete test panels shall be constructed by the nozzlepersons and application crew scheduled to do the work, using equipment, materials, mixing proportions, ambient temperatures and procedures proposed for the work. The preconstruction shotcrete test panels shall conform to the following:

1. One shotcrete test panel, of the size determined by the Contractor, shall be unreinforced and shall have 3 cores taken from it and tested for compressive strength. The compressive strength shall be the average strength of the 3 cores, except that, if any core should show evidence of improper coring, the core shall be discarded and the compressive strength shall be the average strength of the remaining cores. The test panel shall be identified and submitted to the Engineer with the test results including a description of the mixture, proportions, and ambient temperature.
2. One shotcrete test panel shall have the same (1) thickness, (2) bar size and quantity of bar reinforcement or other obstructions, and (3) positioning of bar reinforcement or obstructions as the most heavily reinforced section of shotcrete to be placed. The test panel shall be square with the length of the sides equal to at least 3 times the thickness of the most heavily reinforced section of shotcrete to be placed, but not less than 30 inches. After a minimum 7 days of cure, the test panel shall be broken by the Contractor, in the presence of the Engineer, into pieces no larger than 10 inches in greatest dimension. The surfaces of the broken pieces shall be dense and free of laminations and sand pockets, and shall verify the bar reinforcement or other obstructions are completely encased.
3. Both test panels shall be cured under conditions similar to the actual work.
4. At the option of the Contractor, cores to be used for determining the compressive strength may be taken from the reinforced test panel described above instead of making a separate unreinforced test panel as described above. The compressive strength shall be the average strength of the 3 cores, except that, if any core should show evidence of improper coring or contains bar reinforcement or other obstructions, the core shall be discarded and the compressive strength shall be the average strength of the remaining cores. If cores are taken from the reinforced test panel, the panel shall not be broken into pieces, as described above, until it has cured for a minimum of 14 days.

PLACING

An air blowpipe shall be used during shotcrete placement to remove rebound, overspray, and other debris from the areas to receive shotcrete.

Construction joints shall be tapered and shall conform to the specifications in Sections 51-1.13, "Bonding," of the Standard Specifications.

All overspray and rebound shall be removed before final set and before placement of shotcrete on adjacent surfaces.

Rebound or any other material which has already exited the nozzle shall not be reused.

Shotcrete shall be cured in conformance with the specifications in Section 90-7.03, "Curing Structures," of the Standard Specifications.

When a finish coat is to be used, all loose, uneven or excess material, glaze, and rebound shall be removed by brooming, scraping, or other means and the surface left scarified. Surface deposits which take a final set shall be removed by abrasive blasting. Before placing the finish coat, the receiving surface shall be washed down with an air-water blast.

Shotcrete extending into the space shown on the plans for cast-in-place concrete shall be removed.

TESTING AND ACCEPTANCE

At least 3 production shotcrete test cores shall be taken from each 300 square feet or portion thereof of shotcrete placed each day. The cores shall be 3 inches in diameter. The location where cores are to be taken will be designated by the Engineer. Test cores shall be identified by the Contractor, and a description of the core location and mixture, including proportions, shall be submitted to the Engineer with the test cores, immediately after coring. Cored holes shall be filled with mortar in conformance with the specifications in Section 51-1.135, "Mortar," of the Standard Specifications.

Upon receipt of the cores, the Engineer will perform a visual examination to determine acceptance, as described below. Within 48 hours after receipt, the Engineer will return the cores to the Contractor for compressive strength testing.

The compressive strength test shall be performed using the shotcrete production test cores described above. The compressive strength shall be the average strength of the 3 cores, except that, if any core should show evidence of improper coring, the core shall be discarded, and the compressive strength shall be the average strength of the remaining cores.

The basis of acceptance for production shotcrete test cores shall be (1) that the core is dense and free of laminations and sand pockets, and shows the reinforcement or other obstructions are completely encased and (2) the same as specified for test cylinders in the 4th and 5th paragraphs of Section 90-9.01, "General," of the Standard Specifications.

If any production test core shows signs of defective shotcrete as described in (1) above, the shotcrete represented by that test core will be rejected, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength and quality of the shotcrete placed in the work are acceptable.

The surface finish of the shotcrete shall conform to the specifications in Section 51-1.18, "Surface Finishes," of the Standard Specifications.

MEASUREMENT AND PAYMENT

Full compensation for the Quality Control Plan, constructing and breaking test panels, furnishing and testing cores and patching cored holes shall be considered as included in the contract price paid per cubic yard for shotcrete, and no additional compensation will be allowed therefor.

Bar reinforcement in shotcrete at Retaining Wall No. 8 will be paid for as bar reinforcing steel (retaining wall).

Full compensation for welded wire fabric at Retaining Wall A and B is included in the contract price paid per cubic yard for shotcrete, and no separate payment will be made therefor.

Shotcrete protection wall is measured and paid for as shotcrete.

10-1.89 TUNNEL WATERPROOFING SYSTEM

Tunnel waterproofing system shall be cold fluid applied waterproofing system and shall consist of furnishing, installing, and testing tunnel waterproofing system at Southbound Battery Tunnel in conformance with the details shown on the plans and the requirements specified in these special provisions.

WORKING DRAWINGS

The Contractor shall submit working drawings to the Engineer, in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. Working drawings shall include complete details, information, drawings, and substantiating calculations of proposed waterproofing materials, equipment to be used, methods of installation, and waterproofing test procedures. The working drawings shall include the construction sequences, subsurface preparation, application procedures and details, and construction and seismic expansion joint details. The working drawings and calculations shall be signed by an engineer who is registered as a Civil Engineer in the State of California. The working drawings shall include the following:

A. Product data for the specified waterproofing system including manufacturer's printed instructions for evaluating and preparing the substrate, technical data, and tested physical and performance properties.
B. Manufacturer's installation manual including waterproofing materials application guidelines.
C. Locations and extent of waterproofing system including details for substrate joints and cracks, penetrations, construction joints, seismic expansion joints, and other termination conditions.
D. Samples including the following:

    1. Fully adhered trowel applied waterproofing material
    2. High-density polyethylene (HDPE) sheet
    3. Protection board
    4. Geocomposite mesh
    5. Water-soluble film (Protection Release Sheet)
    6. Ancillary components for the installation of the waterproofing system

E. Installer Certificates signed by manufacturer certifying that the installers have completed training for the application in compliance with the manufacturer's installation requirements. Installers without manufacturer's issued Installer Certificate will not be permitted to perform waterproofing installation.
F. Leakage identification, reporting procedures, repair and replacement criteria, and repair details.
G. Documentation to demonstrate that the specified cold fluid trowel applied waterproofing system has been successfully installed for a minimum of 5 years on projects of similar complexity.

The Contractor shall allow 4 weeks after complete drawings and all support data are submitted for the review and approval of the proposed waterproofing system. No waterproofing work shall begin until complete working drawings are reviewed and approved, in writing, by the Engineer.

In the event the Engineer fails to complete the review and approval within the time allowed, and if, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss, and an extension of time will be granted, in the same manner as provided in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

PRE-INSTALLATION MEETING

Prior to performing waterproofing installation, a pre-installation meeting between the Engineer, the Contractor, the waterproofing material manufacturer representative, and any entity performing waterproofing installation for this project, shall be held to discuss the requirements for the waterproofing installation. The pre-installation meeting shall be held in the San Francisco Bay Area.

MATERIALS

Cold fluid applied waterproofing material shall be a single component, polymer-modified, waterproofing system composed of a cold trowel applied mastic type material and ancillary components. The use of bentonite waterproofing products or sheet membrane will not be permitted.

All of the materials on site shall be a manufacturer specified product and all components of the waterproofing system shall be provided by the same manufacturer.

Waterproofing system shall consist of HDPE sheet, trowel on mastic type material, geocomposite mesh, water-soluble film (protection release sheet), and protection board.

Cold trowel applied mastic waterproofing system shall have the following performance properties:

A. Self-adhering and completely bonded to the entire surface of the concrete with no voids or lack of discontinuity.
B. Resistant to chemical and hydrocarbon attack and not affected by wet/dry cycling.
C. Contain less than 10 percent volatile organic compounds (VOC).
D. Non-toxic and non-flammable.
E. Seamless.
F. One-part mastic type material.
G. Able to be applied the same day as concrete forms are stripped.
H. Bond to fresh concrete and "green" concrete.
I. Applied without primer.
J. Waterproofing material remains flexible and never completely cures.

The waterproofing system components shall have the following physical properties:

Property	Requirements	Test Method
TROWEL APPLIED MASTIC WATERPROOFING		
Resistance to Decay	≤5%	ASTM E154
Hardness	80	ASTM C836-89
Puncture Resistance	100 lbs	ASTM E154
Flash Point	>200°F	ASTM D56
Tensile Strength	≤50 lbs	ASTM D412
Elongation %	300%	ASTM C1135
Hydrostatic Pressure Resistance	≥100 psi	ASTM D751
Adhesion to Concrete	Rating of 1 (Excellent)	ASTM D412
Crack Bridging flexibility	No cracks	ASTM C836
Moisture Permeability	<0.022 perm	ASTM E96
HDPE SHEET		
Classification	Exceeds classes A, B, & C	ASTM E1745
Water Vapor Permeability	≥0.010 perm	ASTM E96
Tensile Strength	>50 lbs/in	ASTM E154
Puncture Resistance	2226 grams	ASTM D1709
Chemical Resistance	Unaffected	ASTM E154
Life Expectancy	Indefinite	ASTM E154
Thickness	Minimum 16 mils	ACI 302.1R

Plywood sheathing for protection board shall be 1/2-inch by 4-foot by 8-foot fire-rated sheathing or 1/2-inch fire rated sheathing Structural I in accordance with NIST Product Standard PS 1-07.

The exposed surface of the waterproofing trowel on mastic shall be protected with a coating to prevent dust and other contaminants from adhering to the waterproofing. The cold trowel applied mastic protection coating shall not prevent the waterproofing from fully bonding to the concrete structure.

Geocomposite mesh applied to the cold trowel applied mastic prior to concrete placement shall be polypropylene with the following properties:

A. Mesh size: 1/2 inch by 1/2 inch +/- 1/16 inch.
B. Weight 24 pounds/1,000 square foot (minimum).
C. Transverse Direction (TD) Strand Count: 1.95 strands/inch +/- 0.15.
D. Machine Direction (MD) Strand Count: 2.2 strands/inch +/- 0.4.
E. Normal Hole Size: 1/2 inch; 80 percent open area normal.
F. Joint Thickness: 0.060 inch guideline.
G. MD Breakload: 17 pounds/strand (minimum).
H. TD Breakload: 15 pounds/strand (minimum).

Water Soluble Film (Protective Release Sheet) shall have the following properties:

A. Soluble resin composed of:

    1. 75 percent polyvinyl alcohol (PVA), polymerization degree: 1,700 to 1800.
    2. Hydrolyzation degree: minimum 86 percent.
    3. 25 percent plasticizers and organic additive.

B. Water soluble and biodegradable without any toxic residue.
C. Stable at normal environmental conditions.

Waterproofing Protection Course shall be HDPE reinforced 16-mil material. Seaming Tape shall be 16-mil laminated, self-adhering polyethylene film.

All materials shall be protected from permanent exposure to the elements and ultraviolet rays when packed, and shall be handled, delivered, and stored on site in accordance with the manufacturer's recommendations.

The Contractor shall furnish a Certificate of Compliance to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for all materials to be used for waterproofing system. The Certificate of Compliance shall include the material name, size, manufactured date and expiration date, manufacturer's name and location, material's intended use, and application and installation instructions.

A warranty shall be provided by the manufacturer of the tunnel waterproofing system and shall include all labor, materials, and incidentals required to seal all leaks that occur within the new Southbound Battery Tunnel and ancillary structures as a result of failure of the waterproofing material. The warranty period shall be 15 years commencing from the project completion date.

MOCK-UP TESTS

The Contractor shall conduct two mock-up test panels of the waterproofing installation similar in configuration to the tunnel wall section and the tunnel invert slab section to verify the performance of the waterproofing materials during placement of concrete at the base, at full height of the wall, and at tunnel invert slab. The test panel for tunnel wall section shall be a minimum of 5 feet wide by 20 feet high by 2.5 feet thick. The test panel for tunnel invert slab section shall be a minimum of 5 feet wide by 15 feet high by 3.5 feet thick. The mock-ups shall be installed in accordance with the manufacturer's recommendations.

The waterproofing material shall be installed and concrete of similar mix to be used on the project shall be cast against the waterproofing material. Each test panel shall be installed and observed during concrete placement by the Engineer. Coring through the test panel shall conform to the following acceptance criteria:

Mock-up Test	Frequency of Coring Tests	Location
Tunnel Wall Panel: Panel shall be divided into two equal segments. One segment is covered with 180-mil thick fully adhered membrane, the other with 90-mil thick fully adhered membrane.	Four at the bottom of the wall panel Four elsewhere	- 1 ft above the bottom of the tunnel wall panel at the location as directed by the Engineer. - To be determined by the Engineer.
Tunnel Invert Slab Panel: Panel shall covered with 90-mil thick fully adhered membrane.	Six	- To be determined by the Engineer.

The Contractor shall provide video tape documentation of the installation, placement, and testing of test panels and submit a report to the Engineer of the performance of the waterproofing material during and after concrete placement. The test panels shall be formed prior to any waterproofing on the project.

If test panel coring results indicate that the cold trowel applied mastic waterproofing thickness is less than the required 90 mils at the normal application and 180 mils at the expansion joints, the mock-ups will be rejected. The Contractor shall propose remedial measures to ensure the minimum thickness of the cold trowel applied mastic waterproofing can be achieved and the Contractor shall perform additional mock-up tests, at the Contractor's expenses, to meet the acceptance criteria.

MANUFACTURER REPRESENTATIVE

Waterproofing system manufacturer shall have a representative full time on site to supervise and coordinate all the waterproofing work during the construction of the waterproofing system. The representative shall sign off on the approval of the substrate for each location of the application of the waterproofing material.

SURFACE PREPARATION

Prior to installation of the waterproofing materials, the Contractor shall examine and prepare all surfaces to receive the waterproofing material in compliance with the manufacturer's requirements and approved working drawing submittal.

Adjacent surfaces not designated for waterproofing application shall be protected. Surfaces shall be clean, clear, smooth, and free of standing water. All holes and voids shall be patched and all substrate surface misalignments shall be smooth out.

APPLICATION

Waterproofing system shall be installed in a dry condition.

All detailing and flashing shall be completed before installing the material over the substrate. HDPE sheet shall be installed as shown on the plans. The cold trowel applied mastic shall be applied at a rate to provide a continuous, monolithic coat of 90-mils minimum, onto the HDPE sheet as recommended by the manufacturer.

After application, apply surface protecting sheet as shown on the plans and as recommended by the manufacturer.

Application blind side: Protection board shall be installed against the retention walls fastened with large head nails or staples as shown on the plans. A retention wall is a soldier pile wall, tieback wall, or shotcrete protection wall as shown on the plans. Apply HDPE sheet against the protection board with large head nails or staples. HDPE seams shall be taped as recommended by the manufacturer prior to the application of the cold trowel applied mastic waterproofing material. Apply the cold trowel applied mastic material at a rate to provide a continuous, monolithic coat of 90-mil minimum as recommended by the manufacturer. Mechanically fasten a geocomposite mesh into the cold trowel applied mastic against the base sheet, if required by the manufacturer. Installation of the geocomposite mesh shall not compromise the water tightness of the poly-rubber gel material. Apply water-soluble film onto the structural mesh prior to concreting. Keep the workplace clean during the application process and after the workday is complete.

Protection layer: Embed the HDPE sheets and overlap adjoining sheet edges (dry) a minimum of 2 to 3 inches to ensure complete coverage. Rigid insulation board shall not be overlapped. Tape all seams. The completed material and protection assembly shall be covered with subsequent topping materials as soon as possible, within 1 Day of application.

Application positive side: Apply the cold trowel applied mastic at a rate to provide a continuous, monolithic coat of 90 mil minimum at the positive side waterproofing section. Apply HDPE sheet against the cold trowel applied mastic material. Do not nail or staple through the material. Install protection board against the HDPE sheet. Do not fasten the protection board to the walls with staples or nails.

Construction joint application: Prior to starting work on construction joints, reinforce both sides for 6-inch centering on the joint preparing surface and installing protective waterproofing layers in conformance with the requirements specified herein.

WATER TEST

Three locations of the tunnel roof or portions thereof shall be water tested by means of electronic testing or ponding water to a minimum depth of 2 inches for a period of 48 hours to check the integrity of the material installation. The test locations will be determined by the Engineer. If leaks occur, the test is deemed to fail and the water shall be drained completely and the Contractor shall repair and retest the material.

JOB COMPLETION

The Contractor and the waterproofing manufacturer's representative shall inspect the waterproofing assembly and notify the Engineer of any defects. All defects shall be corrected at the expense of the Contractor.

After final inspection of the work and acceptance by the manufacturer's representative, the manufacturer's representative shall provide a signed document identifying, by locations and areas, acceptance to the Engineer.

MEASUREMENT AND PAYMENT

Waterproofing system, at the location listed in the Engineer's Estimate, will be measured and paid for by the square foot as determined from the limits shown on the plans.

The contract prices paid per square foot for waterproofing system of location listed in the Engineer's Estimate includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing tunnel waterproofing system, including mock-up test and water test, laps at connections and seams, and special treatment for penetrations, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.90 WATERPROOFING

Waterproofing at Retaining Wall No. 8 shall conform to the provisions in Section 54, "Waterproofing," of the Standard Specifications and these special provisions.

At the option of the Contractor, a preformed membrane waterproofing system may be furnished and applied in lieu of the asphalt membrane waterproofing specified above. Preformed membrane waterproofing shall conform to these special provisions.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications shall be furnished for the preformed membrane sheet. The Certificate of Compliance shall include the following information: (1) type of preformed membrane sheet, and (2) the conditioner or primer application rates.

The preformed membrane waterproofing system shall consist of an adhesive, conditioner or primer applied to a prepared surface; a preformed membrane sheet of rubberized asphalt or polymer modified bitumen; mastic or tape for sealing the edges of the sheet; and a protective covering over the sheet held by an adhesive.

The preformed membrane sheet shall be either permanently applied to a polyethylene film or reinforced with a polypropylene mesh fabric, polyester/polypropylene fabric or a fiberglass mesh fabric. The membrane sheet shall conform to the following requirements:

Property	Test	Requirement	
		Polyethylene Film	Fabric Reinforced
Tensile Strength (min.)(1)	ASTM D 882 (2)	20 lbs/in (3)	20 lbs/in (3)
Percent Elongation at break (min.) (4)	ASTM D 882 (2)	150 percent (3)	25 percent (3)
Pliability	ASTM D 146 (5)	No cracks	No cracks
Thickness (min.) (6)	------	60 mils	60 mils
Rubberized Asphalt Softening Point (min.)	AASHTO T 53	165° F	165° F
Polymer Modified Bitumen Softening Point (min.)	AASHTO T 53	210° F	210° F

Notes:
(1) Breaking factor in machine direction.
(2) Method A, average 5 samples.
(3) At 73.4° F ±3.6° F
(4) Machine direction.
(5) 180-degree bend over a one-inch mandrel at 10° F
(6) Total thickness of preformed membrane sheet and polyethylene film or fabric reinforcement

Adhesives, conditioners, primers, mastics and sealing tapes shall be manufactured for use with the respective preformed membrane sheet materials and shall be applied according to the manufacturer's recommendations.

The protective covering shall be 1/8 inch minimum thickness hardboard or other material that furnishes equivalent protection. Backfill material and equipment shall not cut, scratch, depress or cause any other damage to the preformed membrane.

Surfaces designated to receive preformed membrane waterproofing shall be thoroughly cleaned of dirt, dust, loose or unsound concrete, and other extraneous material and shall be free from fins, sharp edges, and protrusions that would, in the opinion of the Engineer, puncture or otherwise damage the membrane. Sharp corners to be covered shall be rounded (outside) or chamfered (inside).

Surfaces shall be dry when components of the preformed membrane waterproofing system are applied.

Preformed membrane waterproofing shall not be applied to any surface until the Contractor is prepared to follow its application with the placing of the protective covering and backfill within a sufficiently short time that the membrane will not be damaged by workers or equipment, exposure to weathering, or from any other cause. Damaged membrane or protective covering shall be repaired or replaced by the Contractor at the Contractor's expense.

All projecting pipe, conduits, sleeves or other facilities passing through the preformed membrane waterproofing shall be flashed with prefabricated or field-fabricated boots, fitted coverings or other devices as necessary to provide watertight construction.

All conditioner or primers shall be thoroughly mixed and continuously agitated during application. Conditioner, primers or adhesive shall be allowed to dry to a tack free condition prior to placing membrane sheets.

The surfaces shall be recoated if membrane sheets are not placed over primer, conditioner or adhesive within the time recommended by the manufacturer.

The preformed membrane sheet shall not be applied in wet or foggy weather, nor when the ambient temperature is below 40° F.

Preformed membrane material shall be placed starting at the bottom and lapped by a minimum of 6 inches at splices and at repairs to holes or tears.

Exposed edges of membrane sheets shall have a trowelled bead of manufacturer's recommended mastic or sealing tape applied after the membrane is placed.

The surface of the preformed membrane shall be cleaned free of dirt and other deleterious material before the protective covering is placed.

The protective covering shall be placed on a coating of adhesive of a type recommended by the manufacturer. The adhesive shall be applied at a rate sufficient to hold the protective covering in position until the backfill is placed.

Preformed membrane waterproofing will be measured and paid for by the square foot as asphalt membrane waterproofing.

10-1.91 STEEL STRUCTURES

Construction of steel structures shall conform to the provisions in Section 55, "Steel Structures," of the Standard Specifications and these special provisions.

GENERAL

The Contractor shall furnish and erect structural steel for wales, struts, outtrigger, raker, gusset plates, and other appurtenances at Retaining Walls A and B in conformance with the details shown on the plans and the requirements specified herein.

Structural steel components that are no longer needed after tunnel construction shall be removed. Removed structural components shall become the property of the Contractor and shall be removed from the site of the work.

WORKING DRAWINGS

The Contractor shall submit working drawings for structural steel in conformance with the provisions in Section 55-1.02, "Drawings," of the Standard Specifications and the requirements specified herein.

The working drawings shall include all procedures, sequences, and details of furnishing, erecting, jacking, removing, rebracing, and all other operations that are required to constructing structural steel.

Construction sequence and application of struts pre-loading values shall be as shown on the plans.

Bracing shall be provided as necessary to withstand all imposed loads during erection and removal of any structural steel components. The structural steel working drawings shall show provisions for such temporary bracing or methods to be used to conform to these requirements during each phase of erection and removal.

Working drawings shall be signed by an engineer who is registered as a Civil Engineer in the State of California.

The Contractor shall allow 4 weeks after complete working drawings and all support data are submitted for the review and approval. No structural steel work shall begin until complete working drawings are reviewed and approved, in writing, by the Engineer.

Attention is directed to "Welding" in Section 8, "Materials," of these special provisions.

MATERIALS

Structural steel rolled shapes used in wales, struts, outtrigger, and raker shall conform to the Charpy V-notch impact values specified for steel plate in Section 55-2, "Materials," of the Standard Specifications.

ROTATIONAL CAPACITY TESTING PRIOR TO SHIPMENT TO JOB SITE

Rotational capacity tests shall be performed on all lots of high-strength fastener assemblies prior to shipment of these lots to the project site. Zinc-coated assemblies shall be tested after all fabrication, coating, and lubrication of components has been completed. One hardened washer shall be used under each nut for the tests.

The requirements of this section do not apply to high-strength cap screws or high-strength bolts used for slip base plates.

Each combination of bolt production lot, nut lot, and washer lot shall be tested as an assembly.

A rotational capacity lot number shall be assigned to each combination of lots tested. Each shipping unit of fastener assemblies shall be plainly marked with the rotational capacity lot number.

Two fastener assemblies from each rotational capacity lot shall be tested.

The following equipment, procedure, and acceptance criteria shall be used to perform rotational capacity tests on and determine acceptance of long bolts. Fasteners are considered to be long bolts when full nut thread engagement can be achieved when installed in a bolt tension measuring device:

A. Long Bolt Test Equipment:

1. Calibrated bolt tension measuring device with adequate tension capacity for the bolts being tested.
2. Calibrated dial or digital torque wrench. Other suitable tools will be required for performing Steps 7 and 8 of the Long Bolt Test Procedure. A torque multiplier may be required for large diameter bolts.
3. Spacer washers or bushings. When spacer washers or bushings are required, they shall have the same inside diameter and equal or larger outside diameter as the appropriate hardened washers conforming to the requirements in ASTM Designation: F 436.
4. Steel beam or member, such as a girder flange or cross frame, to which the bolt tension measuring device will be attached. The device shall be accessible from the ground.

B Long Bolt Test Procedure:

1. Measure the bolt length. The bolt length is defined as the distance from the end of the threaded portion of the shank to the underside of the bolt head.
2. Install the nut on the bolt so that 3 to 5 full threads of the bolt are located between the bearing face of the nut and the underside of the bolt head. Measure and record the thread stickout of the bolt. Thread stickout is determined by measuring the distance from the outer face of the nut to the end of the threaded portion of the shank.

3. Insert the bolt into the bolt tension measuring device and install the required number of washers, and additional spacers as needed, directly beneath the nut to produce the thread stickout measured in Step 2 of this procedure.
4. Tighten the nut using a hand wrench to a snug-tight condition. The snug tension shall not be less than the Table A value but may exceed the Table A value by a maximum of 2 kips.

Table A

High-Strength Fastener Assembly Tension Values to Approximate Snug-Tight Condition	
Bolt Diameter (inches)	Snug Tension (kips)
1/2	1
5/8	2
3/4	3
7/8	4
1	5
1-1/8	6
1-1/4	7
1-3/8	9
1-1/2	10

5. Match-mark the assembly by placing a heavy reference start line on the face plate of the bolt tension measuring device which aligns with (1) a mark placed on one corner of the nut and (2) a radial line placed across the flat on the end of the bolt or on the exposed portions of the threads of tension control bolts. Place an additional mark on the outside of the socket that overlays the mark on the nut corner such that this mark will be visible while turning the nut. Make an additional mark on the face plate, either 2/3 of a turn, one turn, or 1-1/3 turn clockwise from the heavy reference start line, depending on the bolt length being tested as shown in Table B.

Table B

Required Nut Rotation for Rotational Capacity Tests[(a) (b)]	
Bolt Length (measured in Step 1)	Required Rotation (turn)
4 bolt diameters or less	2/3
Greater than 4 bolt diameters but no more than 8 bolt diameters	1
Greater than 8 bolt diameters, but no more than 12 bolt diameters[(c)]	1-1/3

(a) Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance shall be plus or minus 30 degrees; for bolts installed by 2/3 turn and more, the tolerance shall be plus or minus 45 degrees.
(b) Applicable only to connections in which all material within grip of the bolt is steel.
(c) When bolt length exceeds 12 diameters, the required rotation shall be determined by actual tests in a suitable tension device simulating the actual conditions.

6. Turn the nut to achieve the applicable minimum bolt tension value listed in Table C. After reaching this tension, record the moving torque, in foot-pounds, required to turn the nut, and also record the corresponding bolt tension value in pounds. Torque shall be measured with the nut in motion. Calculate the value, T, where T = [(the measured tension in pounds) x (the bolt diameter in inches) / 48].

Table C

Minimum Tension Values for High-Strength Fastener Assemblies	
Bolt Diameter (inches)	Minimum Tension (kips)
1/2	12
5/8	19
3/4	28
7/8	39
1	51
1-1/8	56
1-1/4	71
1-3/8	85
1-1/2	103

7. Turn the nut further to increase bolt tension until the rotation listed in Table B is reached. The rotation is measured from the heavy reference line made on the face plate after the bolt was snug-tight. Record this bolt tension.
8. Loosen and remove the nut and examine the threads on both the nut and bolt.

C. Long Bolt Acceptance Criteria:

1. An assembly shall pass the following requirements to be acceptable: (1) the measured moving torque (Step 6) shall be less than or equal to the calculated value, T (Step 6), (2) the bolt tension measured in Step 7 shall be greater than or equal to the applicable turn test tension value listed in Table D, (3) the nut shall be able to be removed from the bolt without signs of thread stripping or galling after the required rotation in Step 7 has been achieved, (4) the bolt does not shear from torsion or fail during the test, and (5) the assembly does not seize before the final rotation in Step 7 is reached. Elongation of the bolt in the threaded region between the bearing face of the nut and the underside of the bolt head is expected and will not be considered a failure. Both fastener assemblies tested from one rotational capacity lot shall pass for the rotational capacity lot to be acceptable.

Table D

Turn Test Tension Values	
Bolt Diameter (inches)	Turn Test Tension (kips)
1/2	14
5/8	22
3/4	32
7/8	45
1	59
1-1/8	64
1-1/4	82
1-3/8	98
1-1/2	118

The following equipment, procedure, and acceptance criteria shall be used to perform rotational capacity tests on and determine acceptance of short bolts. Fasteners are considered to be short bolts when full nut thread engagement cannot be achieved when installed in a bolt tension measuring device:

A. Short Bolt Test Equipment:

1. Calibrated dial or digital torque wrench. Other suitable tools will be required for performing Steps 7 and 8 of the Short Bolt Test Procedure. A torque multiplier may be required for large diameter bolts.
2. Spud wrench or equivalent.
3. Spacer washers or bushings. When spacer washers or bushings are required, they shall have the same inside diameter and equal or larger outside diameter as the appropriate hardened washers conforming to the requirements in ASTM Designation: F 436.

4. Steel plate or girder with a hole to install bolt. The hole size shall be 1/16 inch greater than the nominal diameter of the bolt to be tested. The grip length, including any plates, washers, and additional spacers as needed, shall provide the proper number of threads within the grip, as required in Step 2 of the Short Bolt Test Procedure.

B. Short Bolt Test Procedure:

1. Measure the bolt length. The bolt length is defined as the distance from the end of the threaded portion of the shank to the underside of the bolt head.
2. Install the nut on the bolt so that 3 to 5 full threads of the bolt are located between the bearing face of the nut and the underside of the bolt head. Measure and record the thread stickout of the bolt. Thread stickout is determined by measuring the distance from the outer face of the nut to the end of the threaded portion of the shank.
3. Install the bolt into a hole on the plate or girder and install the required number of washers and additional spacers as needed between the bearing face of the nut and the underside of the bolt head to produce the thread stickout measured in Step 2 of this procedure.
4. Tighten the nut using a hand wrench to a snug-tight condition. The snug condition shall be the full manual effort applied to the end of a 12-inch long wrench. This applied torque shall not exceed 20 percent of the maximum allowable torque in Table E.

Table E

Maximum Allowable Torque for High-Strength Fastener Assemblies	
Bolt Diameter (inches)	Torque (ft-lb)
1/2	145
5/8	285
3/4	500
7/8	820
1	1220
1-1/8	1500
1-1/4	2130
1-3/8	2800
1-1/2	3700

5. Match-mark the assembly by placing a heavy reference start line on the steel plate or girder which aligns with (1) a mark placed on one corner of the nut and (2) a radial line placed across the flat on the end of the bolt or on the exposed portions of the threads of tension control bolts. Place an additional mark on the outside of the socket that overlays the mark on the nut corner such that this mark will be visible while turning the nut. Make 2 additional small marks on the steel plate or girder, one 1/3 of a turn and one 2/3 of a turn clockwise from the heavy reference start line on the steel plate or girder.
6. Using the torque wrench, tighten the nut to the rotation value listed in Table F. The rotation is measured from the heavy reference line described in Step 5 made after the bolt was snug-tight. A second wrench shall be used to prevent rotation of the bolt head during tightening. Measure and record the moving torque after this rotation has been reached. The torque shall be measured with the nut in motion.

Table F

Nut Rotation Required for Turn-of-Nut Installation[(a) (,b)]	
Bolt Length (measured in Step 1)	Required Rotation (turn)
4 bolt diameters or less	1/3

(a) Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance shall be plus or minus 30 degrees.
(b) Applicable only to connections in which all material within grip of the bolt is steel.

7. Tighten the nut further to the 2/3-turn mark as indicated in Table G. The rotation is measured from the heavy reference start line made on the plate or girder when the bolt was snug-tight. Verify that the radial line on the bolt end or on the exposed portions of the threads of tension control bolts is still in alignment with the start line.

Table G

Required Nut Rotation for Rotational Capacity Test	
Bolt Length (measured in Step 1)	Required Rotation (turn)
4 bolt diameters or less	2/3

8. Loosen and remove the nut and examine the threads on both the nut and bolt.

C. Short Bolt Acceptance Criteria:

1. An assembly shall pass the following requirements to be acceptable: (1) the measured moving torque from Step 6 shall be less than or equal to the maximum allowable torque from Table E, (2) the nut shall be able to be removed from the bolt without signs of thread stripping or galling after the required rotation in Step 7 has been achieved, (3) the bolt does not shear from torsion or fail during the test, and (4) the assembly shall not seize before the final rotation in Step 7 is reached. Elongation of the bolt in the threaded region between the bearing face of the nut and the underside of the bolt head will not be considered a failure. Both fastener assemblies tested from one rotational capacity lot shall pass for the rotational capacity lot to be acceptable.

INSTALLATION TENSION TESTING AND ROTATIONAL CAPACITY TESTING AFTER ARRIVAL ON THE JOB SITE

Installation tension tests and rotational capacity tests on high-strength fastener assemblies shall be performed by the Contractor prior to acceptance or installation and after arrival of the fastener assemblies on the project site. Installation tension tests and rotational capacity tests shall be performed at the job site, in the presence of the Engineer, on each rotational capacity lot of fastener assemblies.

The requirements of this section do not apply to high-strength cap screws or high-strength bolts used for slip base plates.

Installation tension tests shall be performed on 3 representative fastener assemblies in conformance with the provisions in Section 8, "Installation," of the RCSC Specification. For short bolts, Section 8.2, "Pretensioned Joints," of the RCSC Specification shall be replaced by the "Pre-Installation Testing Procedures," of the "Structural Bolting Handbook," published by the Steel Structures Technology Center, Incorporated.

The rotational capacity tests shall be performed in conformance with the requirements for rotational capacity tests in "Rotational Capacity Testing Prior to Shipment to Job Site" of these special provisions.

At the Contractor's expense, additional installation tension tests, tests required to determine job inspecting torque, and rotational capacity tests shall be performed by the Contractor on each rotational capacity lot, in the presence of the Engineer, if:

1. Any fastener is not used within 3 months after arrival on the job site,
2. Fasteners are improperly handled, stored, or subjected to inclement weather prior to final tightening,
3. Significant changes are noted in original surface condition of threads, washers, or nut lubricant, or
4. The Contractor's required inspection is not performed within 48 hours after all fasteners in a joint have been tensioned.

Failure of a job-site installation tension test or a rotational capacity test will be cause for rejection of unused fasteners that are part of the rotational capacity lot.

When direct tension indicators are used, installation verification tests shall be performed in conformance with Appendix Section X1.4 of ASTM Designation: F 959, except that bolts shall be initially tensioned to a value 5 percent greater than the minimum required bolt tension.

SURFACE PREPARATION

For all bolted connections, the contact surfaces and inside surfaces of bolt holes shall be cleaned and coated before assembly in conformance with the provisions for cleaning and painting structural steel of these special provisions.

SEALING

The perimeter around all direct tension indicator gaps shall be completely sealed with non-silicone type sealing compound conforming to the provisions in Federal Specification TT-S-230, Type II. The sealant shall be gray in color and have a minimum thickness of 50 mils. If painting is required, the sealing compound shall be applied prior to painting.

When zinc-coated tension control bolts are used, the sheared end of each fastener shall be completely sealed with non-silicone type sealing compound conforming to the provisions in Federal Specification TT-S-230, Type II. The sealant shall be gray in color and shall have a minimum thickness of 50 mils. The sealant shall be applied to a clean sheared surface on the same day that the splined end is sheared off.

WELDING

Table 2.2 of AWS D1.5 is superseded by the following table:

Base Metal Thickness of the Thicker Part Joined, inches	Minimum Effective Partial Joint Penetration Groove Weld Size*, inches
Over 1/4 to 1/2 inclusive	3/16
Over 1/2 to 3/4 inclusive	1/4
Over 3/4 to 1-1/2 inclusive	5/16
Over 1-1/2 to 2-1/4 inclusive	3/8
Over 2-1/4 to 6 inclusive	1/2
Over 6	5/8

* Except the weld size need not exceed the thickness of the thinner part

The requirement of conformance with AWS D1.5 shall not apply to work conforming to Section 56-1, "Overhead Sign Structures," or Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications.

STRUTS PRE-LOADING AND STRUCTURAL STEEL COMPONENTS REMOVAL

The Contractor shall pre-load the struts to the values shown on the plans. The Contractor's registered engineer shall be present at the site at all times when pre-loading operations are in progress and when removal operations are in progress. The Contractor's registered engineer shall inspect the pre-loading and removal operations and report in writing on a daily basis the progress of the operation and the status of the remaining structure. A copy of the daily report shall be available at the site of the work at all times. Should an unplanned event occur, the Contractor's registered engineer shall submit immediately to the Engineer for approval, the procedure or proposed operation to correct or remedy the occurrence.

Attention is directed to Section 51 1.06C, "Removing Falsework," of the Standard Specifications. All references to falsework in this section shall also apply to steel structural components.

MEASUREMENT AND PAYMENT

The contract price paid per pound for structural steel (retaining wall -) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing, erecting, pre-loading, removing, rebracing, and all required operations to construct structural steel including working drawings, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.92 SIGN STRUCTURE FOUNDATION

Sign structure foundation shall conform to the details shown on the plans, the provisions in Section 56-1, "Overhead Sign Structures," of the Standard Specifications, "Piling" and "Steel Structures" of these special provisions, and the following requirements.

Before commencing construction of sign structure foundation, the Contractor shall submit 2 sets of working drawings to the Engineer in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The working drawings shall include permanent steel casing for cast-in-drilled-hole concrete pile, temporary shoring details as designed by the Contractor, anchorage layouts, proposed splice locations, a snugging and tensioning pattern for anchor bolts and high-strength bolted connections, and details for permanent steel anchor bolt templates. The working drawings shall be supplemented with a written quality control program that includes methods, equipment, and personnel necessary to satisfy the requirements specified herein.

Working drawings shall be 22" x 34" or 11" x 17" in size and each drawing and calculation sheet shall include the State assigned designations for the sign structure type and reference as shown on the contract plans, District-County-Route-Post Mile, and contract number. Working drawings shall be signed by an engineer who is registered as a Civil Engineer in the State of California.

The Engineer shall have 30 days to review the sign structure working drawings after a complete submittal has been received. No construction of sign structure foundation shall commence until the working drawings are approved in writing by the Engineer.

Should the Engineer fail to complete the review within the time allowance and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in reviewing the sign structure working drawings, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

Steel bolts not designated on the plans as high strength (HS) or stainless steel shall be for general applications and shall conform to the requirements in ASTM Designation: A 307.

A permanent steel template shall be used to maintain the proper anchor bolt spacing.

One top nut, one leveling nut, and 2 washers shall be provided for the upper threaded portion of each anchor bolt.

The Contractor shall design and construct temporary wall bracing as shown on the plans. The temporary wall bracing system shall be designed for a service load of 6.0 kips per foot. After construction of sign structure foundation, the temporary wall bracing system shall be removed and disposed of as provided in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Full compensation for furnishing and installing permanent steel casing, anchor bolt assemblies and templates, and designing, constructing, removing, and disposed of temporary wall bracing are considered as included in the contract price per linear foot for 60" cast-in-drilled-hole concrete pile (sign foundation), and no additional compensation will be allowed therefor.

10-1.93 ROADSIDE SIGNS

Roadside signs shall be furnished and installed at the locations shown on the plans or where designated by the Engineer and in conformance with the provisions in Section 56-2, "Roadside Signs," of the Standard Specifications and these special provisions.

The Contractor shall furnish roadside sign panels in conformance with the provisions in "Furnish Sign" of these special provisions.

Wood posts shall be pressure treated after fabrication in conformance with the provisions in Section 58, "Preservative Treatment of Lumber, Timber and Piling," of the Standard Specifications and AWPA Use Category System: UC4A, Commodity Specification A or B.

10-1.94 FURNISH SIGN

Signs shall be fabricated and furnished in accordance with details shown on the plans, the Traffic Sign Specifications, and these special provisions.

Traffic Sign Specifications for California sign codes are available for review at:

http://www.dot.ca.gov/hq/traffops/signtech/signdel/specs.htm

Traffic Sign Specifications for signs referenced with Federal MUTCD sign codes can be found in Standard Highway Signs Book, administered by the Federal Highway Administration, which is available for review at:

http://mutcd.fhwa.dot.gov/ser-shs_millennium.htm

Information on cross-referencing California sign codes with the Federal MUTCD sign codes is available at:

http://www.dot.ca.gov/hq/traffops/signtech/signdel/specs.htm

Temporary or permanent signs shall be free from blemishes that may affect the serviceability and detract from the general sign color and appearance when viewing during daytime and nighttime from a distance of 25 feet. The face of each finished sign shall be uniform, flat, smooth, and free of defects, scratches, wrinkles, gel, hard spots, streaks, extrusion marks, and air bubbles. The front, back, and edges of the sign panels shall be free of router chatter marks, burns, sharp edges, loose rivets, delaminated skins, excessive adhesive over spray and aluminum marks.

QUALITY CONTROL FOR SIGNS

The requirements of "Quality Control for Signs" in this section shall not apply to construction area signs.

No later than 14 days before sign fabrication, the Contractor shall submit a written copy of the quality control plan for signs to the Engineer for review. The Engineer will have 10 days to review the quality control plan. Sign fabrication shall not begin until the Engineer approves the Contractor's quality control plan in writing. The Contractor shall submit to the Engineer at least 3 copies of the approved quality control plan. The quality control plan shall include, but not be limited to the following requirements:

A. Identification of the party responsible for quality control of signs,
B. Basis of acceptance for incoming raw materials at the fabrication facility,
C. Type, method and frequency of quality control testing at the fabrication facility,
D. List (by manufacturer and product name) of process colors, protective overlay film, retroreflective sheeting and black non-reflective film,
E. Recommended cleaning procedure for each product, and
F. Method of packaging, transport and storage for signs.

No legend shall be installed at the project site. Legend shall include letters, numerals, tildes, bars, arrows, route shields, symbols, logos, borders, artwork, and miscellaneous characters. The style, font, size, and spacing of the legend shall conform to the Standard Alphabets published in the FHWA Standard Highway Signs Book. The legend shall be oriented in the same direction in accordance with the manufacturer's orientation marks found on the retroreflective sheeting.

On multiple panel signs, legend shall be placed across joints without affecting the size, shape, spacing, and appearance of the legend. Background and legend shall be wrapped around interior edges of formed panel signs as shown on plans to prevent delamination.

The following notation shall be placed on the lower right side of the back of each sign where the notation will not be blocked by the sign post or frame:

A. PROPERTY OF STATE OF CALIFORNIA,
B. Name of the sign manufacturer,
C. Month and year of fabrication,
D. Type of retroreflective sheeting, and
E. Manufacturer's identification and lot number of retroreflective sheeting.

The above notation shall be applied directly to the aluminum sign panels in 1/4-inch upper case letters and numerals by die-stamp and applied by similar method to the fiberglass reinforced plastic signs. Painting, screening, or engraving the notation will not be allowed. The notation shall be applied without damaging the finish of the sign.

Signs with a protective overlay film shall be marked with a dot of 3/8 inch in diameter. The dot placed on white border shall be black, while the dot placed on black border shall be white. The dot shall be placed on the lower border of the sign before application of the protective overlay film and shall not be placed over the legend and bolt holes. The application method and exact location of the dot shall be determined by the manufacturer of the signs.

For sign panels that have a minor dimension of 48 inches or less, no splice will be allowed in the retroreflective sheet except for the splice produced during the manufacturing of the retroreflective sheeting. For sign panels that have a minor dimension greater than 48 inches, only one horizontal splice will be allowed in the retroreflective sheeting.

Unless specified by the manufacturer of the retroreflective sheeting, splices in retroreflective sheeting shall overlap by a minimum of one inch. Splices shall not be placed within 2 inches from edges of the panels. Except at the horizontal borders, the splices shall overlap in the direction from top to bottom of the sign to prevent moisture penetration. The retroreflective sheeting at the overlap shall not exhibit a color difference under the incident and reflected light.

Signs exhibiting a significant color difference between daytime and nighttime shall be replaced immediately.

Repairing sign panels will not be allowed except when approved by the Engineer.

The Department will inspect signs at the Contractor's facility and delivery location, and in accordance with Section 6, "Control of Materials," of the Standard Specifications. The Engineer will inspect signs for damage and defects before and after installation.

Regardless of kind, size, type, or whether delivered by the Contractor or by a common carrier, signs shall be protected by thorough wrapping, tarping, or other methods to ensure that signs are not damaged by weather conditions and during transit. Signs shall be dry during transit and shipped on palettes, in crates, or tier racks. Padding and protective materials shall be placed between signs as appropriate. Finished sign panels shall be transported and stored by method that protects the face of signs from damage. The Contractor shall replace wet, damaged, and defective signs.

Signs shall be stored in dry environment at all times. Signs shall not rest directly on the ground or become wet during storage. Signs, whether stored indoor or outdoor, shall be free standing. In areas of high heat and humidity signs shall be stored in enclosed climate-controlled trailers or containers. Signs shall be stored indoor if duration of the storage will exceed 30 days.

Screen processed signs shall be protected, transported and stored as recommended by the manufacturer of the retroreflective sheeting.

When requested, the Contractor shall provide the Engineer test samples of signs and materials used at various stages of production. Sign samples shall be 12" x 12" in size with applied background, letter or numeral, and border strip.

The Contractor shall assume the costs and responsibilities resulting from the use of patented materials, equipment, devices, and processes for the Contractor's work.

SHEET ALUMINUM

Alloy and temper designations for sheet aluminum shall be in accordance with ASTM Designation: B 209.

The Contractor shall furnish the Engineer a Certificate of Compliance in conformance with Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for the sheet aluminum.

Sheet aluminum shall be pretreated in accordance to ASTM Designation: B 449. Surface of the sheet aluminum shall be cleaned, deoxidized, and coated with a light and tightly adherent chromate conversion coating free of powdery residue. The conversion coating shall be Class 2 with a weight between 10 milligrams per square foot and 35 milligrams per square foot, and an average weight of 25 milligrams per square foot. Following the cleaning and coating process, the sheet aluminum shall be protected from exposure to grease, oils, dust, and contaminants.

Sheet aluminum shall be free of buckles, warps, dents, cockles, burrs, and defects resulting from fabrication.

Base plate for standard route marker shall be die cut.

RETROREFLECTIVE SHEETING

The Contractor shall furnish retroreflective sheeting for sign background and legend in conformance with ASTM Designation: D 4956 and "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

Retroreflective sheeting shall be applied to sign panels as recommended by the retroreflective sheeting manufacturer without stretching, tearing, and damage.

Class 1, 3, or 4 adhesive backing shall be used for Type II, III, IV, VII, VIII, and IX retroreflective sheeting. Class 2 adhesive backing may also be used for Type II retroreflective sheeting. The adhesive backing shall be pressure sensitive and fungus resistant.

When the color of the retroreflective sheeting determined from instrumental testing is in dispute, the Engineer's visual test will govern.

PROCESS COLOR AND FILM

The Contractor shall furnish and apply screened process color, non-reflective opaque black film, and protective overlay film of the type, kind, and product that are approved by the manufacturer of the retroreflective sheeting.

The Contractor shall furnish the Engineer a Certificate of Compliance in accordance to Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for the screened process color, non-reflective opaque black film, and protective overlay film.

The surface of the screened process color shall be flat and smooth. When the screened process colors determined from the instrumental testing in accordance to ASTM Designation: D 4956 are in dispute, the Engineer's visual test will govern.

The Contractor shall provide patterns, layouts, and set-ups necessary for the screened process.

The Contractor may use green, red, blue, and brown reverse-screened process colors for background and non-reflective opaque black film or black screened process color for legend. The coefficient of retroreflection for reverse-screened process colors on white retroreflective sheeting shall not be less than 70 percent of the coefficient of retroreflection specified in ASTM Designation: D 4956.

The screened process colors and non-reflective opaque black film shall have the same outdoor weatherability as that of the retroreflective sheeting.

After curing, screened process colors shall withstand removal when tested by applying 3M Company Scotch Brand Cellophane Tape No. 600 or equivalent tape over the color and removing with one quick motion at 90° angle.

SINGLE SHEET ALUMINUM SIGN

Single sheet aluminum signs shall be fabricated and furnished with or without frame. The Contractor shall furnish the sheet aluminum in accordance to "Sheet Aluminum" of these special provisions. Single sheet aluminum signs shall be fabricated from sheet aluminum alloy 6061-T6 or 5052-H38.

Single sheet aluminum signs shall not have a vertical splice in the sheet aluminum. For signs with depth greater than 48 inches, one horizontal splice will be allowed in the sheet aluminum.

Framing for single sheet aluminum signs shall consist of aluminum channel or rectangular aluminum tubing. The framing shall have a length tolerance of ±1/8 inch. The face sheet shall be affixed to the frame with rivets of 3/16-inch diameter. Rivets shall be placed within the web of channels and shall not be placed less than 1/2 inch from edges of the sign panels. Rivets shall be made of aluminum alloy 5052 and shall be anodized or treated with conversion coating to prevent corrosion. The exposed portion of rivets on the face of signs shall be the same color as the background or legend where the rivets are placed.

Finished signs shall be flat within a tolerance of ±1/32 inch per linear foot when measured across the plane of the sign in all directions. The finished signs shall have an overall tolerance within ±1/8 inch of the detailed dimensions.

Aluminum channels or rectangular aluminum tubings shall be welded together with the inert gas shielded-arc welding process using E4043 aluminum electrode filler wires as shown on the plans. Width of the filler shall be equal to wall thickness of smallest welded channel or tubing.

MEASUREMENT AND PAYMENT

Furnishing signs (except for construction area signs) will be measured by the square foot and the quantity to be paid for will be the total area, in square feet, of the sign panel types installed in place.

The contract price paid per square foot for furnish sign of the types specified in the Engineer's estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in fabricating and furnishing the signs, including removable sign panel frame and fastening hardware, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for furnishing and installing protective overlay on signs shall be considered as included in the contract price paid per square foot for furnish sign of the various types and no separate payment will be made therefor.

10-1.95 TIMBER LAGGING

Timber lagging shall conform to the details shown on the plans and the provisions in Sections 57, "Timber Structures," and 58, "Preservative Treatment of Lumber, Timber and Piling," of the Standard Specifications and these special provisions.

All timber members shall be preservative treated Douglas fir of the grades shown on the plans. Timber members shall be full sawn to the dimensions shown on the plans.

Preservative treatment shall conform to AWPA Use Category System: UC4B, Commodity Specification A, except that chromated copper arsenate shall not be used.

Timbers shall be installed with a 1/2-inch gap between lagging members.

10-1.96 PREPARE AND PAINT CALIFORNIA ST-10 BRIDGE RAIL

California ST-10 bridge rail shall be prepared and painted in conformance with the provisions in Section 59-2, "Painting Structural Steel," Section 59-3, "Painting Galvanized Surfaces," and Section 91, "Paint," of the Standard Specifications and these special provisions.

GENERAL

Proof of certification under the SSPC QP Certification Program must be submitted with your bid. Required certifications are as follows:

1. SSPC-QP 3, Enclosed Shop Facility or AISC Sophisticated Paint Endorsement Quality Program, P1-Enclosed

Before performing any painting or paint removal, the Contractor shall submit to the Engineer, in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, 3 copies of a separate Painting Quality Work Plan (PQWP) for each item of work for which painting or paint removal is to be performed. As a minimum, each PQWP shall include the following:

1. The name of each Contractor or subcontractor to be used.
2. One copy each of all current ASTM and "SSPC: The Society for Protective Coatings" specifications or qualification procedures applicable to the painting or paint removal to be performed. These documents shall become the permanent property of the Department.
3. A copy of the coating manufacturer's guidelines and recommendations for surface preparation, painting, drying, curing, handling, shipping, and storage of painted California ST-10 bridge rail, including testing methods and maximum allowable levels for soluble salts.
4. Proposed materials, methods, and equipment to be used.
5. Proof of each of any required certifications, SSPC-QP 1 and SSPC-QP 3.
6. Proposed methods to control environmental conditions in accordance with the manufacturer's recommendations and these special provisions.
7. Proposed methods to protect the coating during curing, shipping, handling, and storage.
8. Proposed rinse water collection plan.
9. A detailed paint repair plan for the repair of damaged areas.
10. Procedures for containing blast media and water during application of coatings and coating repair of erected steel.
11. Examples of proposed daily reports for all testing to be performed, including type of testing, location, lot size, time, weather conditions, test personnel, and results.

Before submitting the PQWP, a prepainting meeting between the Engineer, the Contractor, and a representative from each entity performing painting for this project shall be held to discuss the requirements for the PQWP.

The Engineer shall have 20 days to review the PQWP submittal after a complete plan has been received. No painting or paint removal shall be performed until the PQWP for that work is approved by the Engineer. Should the Engineer fail to complete the review within this time allowance and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the delay in reviewing the PQWP, the delay will be considered a right of way delay in conformance with the provisions in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

The Engineer's approval of the Contractor's PQWP shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformity with the requirements of the plans and specifications.

The Contractor shall provide enclosures to permit painting during inclement weather. Provisions shall be made to control atmospheric conditions inside the enclosures within specified limits during painting operations, drying to solvent insolubility, and throughout the curing period in accordance with the manufacturer's recommendations and these special provisions. Full compensation for providing and maintaining such enclosures shall be considered as included in the contract prices paid per linear foot for California ST-10 bridge rail of the types listed in the Engineer's Estimate and no additional compensation will be allowed therefor.

Fresh, potable water with a maximum chloride content of 75 ppm and a maximum sulfate content of 200 ppm shall be used for water rinsing or pressure washing operations. No continuous recycling of rinse water will be permitted. If rinse water is collected into a tank and subsequent testing determines the collected water conforms to the specified requirements, reuse may be permitted by the Engineer if no collected water is added to the tank after sample collection for determination of conformance to specified requirements.

PAINTING

All areas of manufacturer recommended primer shall be water rinsed in conformance with the requirements in Section 59-1.03, "Application," of the Standard Specifications and these special provisions. Areas of the coating removed by water rinsing shall be reapplied in conformance with Section 59-2.13, "Application of Zinc-Rich Primer," of the Standard Specifications and these special provisions. Except as approved by the Engineer, a minimum time of 72 hours shall be allowed between application of inorganic zinc rich coating and water rinsing.

The single finish coat shall be an inorganic thermosetting hybrid coating based upon a polysiloxane resin coreacted or blended with an epoxy, acrylic, or urethane resin or combination thereof. The coating shall not contain any isocyanate or polyisocyanate components.

The surface of the undercoat shall be free from moisture, visible dust, visible grease, or other deleterious materials immediately before application of finish paint.

Galvanized or metallized surfaces designated to receive finish paint shall be cleaned in accordance with the requirements of SSPC-SP 1, "Solvent Cleaning," of the "SSPC: The Society for Protective Coatings," and then primed with a galvanized surface primer recommended by the manufacturer of the polysiloxane finish paint. The complete finish paint system on galvanized fasteners shall have a minimum adhesion rating of 4 when measured in accordance with ASTM Designation: D 3359.

The finish coat paint shall be formulated for application to inorganic zinc coating and shall conform to the following:

Test	Test Method	Requirement
Solvent Resistance (100 double rubs with Methyl Ethyl Ketone)	ASTM D 5402	No visible topcoat on cloth, no softening (ASTM D 3363)
Adhesion to primed steel	ASTM D 4541 (Type III, IV, or V)	725 psi, minimum
Adhesion to Galvanized steel	ASTM D 3359, Procedure A (surface cleaned per SSPC-SP 1 and primed with manufacturer's recommended galvanized surface primer)	4 A, minimum
Dry-Through time	ASTM D 1640	8 hours, maximum
Abrasion Resistance (1,000 cycles, CS17 wheel, 1 Kg load)	ASTM D 4060	< 0.125 g loss
Mandrel Bend	ASTM D 522 (5 mils dry film applied to abraded steel plate)	No cracking on 1/2-inch mandrel
Water Resistance	ASTM D 870 (5 mils dry film on primed steel, cured 7 days)	No change in color or gloss after 7 days. Adhesion greater than 600 psi after 48 hours recovery

In addition, the finish coat paint shall conform to the following requirements after exposure for 4,000 hours in conformance with the test procedures in ASTM Designation: D 4587, Cycle 2:

Test	Test Method	Requirement
Color retention	ASTM D 2244 (Color change in ΔE^*)	< 2.0
Gloss reduction from original reading	ASTM D 523	10 percent, maximum

The finish coat shall be applied within 48 hours following water rinsing and passing the soluble salt testing requirements herein.

The finish coat shall be applied in 2 applications. The first application shall consist of a spray applied mist application. The second application shall be applied after the mist application has dried to a set to touch condition as determined by the procedure described in Section 7 of ASTM Designation: D 1640. The finish coat color shall match color no. 12197 of FED-STD-595. The total dry film thickness of both applications of the finish coat shall be not less than 5 mils.

10-1.97 ANTI-GRAFFITI COATING

This work includes applying anti-graffiti coating to concrete surfaces.

Comply with Section 59-6, "Painting Concrete," of the Standard Specifications.

Submit manufacturer's application and removal instructions 7 days before starting work.

MATERIALS

Anti-graffiti coating must:

1. Be a nontoxic, sacrificial, nonflammable, water-based coating designed for protecting concrete from graffiti
2. Be compatible with the concrete surface treatment
3. Have a clear matte finish when dry
4. Be removable with a hot pressure washer

CONSTRUCTION

Cure new concrete surfaces under Section 90-7.03, "Curing Structures," of the Standard Specifications.

Test concrete surfaces for acceptance of coating under the manufacturer's recommendations before coating. Areas that resist accepting coating must be cleaned and retested.

Apply anti-graffiti coating under the manufacturer's recommendations in at least 2 even coats.

MEASUREMENT AND PAYMENT

The contract price paid per square foot for anti-graffiti coating includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and applying anti-graffiti coating to concrete surfaces, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.98 ALTERNATIVE PIPE

Alternative pipe culverts must comply with Section 62, "Alternative Culverts," of the Standard Specifications.

Concrete backfill for alternative culverts shall be constructed in conformance with the provisions in Section 66-1.045, "Concrete Backfill," of the Standard Specifications and will be measured and paid for in conformance with the provisions in Section 66-4, "Measurement and Payment," of the Standard Specifications and the following:

A. The quantity of concrete backfill to be paid for, regardless of the kind of culvert and wall thickness of the culvert installed, will be based on the dimensions shown on the plans and the installation of corrugated steel pipe.

10-1.99 PLASTIC PIPE

Plastic pipe shall conform to the provisions in Section 64, "Plastic Pipe," of the Standard Specifications.

10-1.100 REINFORCED CONCRETE PIPE

Reinforced concrete pipe shall conform to the provisions in Section 65, "Reinforced Concrete Pipe," of the Standard Specifications and these special provisions.

GENERAL

Where embankment will not be placed over the top of the pipe, a relative compaction of not less than 85 percent shall be required below the pipe spring line for pipe installed using Method 1 backfill in trench, as shown on Standard Plan A62D. Where the pipe is to be placed under the traveled way, a relative compaction of not less than 90 percent shall be required unless the minimum distance between the top of the pipe and the pavement surface is the greater of 4 feet or one half of the outside diameter of the pipe.

Except as otherwise designated by classification on the plans or in the specifications, joints for culvert and drainage pipes shall conform to the plans or specifications for standard joints.

MATERIALS

The Contractor shall use one of the options shown in the following table. Supplementary cementitious material is optional.

Minimum Cementitious Material Content in Pounds per CY

Minimum Concrete Cover	Maximum water to cementitious material ratio	
	0.35	0.40
1.50 inches	564 (Type II Modified)	

Special reinforced concrete pipe, having concrete cover over the steel reinforcement greater than the cover specified in AASHTO Designation: M 170, shall conform to the provisions in Section 65-1.02, "Materials," and Section 65-1.02A, "Circular Reinforced Concrete Pipe," of the Standard Specifications, except the width of crack produced by the D-load test specified in AASHTO Designation: M 170 shall be the width determined by the following formula:

$$b = \frac{t - 3/8d}{t - 3/8d - C} \times 0.01 \text{ inch}$$

Where:

b = Width of crack to be produced in lieu of the 0.01-inch crack specified in AASHTO Designation: M 170
t = Wall thickness of pipe, inches
d = Effective depth of the section to be tested, feet
C = Concrete cover over steel reinforcement in excess of cover specified in AASHTO Designation: M 170

Reinforced concrete pipe that is to be hydrostatically tested shall be strength tested by the 3-edge bearing method to a maximum D-load of 10 percent greater than the 0.01-inch cracking D-load specified in AASHTO Designation: M 170 or to the actual D-load required to produce a 0.01-inch crack, whichever is the lesser.

Special oval shaped reinforced concrete pipe, having concrete cover over the steel reinforcement greater than the cover specified in AASHTO Designation: M 207, shall conform to the provisions in Section 65-1.02, "Materials," and Section 65-1.02B, "Oval Shaped Reinforced Concrete Pipe," of the Standard Specifications, except the width of crack produced by the D-load test specified in AASHTO Designation: M 207 shall be the width determined by the following formula:

$$b = \frac{t - 3/8d}{t - 3/8d - C} \times 0.01 \text{ inch}$$

Where:

b = Width of crack to be produced in lieu of the 0.01-inch crack specified in AASHTO Designation: M 207
t = Wall thickness of pipe, inches
d = Effective depth of the section to be tested, feet
C = Concrete cover over steel reinforcement in excess of cover specified in AASHTO Designation: M 207

Oval shaped reinforced concrete pipe that is to be hydrostatically tested shall be strength tested by the 3-edge bearing method to a maximum D-load of 10 percent greater than the 0.01-inch cracking D-load specified in AASHTO Designation: M 207 or to the actual D-load required to produce a 0.01-inch crack, whichever is the lesser.

MEASUREMENT AND PAYMENT

The Department does not pay any additional cost for use of optional supplementary cementitious material.

The Department does not pay any additional cost for excess concrete cover over steel reinforcement.

10-1.101 CORRUGATED METAL PIPE

Corrugated steel pipe culverts shall conform to the provisions in Section 66, "Corrugated Metal Pipe," of the Standard Specifications and these special provisions.

Asphaltic mastic coating or polymeric sheet coating substituted for bituminous coating shall be placed on the outside and inside surfaces of the pipe.

Corrugated steel pipe shall be fabricated from zinc-coated steel sheet.

10-1.102 SPIRAL RIB PIPE

GENERAL

Summary

Manufactured spiral rib pipe must comply with Section 66, "Corrugated Metal Pipe," of the Standard Specifications, except for profile and fabrication requirements.

MATERIALS

You must use spiral rib pipe fabricated with either:

1. Three rectangular ribs spaced midway between seams with ribs 3/4" wide x 3/4" high at a maximum rib pitch of 7-1/2 inches,
2. Two rectangular ribs and one half-circle rib equally spaced between seams with ribs 3/4" wide x 1" high at a maximum rib pitch of 11-1/2 inches with the half-circle rib diameter spaced midway between the rectangular ribs, or
3. Two rectangular ribs equally spaced between seams with ribs 3/4" wide x 1" high at a maximum rib pitch of 8-1/2 inches.

Rib pitch measured at right angles to the direction of the ribs may vary +/-1/2 inch.

Corrugated steel spiral rib pipe must be fabricated by continuous helical lock seam under Section 66-3.03C(1), "Fabrication by Continuous Lock Seam," of the Standard Specifications.

JOINTS

Coupling bands for spiral rib pipe must comply with Section 66-1.07, "Coupling Bands," of the Standard Specifications. A coupling band shown on the plans or approved by the Engineer under Section 61-1.02, "Performance Requirements for Culvert and Drainage Pipe Joints," of the Standard Specifications, for use on a pipe corrugation of 2-2/3" x 1/2" for corrugated metal pipe may be used on spiral rib pipe having 2-2/3" x 1/2" rerolled annular ends.

10-1.103 UNDERDRAIN

Plastic pipe underdrains and slotted and unslotted high density polyethylene (HDPE) pipe underdrains at Southbound Battery Tunnel shall conform to the details shown on the plans and the provisions in Section 68-1, "Underdrains," of the Standard Specifications and these special provisions.

Filter fabric shall conform to the provisions in Section 88-1.02, "Filtration," of the Standard Specifications and these special provisions. Filter fabric shall be Class A.

Permeable material used at Southbound Battery Tunnel shall be placed in horizontal layers and thoroughly consolidated along with and by the same methods specified for structure backfill in Section 19-3, "Structure Excavation and Backfill," of the Standard Specifications. Ponding and jetting of permeable material or structure backfill adjacent to permeable material will not be permitted.

Class 1 permeable material shall be used. Filter fabric shall be placed between Class 1 permeable material and backfill.

The contract price paid per linear foot for pipe underdrains of the sizes and types listed in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in installing pipe underdrains complete in place, including excavation, filter fabric, permeable material, caps and drain connectors, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

10-1.104 OVERSIDE DRAIN

Corrugated steel pipe downdrains shall conform to the provisions in Section 69, "Overside Drains," of the Standard Specifications and these special provisions.

Steel entrance tapers and pipe downdrains shall be fabricated from zinc-coated steel sheet.

10-1.105 SLOPE PROTECTION

Slope protection shall be placed or constructed in conformance with the provisions in Section 72, "Slope Protection," of the Standard Specifications.

Rock slope protection fabric must be Class A.

10-1.106 MISCELLANEOUS CONCRETE CONSTRUCTION

Minor concrete (backfill), minor concrete (curb), minor concrete (gutter), minor concrete (miscellaneous construction), minor concrete (sidewalk) and minor concrete (curb, sidewalk and curb ramp) shall conform to the provisions in Section 73, "Concrete Curbs and Sidewalks," of the Standard Specifications and these special provisions.

Curb ramp detectable warning surface shall consist of raised truncated domes constructed or installed on curb ramps in conformance with the details shown on the plans and these special provisions. At the option of the Contractor, the detectable warning surface shall be prefabricated, cast-in-place, or stamped into the surface of the curb ramp. The color of the detectable warning surface shall be yellow conforming to Federal Standard 595B, Color No. 33538.

Prefabricated detectable warning surface shall be in conformance with the requirements established by the Department of General Services, Division of State Architect and be attached in conformance with the manufacturer's recommendations.

Cast-in-place and stamped detectable warning surfaces shall be painted in conformance with the provisions in Section 59-6, "Painting Concrete," of the Standard Specifications.

The finished surfaces of the detectable warning surface shall be free from blemishes.

Prior to constructing the cast-in-place or stamping the detectable warning surface, the Contractor shall demonstrate the ability to produce a detectable warning surface conforming to the details shown on the plans and these special provisions by constructing a 24" x 24" test panel.

The manufacturer shall provide a written 5-year warranty for prefabricated detectable warning surfaces, guaranteeing replacement when there is defect in the dome shape, color fastness, sound-on-cane acoustic quality, resilience, or attachment. The warranty period shall begin upon acceptance of the contract.

Full compensation for constructing or furnishing and installing curb ramp detectable warning surfaces shall be considered as included in the contract price paid per cubic yard for minor concrete (curb, sidewalk and curb ramp) and no separate payment will be made therefor.

10-1.107 MISCELLANEOUS IRON AND STEEL

Miscellaneous iron and steel shall conform to the provisions in Section 75, "Miscellaneous Metal," of the Standard Specifications and these special provisions.

FALL PROTECTION DEVICE

Fall protection device for manhole ladders shall be furnished and installed as shown on the plans and in conformance with these special provisions.

Fall protection device shall be compatible with full body harnesses and lanyards with snap hooks.

The allowable fall protection device shall consist of one of the following or a Department approved equal.

A. Miller Fall Protection
1345 15th Street
P.O. Box 271
Franklin, PA 16323
800-873-5242
http://www.millerfallprotection.com/fall-protection-products/miller-premium-products/climbing-fall-protection-systems

B. Flexible Lifeline Systems
14325 West Hardy Road
Houston, TX 77060
281-617-2215
http://fallarrest1-px.rtrk.com/about/contact.asp

C. Capital Safety
3833 SALA Way
Red Wing, MN 55066-5005
651.388.8282
http://www.capitalsafety.com/Products/ProtectaProducts/tabid/46/ctl/Listing/mid/380/CatalogId/3/Source/Category/CategoryId/149/Default.aspx

Fall protection device shall be installed in conformance with the manufacturer's installation instructions.

Full compensation for fall protection device shall be considered as included in the contract price paid per cubic yard for minor concrete (minor structure) and no separate payment will be made therefor.

10-1.108 MISCELLANEOUS METAL (TUNNEL)

Miscellaneous metal (tunnel) shall conform to the provisions for miscellaneous bridge metal in Section 75, "Miscellaneous Metal," of the Standard Specifications and these special provisions.

Attention is directed to "Welding" of these special provisions.

Stainless steel dowels shown on the plans shall be Type 316 stainless steel.

Miscellaneous metal (tunnel) shall consist of the miscellaneous bridge metal items listed in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications and the following:

A. Electrical manhole cover
B. Manhole dividing steel
C. Drain interceptor
D. Edge angle along ductbanks

E. Jet fan anchorage assembly including channel support framing and anchor bolts
F. Stainless steel dowels
G. Niche cover access doors with louvers, door silencers, dead bolt, hinges, astragals, throw bolts, metal panels, and all finish hardware shown on the plans.
H. Sign supports.
I. Embedded plate and studs for future precast panels.

Niche cover access doors, louvers, door silencers, dead bolt, hinges, astragals, throw bolts, metal panels, and all other finish hardware shown on the plans shall conform to the requirements specified in the following sections of these special provisions:

A. Section 12-1, "General Requirements," subsection, "Submittals."
B. Section 12-1, "General Requirements," subsection, "Project Record Drawings."
C. Section 12-8, "Doors and windows."
D. Section 12-10, "Specialties."

10-1.109 BRIDGE DECK DRAINAGE SYSTEM

Bridge deck drainage systems shall conform to the provisions for miscellaneous bridge metal in Section 75, "Miscellaneous Metal," of the Standard Specifications and these special provisions.

Self-tapping screws used for sleeve connections shall be hex-head stainless steel, installed in holes drilled to fit the self-tapping screws, conforming to the requirements of ASTM Designation: A 276, Type 316.

At the Contractor's option, fiberglass pipes and fittings with the same diameter and minimum bend radius as those shown on the plans may be substituted for welded steel pipe in deck drain systems.

Fiberglass pipe and fittings shall conform to the requirements in ASTM Designation: D 2996, and shall have a minimum short-term rupture strength of 30,000 psi. The adhesive type recommended by the manufacturer shall be used for joining pipe and fittings. Fiberglass pipe not enclosed in a box girder cell or encased in concrete shall be manufactured from ultraviolet-resistant resin pigmented with concrete-gray color, or be coated with a concrete-gray resin-rich exterior coating. Paint shall not be used. Fiberglass pipe treated with ultraviolet protection shall withstand a minimum of 2,500 hours of accelerated weathering when tested in conformance with the requirements in ASTM Designation: G 154. Lamps shall be UV-B (313 nm wavelength). The resting cycle shall be 4 hours of ultraviolet exposure at 140° F, and then 4 hours of condensate exposure at 120° F. After testing, the surface of the pipe shall exhibit no fiber exposure, crazing, or checking, and only a slight chalking or color change.

Support spacing for fiberglass pipe shall be the same as shown on the plans for welded steel pipe. Pipe supports shall have a width of not less than 1.5 inches.

A Certificate of Compliance for fiberglass pipe and fittings shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The Certificate of Compliance shall include all laboratory test results conforming to the provisions specified herein.

For drainage piping NPS 8 or smaller, the Contractor shall have the option of substituting polyvinyl chloride (PVC) plastic pipe and fittings with the same diameter and minimum bend radius as shown on the plans for welded steel pipe, which is:

A. Enclosed in a box girder cell and exposed for a length not greater than 20 feet within the cell, or
B. encased in concrete.

The PVC plastic pipe and fittings shall be Schedule 40 conforming to the requirements of ASTM Designations: D 1785. The maximum support spacing for PVC plastic pipe shall be 6 feet.

Couplings used to connect PVC plastic pipe or fiberglass pipe to steel shall be threaded or flanged. The sleeve connections shown on the plans shall not be used for either PVC plastic pipe or fiberglass pipe.

If PVC plastic pipe or fiberglass pipe is substituted for welded steel pipe, the quantity of drainage piping will be computed on the basis of the dimensions and details shown on the plans, and no change in the quantities to be paid for will be made because of the use of PVC plastic pipe or fiberglass pipe.

Bridge deck drainage systems will be measured and paid for by the pound in the same manner specified for miscellaneous metal (bridge) in Section 75-1.06, "Measurement," and Section 75-1.07, "Payment," of the Standard Specifications.

10-1.110 ARCHITECTURAL FENCE

Architectural fence shall consist of welded wire mesh, modified structural tees posts, tube railings, steel plates, and drill and bond anchor bolts in conformance with the details shown on the plans and to the provisions in Section 80, "Fences," of the Standard Specifications. Architectural fence shall be Type WM fence except that the sizes, dimensions, and details of wire mesh shall conform to the details shown on the plans.

Welding shall conform to the requirements specified in "Welding" of these special provisions.

The fence material shall be fastened to the top and bottom tube railings, and to the structural tees posts. All metal components of architectural fence shall be galvanized.

The Contractor shall submit working drawings for architectural fence in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications.

The working drawings shall include the following:

A. Details of materials ASTM specifications for architectural fence components.
B. Connections of fence to tube railings and to the structural tees posts.
C. Complete details for the construction of the work including methods of construction, sequence of shop and field assembly, and installation and welding procedures.

Working drawings shall be 11" x 17" minimum in size and shall be printed on 20-lb (minimum) bond paper. Each drawing shall include the name of the structure as shown on the plans, the District-County-Route-Post Mile, bridge number, and contract number. The working drawings shall be clearly legible, and text shall be a 12-point minimum font size.

The Contractor shall submit 9 copies of each set of drawings to the Engineer for review and approval. The Contractor shall allow 25 days after complete drawings are submitted for the review. Upon approval, the Engineer will stamp or mark the drawings approved and return 2 sets of these drawings to the Contractor for use during construction.

In the event the Engineer fails to complete the review within the time allowed, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss in the same manner as provided for in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

Architectural fence will be measured by the linear foot from end to end along the face of the tube railing.

The contract price paid per linear foot for architectural fence shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the architectural fence, complete in place, including welded wire mesh, modified structural tees posts, tube railings, steel plates, welding, and drill and bond anchor bolts as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.111 METAL BEAM GUARD RAILING

Metal beam guard railing shall be constructed in conformance with the provisions in Section 83-1, "Railings," of the Standard Specifications and these special provisions.

Attention is directed to "Order of Work" of these special provisions.

Line posts shall be wood, steel, or plastic. Blocks shall be wood or plastic.

ALTERNATIVE IN-LINE TERMINAL SYSTEM

Alternative in-line terminal system shall be furnished and installed as shown on the plans and in conformance with these special provisions.

The allowable alternatives for an in-line terminal system shall consist of one of the following or a Department approved equal.

A. TERMINAL SYSTEM (TYPE SKT) - Terminal system (Type SKT) shall be a SKT 350 Sequential Kinking Terminal manufactured by Road Systems, Inc., located in Big Spring, Texas, and shall include items detailed for terminal system (Type SKT) shown on the plans. The SKT 350 Sequential Kinking Terminal can be obtained from the distributor, Universal Industrial Sales, P.O. Box 699, Pleasant Grove, UT 84062, telephone (801) 785-0505 or from the distributor, Gregory Highway Products, 4100 13th Street, S.W., Canton, OH 44708, telephone (330) 477-4800.

B. TERMINAL SYSTEM (TYPE ET) - Terminal system (Type ET) shall be an ET-2000 PLUS (4-tube system) extruder terminal as manufactured by Trinity Industries, Inc., and shall include items detailed for terminal system (Type ET) shown on the plans. The ET-2000 PLUS (4-tube system) extruder terminal can be obtained from the manufacturer, Trinity Industries, Inc., P.O. Box 99, 950 West 400S, Centerville, UT 84014, telephone (800) 772-7976.

The Contractor shall provide the Engineer with a Certificate of Compliance from the manufacturer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The Certificate of Compliance shall certify that the terminal systems furnished conform to the contract plans and specifications, conform to the prequalified design and material requirements, and were manufactured in conformance with the approved quality control program.

Terminal systems shall be installed in conformance with the manufacturer's installation instructions and these requirements. Each terminal system installed shall be identified by painting the type of terminal system in neat black letters and figures 2 inches high on the backside of the rail element between system posts numbers 4 and 5.

For terminal system (Type ET) the steel foundation tubes with soil plates attached shall be, at the Contractor's option, either driven, with or without pilot holes, or placed in drilled holes. Space around the steel foundation tubes shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer shall be moistened and thoroughly compacted. The wood terminal posts shall be inserted into the steel foundation tubes by hand and shall not be driven. Before the wood terminal posts are inserted, the inside surfaces of the steel foundation tubes to receive the wood posts shall be coated with a grease which will not melt or run at a temperature of 149° F or less. The edges of the wood terminal posts may be slightly rounded to facilitate insertion of the post into the steel foundation tubes.

For terminal system (Type SKT) the soil tubes shall be, at the Contractor's option, driven with or without pilot holes, or placed in drilled holes. Space around the steel foundation tubes shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches thick and each layer shall be moistened and thoroughly compacted. Wood posts shall be inserted into the steel foundation tubes by hand. Before the wood terminal posts are inserted, the inside surfaces of the steel foundation tubes to receive the wood posts shall be coated with a grease which will not melt or run at a temperature of 149° F or less. The edges of the wood posts may be slightly rounded to facilitate insertion of the post into the steel foundation tubes.

Surplus excavated material remaining after the terminal system has been installed shall be disposed of in a uniform manner along the adjacent roadway where designated by the Engineer.

The contract unit price paid for alternative in-line terminal system shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing alternative in-line terminal system, complete in place, including excavation, backfill and disposal of surplus material, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.112 METAL RAILING

Metal railing consisting of safety railing of types shown on the plans shall conform to the details shown on the plans and to the provisions in Section 83-1, "Railings," of the Standard Specifications.

Safety railing shall include standard pipe rails, modified structural tees, stainless steel wire, handrail, flat bar, steel base plate, and bolts as shown on the plans. Stainless steel wire shall conform to ASTM A493.

Drilling and bonding threaded rods shall conform to the details shown in the plans, the provisions in Section 83-2.02D(1), "General," of the Standard Specifications, and these special provisions. Threaded rods shall conform to Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

The contract price paid per linear foot for safety railing of types as listed in the Engineer's Estimate includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in safety railing, complete in place, including cement grout, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.113 CALIFORNIA ST-10 BRIDGE RAIL

California ST-10 bridge rail shall consist of prepared and painted metal railing mounted on a reinforced concrete parapet or reinforced concrete wall as shown on the plans and as specified in these special provisions.

Metal railing shall conform to the provisions in Section 83-1.02D, "Steel Bridge Railing," of the Standard Specifications. Stud bolts shall conform to the provisions for stud connectors in Section 55-2, "Materials," of the Standard Specifications.

Resin capsule anchors shall conform to Section 75 1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

Reinforced concrete shall conform to the provisions in Section 51, "Concrete Structures," and Section 52, "Reinforcement," of the Standard Specifications.

Ferrous metal parts shall be galvanized. Galvanizing shall conform to the provisions in Section 75-1.05, "Galvanizing," of the Standard Specifications.

Exposed galvanized surfaces shall be prepared and painted in conformance with the provisions in Section 59-3, "Painting Galvanized Surfaces," of the Standard Specifications and "Prepare and Paint California ST-10 Bridge Rail," of these special provisions, except that in lieu of inorganic zinc undercoat, a manufacturer recommended primer shall be applied over the galvanized metal railing prior to the finish coat.

The polysiloxane finish coat paint shall be formulated for application to galvanized metal surfaces.

There shall be no chemical treatment of galvanized surfaces prior to cleaning and painting. Nuts, bolts, and washers shall be galvanized after fabrication.

The Contractor shall submit working drawings for the California ST-10 bridge railing in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications.

The working drawings shall include the following:

A. Details for venting and pick-up holes in rails and sleeves.
B. Railing layout.
C. Complete details for the construction of the work including methods of construction, sequence of shop and field assembly, and installation procedures.

Working drawings shall be 11" x 17" minimum in size and shall be printed on 20-lb (minimum) bond paper. Each drawing shall include the name of the structure as shown on the plans, the District-County-Route-Post Mile, bridge number, and contract number. The working drawings shall be clearly legible, and text shall be a 12-point minimum font size.

The Contractor shall submit 9 copies of each set of drawings to the Engineer for review and approval. The Contractor shall allow 25 days after complete drawings are submitted for the review. Upon approval, the Engineer will stamp or mark the drawings approved and return 2 sets of these drawings to the Contractor for use during construction.

In the event the Engineer fails to complete the review within the time allowed, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss in the same manner as provided for in Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

California ST-10 bridge railing will be measured by the linear foot from end to end along the face of the railing, including reinforced concrete end blocks and intermediate posts.

The contract price paid per linear foot for California ST-10 bridge rail of the types listed in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the railing, complete in place, including the reinforced concrete curb and parapet, resin capsule, anchor, nut and washer, anchor blocks, California ST-10 barrier transition and preparing and painting, and epoxy coated bar reinforcement at Retaining Wall No. 8 as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.114 CONCRETE BARRIER (TYPE K)

Concrete barrier (Type K) shall conform to the provisions in Section 83-2, "Barriers," of the Standard Specifications and these special provisions.

Concrete barrier (Type K) shall consist of precast units conforming to the provisions for temporary railing (Type K) in Section 12-3.08, "Temporary Railing (Type K)," of the Standard Specifications, except that removable panels shall not be used and the concrete barrier (Type K) shall remain in place at the completion of the contract.

Temporary railing (Type K) reflectors on concrete barrier (Type K) shall conform to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions.

Full compensation for furnishing and installing temporary railing (Type K) reflectors on concrete barrier (Type K) shall be considered as included in the contract price paid per linear foot for concrete barrier (Type K) and no additional compensation will be allowed therefor.

10-1.115 TRANSITION RAILING (TYPE WB)

Transition railing (Type WB) shall be furnished and installed in conformance with details shown on the plans, the provisions in Section 83-2, "Barriers," of the Standard Specifications and these special provisions.

The 10-gage rail elements shall conform to the requirements of Class B, Type 1 thrie beam guard railing as shown in AASHTO Designation: M 180. End caps shall conform to the requirements of Class A, Type 1 thrie beam guard railing as shown in AASHTO Designation: M 180.

Surplus excavated material remaining after the transitional railing (Type WB) has been constructed shall be disposed of in a uniform manner along the adjacent roadway where designated by the Engineer.

The contract unit price paid for transition railing (Type WB) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing transition railing (Type WB), complete in place, including drilling holes for wood posts, driving posts, backfill, and disposal of surplus material, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.116 THERMOPLASTIC TRAFFIC STRIPE AND PAVEMENT MARKING

Thermoplastic traffic stripes (traffic lines) and pavement markings shall be applied in conformance with the provisions in Section 84, "Traffic Stripes and Pavement Markings," of the Standard Specifications and these special provisions.

Thermoplastic material shall be free of lead and chromium, and shall conform to the requirements in State Specification PTH-02ALKYD.

Retroreflectivity of the thermoplastic traffic stripes and pavement markings shall conform to the requirements in ASTM Designation: D 6359-99. White thermoplastic traffic stripes and pavement markings shall have a minimum initial retroreflectivity of 250 mcd m^{-2} lx^{-1}. Yellow thermoplastic traffic stripes and pavement markings shall have a minimum initial retroreflectivity of 150 mcd m^{-2} lx^{-1}.

Where striping joins existing striping, as shown on the plans, the Contractor shall begin and end the transition from the existing striping pattern into or from the new striping pattern a sufficient distance to ensure continuity of the striping pattern.

Thermoplastic traffic stripes shall be applied at the minimum thickness and application rate as specified below. The minimum application rate is based on a solid stripe of 4 inches in width.

Minimum Stripe Thickness (inch)	Minimum Application Rate (lb/ft)
0.098	0.34

Thermoplastic traffic stripes and pavement markings shall be free of runs, bubbles, craters, drag marks, stretch marks, and debris.

At the option of the Contractor, permanent traffic striping and pavement marking tape conforming to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions may be placed instead of the thermoplastic traffic stripes and pavement markings specified herein. Permanent tape, if used, shall be installed in conformance with the manufacturer's specifications.

If permanent tape is placed instead of thermoplastic traffic stripes and pavement markings, the tape will be measured and paid for by the linear foot as thermoplastic traffic stripe and by the square foot as thermoplastic pavement marking.

10-1.117 PAINT TRAFFIC STRIPE AND PAVEMENT MARKING

Painted traffic stripes (traffic lines) and pavement markings shall be applied in conformance with the provisions in Section 84, "Traffic Stripes and Pavement Markings," of the Standard Specifications and these special provisions.

Traffic stripe and pavement marking paint shall conform to the requirements in State Specification No. PTWB-01.

The color of the painted traffic stripes and pavement markings shall conform to the requirements in ASTM Designation: D 6628-01.

Retroreflectivity of the paint traffic stripes and pavement markings shall conform to the requirements in ASTM Designation: D 6359-99. White painted traffic stripes and pavement markings shall have a minimum initial retroreflectivity of 250 mcd m^{-2} lx^{-1}. Yellow painted traffic stripes and pavement markings shall have a minimum initial retroreflectivity of 150 mcd m^{-2} lx^{-1}.

At the option of the Contractor, permanent traffic striping and pavement marking tape conforming to the provisions in "Prequalified and Tested Signing and Delineation Materials" of these special provisions may be placed instead of painted traffic stripes and pavement markings. Permanent tape, if used, shall be placed in conformance with the manufacturer's specifications.

If permanent tape is placed instead of painted traffic stripes and pavement markings, the tape will be measured and paid for by the linear foot as paint traffic stripe and by the square foot as paint pavement marking of the number of coats designated in the Engineer's Estimate.

10-1.118 PAVEMENT MARKERS

Pavement markers shall be placed in conformance with the provisions in Section 85, "Pavement Markers," of the Standard Specifications and these special provisions.

Attention is directed to "Traffic Control System For Lane Closure" of these special provisions regarding the use of moving lane closures during placement of pavement markers with bituminous adhesive.

The Contractor shall furnish the Engineer certificates of compliance for the pavement markers in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

Retroreflective pavement markers shall be marked as abrasion resistant on the body of the markers.

SECTION 10-2. (BLANK)

SECTION 10-3. ELECTRICAL SYSTEMS

10-3.01 DESCRIPTION

Signal and lighting (temporary), lighting and sign illumination, lighting (city street), lighting (parking lot), lighting (detour),high voltage conduit, traffic operations system, battery substation and tunnel work, tunnel traffic operations system, radio rebroadcast systems, tunnel lighting, grounding and conduits embedded in structures, and maintaining existing traffic management system elements during construction shall conform to the provisions in Section 86, "Electrical Systems," of the Standard Specifications and these special provisions.

Traffic operations system shall consist of:

1. CCTV camera system.
2.
3. Variable message sign system.
4. Traffic monitoring station.

Lighting equipment is included in the following structures:

A. SB Battery Tunnel

Retaining Wall No. 6 and 8

10-3.02 COST BREAK-DOWN

Cost break-downs shall conform to the provisions in Section 86-1.03, "Cost Break-Down," of the Standard Specifications and these special provisions.

The Engineer shall be furnished a cost break-down for each contract lump sum item of work described in this Section 10-3.

The cost break-down shall be submitted to the Engineer for approval within __ days after the contract has been approved. The cost break-down shall be approved, in writing, by the Engineer before any partial payment for the items of electrical work will be made.

The cost break-down shall include the following items in addition to those listed in the Standard Specifications:

A. Stainless steel continuous hinge NEMA type 4X junction box
B. Stainless steel NEMA type 4X junction box
C. Medium voltage power cable
D. Ground well
E. Grounding electrode
F. Grounding electrode system testing
G. Conductive cement
H. Power control relays
I. SCADA control and indication relays
J. Transfer relays
K. Protective relays
L. Back up protective relay
M. Breaker interface module
N. Feeder circuit breaker
O. Power meter
P. Tunnel systems and equipment studies and commissioning
Q. Power supply and battery charger
R. Transient voltage surge suppression (TVSS)
S. Secondary unit substation
T. Supervisory control and data acquisition (SCADA) System
U. Utility pull box
W. Junction box cooling fan
X. Wire trough
Y. Hydrogen gas detector

10-3.03 EQUIPMENT LIST, DRAWINGS, AND REPORTS

The junction boxes and cabinets that contain electrical equipment, medium voltage, and radio rebroadcast shall have a copy of schematic wiring diagram, and layout of the equipment in the junction box and cabinet and they shall be placed inside the cabinet or junction box door pocket. A copy of the schematic wiring diagram and layout of the equipment in each junction box and cabinet shall be given to the Engineer.

The controller cabinet schematic wiring diagram and intersection sketch shall be combined into one drawing, so that, when the cabinet door is fully open, the drawing is oriented with the intersection.

Five copies of maintenance manual shall be furnished for all the battery substation items such as but not limited to the secondary unit substation, 3-phase power supply and battery charger, power supply and battery charger, protective relays, backup protective relays, power meters, power circuit breakers, CO monitors, CO monitor controller, sub-master server, CO calibration server, rack-mounted Ethernet switch, Ethernet router, motor control centers, programmable automation controllers, field control stations, switchboard, inverter, rack-mounted inverter, rack-mounted DC-to-DC converter, tunnel fire alarm control panel, substation fire alarm panel, 12-20 kVA modular UPS system, and the breaker interface module. The maintenance manuals and operation manuals may be combined into one manual. The maintenance manuals or combined maintenance and operation manuals shall be submitted at the time the battery substation items are delivered for testing or, if ordered by the Engineer, prior to purchase. The maintenance manuals for each of the battery substation items shall include, but need not be limited to, the following items:

A. Specifications
B. Design characteristics
C. General operation theory
D. Function of all controls
E. Trouble shooting procedure (diagnostic routine)
F. Block circuit diagram
G. Layout of all the electrical components in the junction boxes and cabinet including medium voltage vertical section and compartments
H. Schematic diagrams
I. List of replaceable component parts with stock numbers
J. The Contractor shall provide to the Engineer with six bound copies of the final report as specified in the “Study Reports” section of the “Short Circuit, Protection, Coordination and Arc Flash Hazard Study” in these special provisions.
K. The Contractor shall provide to the Engineer with a copy of the test report as specified in the “Grounding Electrode System Testing” in these special provisions.
L. The Contractor shall provide to the Engineer with two copies of the manufacturer’s splicing and termination procedures for the medium voltage power cable as specified in the “Cables, Conductors, and Wirings” in these special provisions.
K. The Contractor shall provide to the Engineer with three copies of the final test report for the medium voltage power cable installation as specified in the “Cables, Conductors, and Wirings” in these special provisions.

10-3.04 MAINTAINING EXISTING TRAFFIC MANAGEMENT SYSTEM ELEMENTS DURING CONSTRUCTION

Traffic Management System (TMS) elements include, but are not limited to ramp metering (RM) system, communication system, traffic monitoring stations, video image vehicle detection system (VIVDS), microwave vehicle detection system (MVDS), loop detection system, changeable message sign (CMS) system, extinguishable message sign (EMS) system, highway advisory radio (HAR) system, closed circuit television (CCTV) camera system, roadway weather information system (RWIS), visibility sensor, and fiber optic system.

Existing TMS elements, including detection systems, identified on the plans and located within the project limits shall remain in place and be protected from damage. If the construction activities require existing TMS elements to be nonoperational or off line, and if temporary or portable TMS elements are not shown on the plans, the Contractor shall provide for temporary or portable TMS elements. The Contractor shall receive the Engineer's approval on the type of temporary or portable TMS elements and installation method.

Before work is performed, the Engineer, the Contractor, and the Department's Traffic Operations Electrical representatives shall jointly conduct a pre-construction operational status check of all existing TMS elements and each element's communication status with the Traffic Management Center (TMC), including existing TMS elements that are not shown on the plans and elements that may not be impacted by the Contractor's activities. The Department's Traffic Operations Electrical representatives will certify the TMS elements' location and status, and provide a copy of the certified list of the existing TMS elements within the project limits to the Contractor. The status list will include the operational, defined as having full functionality, and the nonoperational components.

The Contractor shall obtain written approval from the Engineer at least 72 hours before interrupting existing TMS elements' communication with the TMC that will result in the elements being nonoperational or off line. The Contractor shall notify the Engineer at least 72 hours before starting excavation activities.

Traffic monitoring stations and their associated communication systems, which were verified to be operational during the pre-construction operational status check, shall remain operational on freeway/highway mainline at all times, except:

1. For a duration of up to 15 days on any continuous segment of the freeway/highway longer than 3 miles
2. For a duration of up to 60 days on any continuous segment of the freeway/highway shorter than 3 miles

If the construction activities require existing detection systems to be nonoperational or off line for a longer time period or the spacing between traffic monitoring stations is more than the specified criteria above, and temporary or portable detection operations are not shown on the plans, the Contractor shall provide provisions for temporary or portable detection operations. The Contractor shall receive the Engineer's approval on the type of detection and installation before installing the temporary or portable detection.

If existing TMS elements shown on the plans or identified during the pre-construction operational status check, except traffic monitoring stations, are damaged or fail due to the Contractor's activity, where the elements are not fully functional, the Engineer shall be notified immediately. If the Contractor is notified by the Engineer that existing TMS elements have been damaged, have failed or are not fully functional due to the Contractor's activity, the damaged or failed TMS elements, excluding structure-related elements, shall be repaired or replaced, at the Contractor's expense, within 24 hours. For a structure-related elements, the Contractor shall install temporary or portable TMS elements within 24 hours. For nonstructure-related TMS elements, the Engineer may approve temporary or portable TMS elements for use during the construction activities.

The Contractor shall demonstrate that repaired or replaced elements operate in a manner equal to or better than the replaced equipment or as directed by the Engineer. If the Contractor fails to perform required repairs or replacement work, as determined by the Engineer, the State may perform the repair or replacement work and the cost will be deducted from monies due to the Contractor.

A TMS element shall be considered nonoperational or off line for the duration of time that active communications with the TMC is disrupted, resulting in messages and commands not transmitted from or to the TMS element.

The Contractor shall provide provisions for replacing existing TMS elements within the project limits, including detection systems, that were not identified on the plans or during the pre-construction operational status check that became damaged due to the Contractor's activities.

If the pre-construction operational status check identified existing TMS elements, then the Contractor, the Engineer, and the Department's Traffic Operations Electrical representatives shall jointly conduct a post construction operational status check of all existing TMS elements and each element's communication status with the TMC. The Department's Traffic Operations Electrical representatives will certify the TMS elements' status and provide a copy of the certified list of the existing TMS elements within the project limits to the Contractor. The status list will include the operational, defined as having full functionality, and the nonoperational components. TMS elements that cease to be functional between pre and post construction status checks shall be repaired at the Contractor's expense and as directed by the Engineer.

The Engineer will approve, in writing, the schedule for final replacement, the replacement methods and the replacement elements, including element types and installation methods before repair or replacement work is performed. The final TMS elements shall be new and of equal or better quality than the existing TMS elements.

PAYMENT

The contract lump sum price paid for maintaining existing traffic management system elements during construction shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in maintaining existing traffic management system elements as shown on the plans, specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

If no electrical work exists on the project and no TMS elements are identified within the project limits, the pre-construction operational status check will be paid for as extra work as provided in Section 4-l.03D, "Extra Work," of the Standard Specifications.

Furnishing and installing temporary or portable TMS elements that are not shown on the plans, but are required when an existing TMS element becomes nonoperational or off line due to construction activities, will be paid for as extra work as provided in Section 4-l.03D, "Extra Work," of the Standard Specifications.

Furnishing and installing temporary or portable TMS elements and replacing TMS elements that are not shown on the plans nor identified during the pre-construction operational status check and were damaged by construction activities will be paid for as extra work as provided in Section 4-l.03D, "Extra Work," of the Standard Specifications.

If the Contractor is required to submit provisions for the replacement of TMS elements that were not identified, the provisions will be paid for as extra work as provided in Section 4-l.03D, "Extra Work," of the Standard Specifications.

10-3.05 CAST-IN-DRILLED-HOLE CONCRETE PILE FOUNDATIONS

GENERAL

Summary

This work includes constructing cast-in-drilled-hole concrete pile foundations for traffic signal and lighting standards. Comply with Section 86-2.03, "Foundations," of the Standard Specifications.

MATERIALS

Concrete must contain not less than 590 pounds of cementitious material per cubic yard.

CONSTRUCTION

For standards located in sidewalk areas, the pile foundation must be:

1. Placed to final sidewalk grade before the sidewalk is placed
2. Square for the top 4 inches

Use sleeve nuts on 1-B standards. The bottom of the base plate must be flush with finished grade.

PAYMENT

Payment for cast-in-drilled-hole concrete pile foundations shall conform to the provisions in Section 86-8, "Payment," of the Standard Specifications.

10-3.06 STANDARDS, STEEL PEDESTALS, AND POSTS

Standards, steel pedestals, and posts for traffic signal and lighting standards shall conform to the provisions in Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications, "Steel Structures" of these special provisions, and the following requirements.

Steel bolts not designated on the plans as high-strength (HS) or stainless steel shall be for general applications and shall conform to the requirements in ASTM Designation: A 307.

Anchor bolts shall conform to the requirements in ASTM Designation: F 1554, Grade 36. High-strength (HS) anchor bolts shall conform to the requirements in ASTM Designation: F 1554, Grade 105.

Where the plans refer to the side tenon detail at the end of the signal mast arm, the applicable tip tenon detail may be substituted.

The sign mounting hardware shall be installed at the locations shown on the plans.

The sign panels will be State furnished in conformance with the provisions in "Materials" of these special provisions.

Handhole reinforcement rings for standards, steel pedestals, and posts shall be continuous around the handholes.

Type 1 standards shall be assembled and set with the handhole on the downstream side of the pole in relation to traffic or as shown on the plans.

10-3.07 CONDUIT

Conduit to be installed underground shall be Type 1 or Type 3 unless otherwise specified.

The conduit in a foundation and between a foundation and the nearest pull box shall be Type 1.

When Type 3 conduit is placed in a trench (not in pavement or under portland cement concrete sidewalk), after the bedding material is placed and the conduit is installed, the trench shall be backfilled to not less than 4 inches above the conduit with minor concrete conforming to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications, except the concrete shall contain not less than 421 pounds of cementitious material per cubic yard. The remaining trench shall be backfilled to finished grade with backfill material.

Conduit runs shown on the plans to be located behind curbs may be installed in the street, within 3 feet of, and parallel with the face of the curb, by the trenching in pavement method in conformance with the provisions in Section 86-2.05C, "Installation," of the Standard Specifications. Pull boxes shall be located behind the curb or at the locations shown on the plans.

After conductors have been installed, the ends of conduits terminating in pull boxes, service equipment enclosures, and controller cabinets shall be sealed with an approved type of sealing compound.

At those locations where conduit is required to be installed under pavement and underground facilities designated as high priority subsurface installation under Govt Code § 4216 et seq. exist, conduit shall be placed by the trenching in pavement method in conformance with the provisions in Section 86-2.05C, "Installation," of the Standard Specifications.

At other locations where conduit is required to be installed under pavement and if a delay to vehicles will not exceed 5 minutes, conduit may be installed by the "Trenching in Pavement Method."

At the option of the Contractor, the final 2 feet of conduit entering a pull box in a reinforced concrete structure may be Type 4.

Conduit to be installed underground (except for the grounding electrode conductor conduits), in the structures, inside the southbound tunnel, and in the battery substation building shall be Type 1 unless otherwise specified. .Conduits to be installed for the grounding electrode conductors shall be Type 3 (fiberglass reinforced epoxy (FRE) conduit) unless otherwise specified. Conduits to be installed outdoors on structures shall be Type 2 unless otherwise specified.

10-3.08 PULL BOXES

Grout shall not be placed in the bottom of pull boxes.

10-3.09 CABLES, CONDUCTORS AND WIRING

Splices shall be insulated by "Method B" for all conductors and cable except for the medium voltage power cable. The splices, terminals, test, and installation for the medium voltage power cable shall be as specified in these special provisions.

Conductors shall be wrapped around projecting end of conduit in pull boxes, as shown on the plans. Cables shall be secured to the projecting end of conduit in pull boxes to prevent pulling of cables without removing the securing device.

10-3.10 SERVICE

Service equipment enclosures shall be the aluminum type.

Circuit breakers shall be the cable-in/cable-out type, mounted on non-energized clips. All circuit breakers shall be mounted vertically with the up position of the handle being the "ON" position.

Each service shall be provided with up to 2 main circuit breakers which shall disconnect ungrounded service entrance conductors. Where the "Main" circuit breaker consists of 2 circuit breakers as shown on the plans or required in the special provisions, each of the circuit breakers shall have a minimum interrupting capacity of 10,000 A, rms.

10-3.11 NUMBERING ELECTRICAL EQUIPMENT

The placement of numbers on electrical equipment will be done by others.

10-3.12 MODEL 334 CONTROLLER CABINETS

The Model 334 cabinets shall conform to the provisions in Section 86-3.01, "Controller Assemblies," of the Standard Specifications and these special provisions.

Cabinets shall be Model 334 and shall consist of a housing (A), a mounting cage 1, and the following listed equipment. The equipment shall conform to Chapter 6 of the Transportation Electrical Equipment Specifications (TEES).

1. Service panel No. 1
2. Power distribution assembly
3. Input file No. 3, upper part
4. C1 harness
5. Controller and equipment shelves
6. Dual fan assembly with thermostatic control
7. Mechanical armature-type relays
8. Model 208 watchdog monitor

Police panels will not be required.

Prior to shipping to the project site, each Model 334 cabinet shall be submitted to the Transportation Laboratory for acceptance testing.

The Engineer shall be notified when each Model 334 cabinet is ready for the functional test. The functional test will be conducted by State forces.

The following equipment shall be provided with each power distribution assembly:

1. Two each of Duplex NEMA 5-20R controller receptacle
2. One each of 30 A, 1-pole, 120 V(ac) Main circuit breaker
3. One each of 15 A, 1- pole, 120 V(ac) circuit breaker
4. Two each of 20 A, 1- pole, 120 V(ac) circuit breaker

Three shelves shall be furnished as shown on the plans. Each shelf shall be attached to the tops of 2 supporting angles with 4 screws. Supporting angles shall extend from the front to the back rails. The front of the shelf shall abut the front member of the mounting cage. The shelves shall be arranged as shown on the plans. The angles shall be designed to support a minimum of 50 pounds each. The horizontal side of each angle shall be a minimum of 3 inches. The angles shall be vertically adjustable.

Three terminal blocks shall be furnished as shown on the plans. Terminal blocks shall conform to the requirements in Chapter 6 of the TEES, except that the screw size shall be 8-32.

A maintenance manual shall be furnished for all controller units, auxiliary equipment, vehicle detector sensor units, control units, and amplifiers. The maintenance and operation manuals may be combined into one manual. The maintenance manual or combined maintenance and operation manual shall be submitted at the time the controllers are delivered for testing or, if ordered by the Engineer, before purchasing. The maintenance manual shall include the following:

1. Specifications
2. Design characteristics
3. General operation theory
4. Function of all controls
5. Trouble shooting procedure (diagnostic routine)
6. Block circuit diagram
7. Geographical layout of components
8. Schematic diagrams
9. List of replaceable component parts with stock numbers

10-3.13 STATE-FURNISHED CONTROLLER ASSEMBLIES

The Model 170 controller assembly, excluding anchor bolts, will be State-furnished as provided under "Materials" of these special provisions.

The Contractor shall construct each controller cabinet foundation as shown on the plans for Model 332A and 334 cabinets (including furnishing and installing anchor bolts), shall install the controller cabinet on the foundation, and shall make field wiring connections to the terminal blocks in the controller cabinet.

A listing of field conductor terminations, in each State-furnished controller cabinet, will be furnished free of charge to the Contractor at the site of the work.

State forces will maintain controller assemblies. The Contractor's responsibility for controller assemblies shall be limited to conforming to the provisions in Section 6-1.02, "State-Furnished Materials," of the Standard Specifications.

10-3.14 PROGRAMMED VISIBILITY VEHICLE TRAFFIC SIGNAL HEADS

A signal technician qualified to program the programmed visibility signal heads shall be present at the time the signal heads are placed in operation.

10-3.15 DETECTORS

Loop detector sensor units will be State-furnished in conformance with the provisions in "Materials" of these special provisions.

Loop wire shall be Type 2.

Loop detector lead-in cable shall be Type B.

Slots shall be filled with elastomeric sealant or hot-melt rubberized asphalt sealant.

At the Contractor's option, where a Type Aloop is designated on the plans, a Type E loop may be substituted.

For Type E detector loops, sides of the slot shall be vertical and the minimum radius of the slot entering and leaving the circular part of the loop shall be 1-1/2 inches. Slot width shall be a maximum of 5/8 inch. Loop wire for circular loops shall be Type 2. Slots of circular loops shall be filled with elastomeric sealant or hot melt rubberized asphalt sealant.

The depth of loop sealant above the top of the uppermost loop wire in the sawed slots shall be 2 inches, minimum.

Slots in portland cement concrete shall be filled with elastomeric sealant or hot-melt rubberized asphalt sealant, or shall be filled with an epoxy sealant conforming to the provisions in Section 95-2.09, "Epoxy Sealant for Inductive Loops," of the Standard Specifications.

10-3.16 LUMINAIRES

Ballasts shall be the lag or lead regulator type.

10-3.17 CAMERA STATION

GENERAL

The Contractor shall furnish and install the following closed circuit television (CCTV) equipment at each camera station as described in these special provisions and as shown on the plans:

1. One integrated camera unit.
2. One CCTV pole and camera mounting adapter
3. One camera control unit (CCU).

4. One video encoder unit (VEU).
5. Power strip.
6. Hybrid camera cable (HCC), connectors and fittings as required.
7. Interface cable and conductors as required.
8. Equipment shelf with brackets as required.

INSTALLATION OF CAMERA STATION

The Contractor shall install CCTV pole with foundation, conduits and pull boxes as required and as shown on the plans. The type of CCTV pole is shown on the plan and shall meet the specifications describe elsewhere in these special provisions. The Contractor shall install and terminate the HCC with connectors as shown on the plans. The HCC shall connect to camera pigtail cable and secure to the pole as shown on the plans for strain-relief.

The integrated camera unit shall be installed on camera mounting plate as shown on the plans. The integrated camera unit shall be secured to the mounting plate using the stainless steel bolts provided with the integrated camera unit. Before each bolt is fastened, a locking type coating shall be applied to the threads. The coating shall lock the bolt and nut in place, making it impossible to turn the bolt or nut without tools. This coating shall last through and be effective through at least ten insertions and withdrawals of the bolt or nut.

The Contractor shall install CCU, VEU, router, power strip, 8-position connecting block, equipment shelves and all the interface cables in the controller cabinet as shown on the plans. The power strip shall be mounted on the rear mounting rack of the controller cabinet.

The Contractor shall furnish all materials necessary to provide a complete and functional camera station in accordance with these special provisions. Miscellaneous equipment, and materials not mentioned but necessary to provide a complete and fully operational camera station shall be furnished by the Contractor as incidental to the work for which no additional compensation will be allowed therefore.

All items furnished under this contract shall be new and shall be the latest version.

CAMERA STATION TESTING

Prior to removal or relocation of existing CCTV equipment including cables, pole, camera, pan and tilt unit, controller cabinet, etc., the Engineer in the presence of the Contractor will test the camera station in the field. Existing equipment that fail during this test period will be replaced or repaired by the State or, if directed by the Engineer, by the Contractor, and such work will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications. The Contractor shall notify the Engineer in writing fifteen days prior to the scheduled testing.

Upon completion of work, each camera station shall be subjected to post-installation tests as outlined herein. All software shall be provided and loaded before the start of testing The District Electrical Systems Branch personnel, arranged by the Engineer and in the presence of the Contractor, shall perform all tests. The Contractor shall notify the Engineer in writing fifteen days prior to the scheduled testing. Upon receipt of the notification, the Engineer shall contact Office of Electrical Systems at (510) 286-6142. The Contractor shall provide all necessary equipment required to access the CCTV equipment for testing.

The testing shall consist of five consecutive days of continuous satisfactory operation of each camera station. If any material and equipment furnished and installed by the Contractor in this project is found defective or otherwise unsuitable, or the workmanship does not conform to the accepted standards, the Contractor shall replace such defective material and equipment at no cost to the State.

The Contractor may offer rejected material or equipment for consideration provided all non-compliance has been corrected and pretested by the Contractor. After all defects have been corrected, the camera station shall be re-tested until five consecutive days of continuous satisfactory operation is obtained.

The post-installation tests shall consist of, but not be limited to, inspection and functional testing in accordance with these special provisions.

Inspection shall consist of, but not be limited to, verification of correct wiring terminations, correct cable interconnections, good workmanship and compliance with these special provisions.

Functional testing shall include, but not be limited to, the following:

a. Verify all local mode CCTV operations using the CCU front panel controls.
b. Verify video signal output from CCU with a National Television Systems Committee (NTSC) monitor.
c. Verify the correct operation of the auto/manual iris and focus, and manual zoom functions.
d. Verify the correct operation of the pan/tilt function. The pan/tilt function shall be tested over 355 degrees in the horizontal plane and +20 to -90 degrees in the vertical plane
e. Verify the correct operation of the preset positions.

10-3.18 CAMERA CONTROL UNIT

GENERAL

The Contractor shall furnish and install Camera Control Units (CCU) at each field CCTV assembly location. The camera control units shall consist of a rack-mounted field unit. The camera control unit shall have the same manufacturer as the integrated camera unit. The camera control unit shall be designed to provide on-site camera control functions. The control functions shall include pan/tilt positioning, zoom in/out control, auto/manual focus, and auto/manual iris.

CCU shall include a local/remote switch that transfers control from the remote system to local. This shall allow the remote control system and the CCU to remain connected while transfer the control function without disconnection of the camera site equipment. The local function shall time-out and return to remote mode in 10 minutes.

LED indicators on the CCU shall provide positive feedback of the automatic and manual mode status of the camera focus and iris functions, and the manual mode status of the pan/tilt function.

PHYSICAL AND MECHANICAL REQUIREMENTS

Each CCU shall mount in 2 inches (1 rack unit) of EIA-310 rack space with a maximum depth of 14 inches. The front panel shall be black gloss color Number 17986 as per Federal Standard Color Chart 595B. The front and rear panel lettering shall be white color Number 17886 as per Federal Standard Color Chart 595B.

A high-impedance front and rear panel jack bayonet nut connector (BNC) shall be installed on the front and rear panel as shown on the plans. These connectors shall provide video input to a test monitor without affecting the remainder of the CCTV system. These connectors shall be directly monitoring the video input from the camera. The connectors shall be of copper material with bright nickel (tarnish resistant) finish for the body and silver finish for the contact.

A automobile glass (AG), size 1/4" x 1 1/4" inches, slow blow fuse shall be installed and replaceable from the outside of the unit.

Switches shall protrude no more than 0.5-inch from the front panel and shall be mounted as shown on the plans. Each switch shall be labeled as to their functions.

The rear panel connectors shall be mounted as shown on the plans and shall meet the following requirements:

1. Camera Connector shall be of the following type or equivalent: AMP 206037-1, Square Flange type. The socket contacts for camera connector shall be constructed with brass contact body material and with stainless steel spring that are sub-plated with 0.000050-inch nickel and plated with 0.000030-inch gold. Contact size shall be 16. AMP No. 305183 contact extraction tool shall be used to replace contact.
2. The EIA-232 connectors shall be a DE9 pin connector and EIA-422 connector shall be a DB9 socket connector.
3. One mating connector, AMP 206036-3 with a full set crimp contact pins and strain relief back shell, AMP 206070-1 shall be supplied with each CCU supplied in the contract.

The Contractor shall provide all necessary interface cables for CCU to connect to all other camera equipment.

Each LED shall be High Intensity Untinted, Non-diffused LED. Each LED shall be mounted as shown on the plans.

An on/off switch to turn the CCU on/off shall be provided. An LED to indicate the AC power is on shall be provided.

Each CCU shall not weight more than 5 lbs.

ELECTRICAL REQUIREMENTS

Camera Control Functions

Each CCU shall have circuitry to detect the absence and presence of video sync on its video input. Each CCU shall have auto-iris override. Each CCU shall have a transfer switch between local and remote mode. The local function shall time-out and return to the remote mode within 5 minutes. A system-reset switch with momentary-pushbutton type shall be mounted on the front panel to function as external reset input to the microprocessor. The system-reset shall exercise the pan and tilt movements through their ranges and return the camera to the prior position. The system-reset function shall allow remote execution.

The CCU shall have, as a minimum, control and drive circuits for the following camera control functions:

Control Function	Switch Position
Pan momentary toggle switch	Left-Stop-Right
Tilt momentary toggle switch	Up-Stop-Down
Zoom In/Out momentary toggle switch	Telephoto-Stop-Wide Angle
Focus Automatic/Manual momentary toggle Switch	Auto Focus -Manual
Manual Focus toggle Switch	Near-Stop-Far
Iris Automatic/Manual toggle Switch	Auto Iris -Manual Override
Manual Iris toggle Switch	Open-Stop-Close
Remote/Local momentary toggle Switch (Local function shall time-out and return to remote mode in 10 Minutes)	Remote-Local
Reset momentary push button switch	Reset

Camera Connector Contact Assignment:

Position	Function	Position	Function
1	Video, 75 ohm	9	Not Used
2	Video Ground	10	Not Used
3	Data Ground	11	Not Used
4	Rx-	12	115 V(ac), Hot
5	Rx+	13	115 V(ac), Neutral
6	Tx+	14	Not Used
7	Tx-	15	115 V(ac), Ground
8	Not Used	16	Not Used

EIA-232 Connector Contact Assignment (DE9 Pins):

Position	Function	Position	Function
1	Not Used	6	Not Used
2	Receive Data, Rx	7	RTS
3	Transmit Data, Tx	8	CTS
4	Not Used	9	Not Used
5	Signal Ground		

EIA-422 Connector Contact Assignment (DE9 Sockets):

Position	Function	Position	Function
1	Tx+	6	Signal Ground
2	Tx-	7	Not Used
3	Signal Ground	8	Not Used
4	Rx+	9	Not Used
5	Rx-		

Communication and Camera Addressing Protocol

The execution of CCU functions, other than the hardware controls on the front panel, shall be done through either EIA-232 or EIA-422 optically isolated serial communication ports on the back panel. A minimum 9,600-baud data rate shall be used. The CCU shall have a front panel EIA-232 port for connection to a local laptop computer. The (NTCIP) 1205 MIB communications protocol shall be included.

The communications between CCU and the integrated camera unit shall be conducted through an EIA-422 circuit with full handshake support. A minimum 9,600-baud data rate shall be used. The CCU shall be 100 percent compatible with the protocol and data backbone architecture.

Power Consumption

The maximum power consumption for the CCU shall not exceed 45 W. Power consumption of equipment attached to CCU shall not exceed 250 W.

CCU to Laptop PC Cable

The Contractor shall furnish and install a universal serial bus (USB) to EIA-232 serial adapter at each camera location. The adapter shall have a DE9 socket connector for EIA-232 and Type A plug connector for USB. The Contractor shall also supply a 6 feet straight through USB extension cable. The USB function shall conform to version 2.0. The Contractor shall submit the adapter software in CD format.

ENVIRONMENTAL REQUIREMENTS

Each CCU shall operate in an ambient temperature environment of –34 °C to +74 °C and up to 90 percent relative humidity. Each CCU shall pass 5 Gs, 11 ms, in any axis under non-operating conditions, MIL-E-5400T, para 3.2.24.6 shock test. Each CCU shall pass vibration tests**:**

1. Sine vibration from 5 to 60 Hz with 0.082-inch total excursion without damage.
2. Random vibration from 60 to 1,000 Hz, 5 Gs RMS (0.027-G^2/Hz) without damage.

10-3.19 HYBRID CAMERA CABLE AND CONNECTORS

The Hybrid camera cable (HCC) shall consist of one RG-59/U type analog video coaxial cable, one 6-No. 22 AWG conductor group, one 8-No. 26 AWG conductor group and a two twist pair 4-No. 26 AWG conductor group in a common outer jacket. The hybrid camera cable cross section is shown on the plans.

The Coaxial cable shall conform to:

Electrical	Coaxial
Capacitance (picofarads/ft nominal)	17.3
Impedance (ohms-nominal)	75
Velocity of propagation (nominal)	78 percent
Nominal Diameter (inch)	0.242
Insulation Rating	300 V

Frequency (MHz)	Nominal dB/ 100 ft
1	0.30
10	0.90
50	2.10

The coaxial cable physical measurements:

Component	Nominal O.D. (inches)
Copper center conductor	0.040
Foam polyethylene dielectric	0.180
Sealed APA tape with 0.06-inch overlap	0.216
Woven aluminum braid	0.241
PVC outer jacket	0.297

(APA = Aluminum polyolefin and aluminum with adhesive)

The 6-No. 22 AWG shall be stranded 7 x 30, tinned copper insulated with 0.009" nominal wall of S-R PVC and a nominal O.D. of 0.048". The 6 conductors shall be color coded as follows:

1. Black
2. Red
3. Green
4. White
5. Blue
6. Yellow

The 8-No. 26 AWG shall be stranded 7 x 34, tinned copper insulated with 0.009" nominal wall of S-R PVC and a nominal O.D. of 0.037". The 8 conductors shall be color coded as follows:

1. Brown
2. Blue
3. Orange
4. Yellow
5. Purple
6. Gray
7. White with Black Stripe
8. Red with Green Stripe

The 4-No. 26 AWG in 2 twisted pairs shall be stranded 7 x 34, tinned copper insulated with 0.009" nominal wall of S-R PVC and a nominal O.D. of 0.037". The 4 conductors shall be color coded as follows:

Pair 1

1. Black
2. White

Pair 2

3. Red
4. Green

The HCC shall also have a 36 AWG tinned copper braid with 90 percent coverage, an O/A binder of 0.001" polyester 25 percent overlap, and an outer jacket conforming to: color to match Fed-Std-595 color No.-24091, material 0.032" dark gray UV resistant PVC to 0.425" O. D. and must pass the VW-1 vertical flame test. Fillers shall be used as required to form a uniform round cable. The insulation rating of the overall cable jacket shall be 300 V.

The manufacture identification shall be surface printed in white ink every foot along the length of the cable.

The HCC shall be continuous from the integrated camera unit to CCU in the controller cabinet without splicing, unless shown on the plan or approved by the Engineer. The maximum length of HCC is 750 feet.

The HCC shall be terminated with cable connectors on both ends. Connector AMP 206036-3 with a full set crimp contact pins and strain relief back shell, AMP 206070-1 shall be installed on the cable end toward CCU. Connector AMP 206037-1 with a full set crimp contact sockets and strain relief back shell, AMP 206070-1 shall be installed on the cable end toward the integrated camera unit. All connector contact shall be constructed with brass contact body material and with stainless steel spring that are sub-plated with 0.000050-inch nickel and plated with 0.000030-inch gold. Contact size shall be 16. AMP No. 305183 contact extraction tool shall be used to replace contact. AMP hand tool assembly 58495-1 with die assembly 58495-2 shall be used to place contacts on to each conductor. No other tool, unless approved by the Engineer shall be used for this work.

INSPECTION AND TESTING

Testing of HCC and connectors shall be performed in accordance with provisions in Section 86-2.14B, "Field Testing" of the Standard Specifications and these special provisions. Any cable lengths found to have faults shall be replaced and retested. The Contractor shall dispose of the removed faulty cable. The cable termination shall be randomly inspected for contact crimping quality control. Any contact found not crimped with the correct crimping tool and is defect shall be rejected. The Contractor shall redo the termination until all defects are corrected.

Prior to the beginning of work, the coaxial cable length of HCC shall be tested for attenuation and faults to ensure compliance with specifications contained herein using a time domain reflectometer (TDR). For the purpose of these special provisions, one or more of the following defines a fault in a long length of cable:

a. Return loss measurements indicating that attenuation exceeds 3 dB at 5 MHz to 30 MHz in a portion of cable less than 10 feet long.
b. A return loss measurement indicating that there is a short in the cable.
c. A return loss measurement indicating a cut or open circuit in the cable.
d. A visual inspection that reveals exposure of or damage to the cable shielding.

10-3.20 INTEGRATED CAMERA UNIT

GENERAL

Each integrated camera unit shall consist of a camera, lens, receiver/driver, pan/tilt assembly, environmental housing, sunshield and pigtail cable with connector. The integrated camera unit shall automatically switch to monochrome mode when ambient light level is at 20 foot-candles and switch back to color at 180 foot-candles.

Each integrated camera unit shall be assembled, inspected and tested in accordance with these special provisions prior to delivery to the job site. Installation, operations and maintenance manuals shall also be submitted at the time of delivery. The Contractor shall submit the applicable documents of the U.S. Military Specification (MIL-SPEC), Underwriters Laboratories Inc. (UL), Electronics Industries Association (EIA) Standards and other Standards from parts of the specification to the extent specified in these standards. In the event of a conflict between the content of this section and the content of the specification, the standards defined in this section shall supersede.

Military Specification Documents	
MIL-I-45208A	Inspection System Requirements, Dec. 16, 1963
MIL-C-45662	Calibration System Requirements, June 10, 1980
MIL-STD-416A	Electromagnetic Interface Characteristics Requirements for Equipment, Subsystems & Systems, Aug. 1, 1968
MIL-E-5400T	Electronic Equipment, Airborne General Specification
MIL-STD-810	Environmental Test Methods, 19 July 1983
MIL-C-5541	Chemical Conversion Coatings on Aluminum Alloys, June 3, 1970

Underwriters' Laboratory, Inc. and other documents	
UL-796	Printed Circuit Boards
EIA-170A	Electrical Performance Standards Color Television Studio Facilities
EIA RS-330	Electrical Performance Standards for Closed Circuit Television (CCTV) Camera 525/60 Interlaced

CAMERA

Each camera shall meet the following specifications at a minimum:

Imager	Interline transfer Progressive Scan CCD with mosaic-type color compensating filter
Image Area	1/4" Format, 3.6 mm (H) x 2.7 mm (V)
Resolution	540 horizontal; 350 vertical
Picture Elements	811 (H) x 508 (V), Total 411,988
Video Output	NTSC, 1 V p-p @ 75 ohms, unbalanced
Lens	Aperture: f/1.4 (wide angle) to f/4.2 (telephoto)
Optical Zoom Range	35X, 3.4 mm to 119 mm
Digital Zoom Range	1X (Off) through 210X, Smooth transition from Optical to Digital Zoom
Horizontal Angle of View	Optical: 55.8° to 1.7°; At 10X Digital: 55.8° to 0.17°.
Focus Distance.	40" in telephoto, 0.4" in wide angle
Digital Compass	8 or 16 direction point compass annotation with primary direction spelled out and intermediate directions abbreviated with two letters
Auto Focus	Selectable Auto/Manual
Manual Focus Speed	Approximately 2.0 seconds to full range
Minimum Scene Illumination	For Reliable Auto Focus, 30 percent video
Zoom & Focus Presets	64 preset positions with auto focus and ID
Flash Memory	Update firmware and new features via serial communication

Shutter speeds	1/60; 1/120; 1/180; 1/250; 1/500; 1/1,000; 1/2,000; 1/4,000; 1/10,000; 1/30,000 second
Auto Iris	Automatically adjusts to compensate for changes in scene illumination to maintain constant video level output within sensitivity specifications
Manual Iris	Changing the video level to give the effect of open iris/close iris
Gamma	0.45
AGC	0 to 28 dB
Color Balance	Auto Tracking Color Balance/Manual with adjustable Red and Blue Levels
Signal to Noise Ratio	>50 dB
Synchronization	Crystal or Phase-Adjust Line Lock on 60 Hz
Sensitivity	@F1.4, Wide Angle 35 IRE 0.5-Lux @ 1/60 s, F1.4, Shutter, Color I.R. Cut On 0.05-Lux @ 1/2 s, F1.4, Shutter, Color I.R.Cut On 0.2-Lux@ 1/60 s, F1.4, Shutter, monochrome mode I.R. Cut Off 0.01-Lux@ 1/4 s, F1.4, Shutter, monochrome mode I.R. Cut Off

Pan and tilt function specifications:

1	Continuous rotation capability in either direction
2	110° of tilt movement, +20° to –90° unobstructed
3	Pan Speed (Operator Control): Variable from 0.1°/s to 80 °/s
4	Pan Speed (Preset Control): >140°/s
5	Tilt Speed (Operator Control): Variable from 0.1°/s to 40 °/s
6	Tilt Speed (Preset Control): 140°/s
7	64 Pan & Tilt preset positions with repeatability within ±0.5°
8	The positioning system shall be invertible if inverse mounting is required

The integrated camera unit shall have eight programmable camera movement sequences. Each sequence is programmed by selecting the preset position by number, and then selecting a dwell time. The presets can be used in any order, and the same preset may be used more than once as long as the total number of preset positions used does not exceed 32. The dwell time defines the length of time paused at each preset position. It can be from 1 second to 60 seconds. The dwell time can be changed individually for all stops on the sequence. If the appropriate preset ID is programmed, it shall be displayed for each preset position used on the sequence. The sequence shall stop upon receipt of a pan command. All programmable functions shall be stored in non-volatile memory.

The camera housing shall be a corrosion resistant and tamper proof sealed and pressurized housing with five pounds dry nitrogen with Schrader purge fitting and 20 psi relief valve for each camera. The size of the housing shall be 3 1/2" diameter or smaller. The housing exterior shall be finished by pre-treatment with conversion coating and baked enamel paint. The camera enclosure shall be designed to withstand the effects of sand, dust and hose-directed water.

The internal humidity of the housing shall be less than 10 percent, when sealed and pressurized. Desiccant packs shall be securely placed inside the housing to absorb any residual moisture and maintain internal humidity at 10 percent or less. The housing shall include a thermostatically controlled heating pad rated at 115 V(ac) 100 W maximum.

A sun shield or visor shall be provided to shield the lens from direct sunlight.

The integrated camera unit shall include a character generator. The text characters shall be uppercase white with black border impose on the video stream. A maximum of six lines of user programmable alphanumeric text shall be displayed through serial communications. Messages can be positioned at either the top or the bottom of display. The Right side positioning is accomplished by padding left side of message with spaces. Blank lines shall not be displayed. Any programmed line being displayed shall fill in toward the top if top positioning is selected, or toward the bottom if bottom position is selected.

Camera ID shall be used for upper 2 lines with each up to 24 characters long. If both lines are programmed, line 1 of Camera ID shall always appear above line 2 of Camera ID regardless of top or bottom selection.

Preset ID shall be 1 line, up to 24 characters long, user programmable for each of the 64 preset positions. When a preset position is recalled the corresponding preset ID shall be displayed. The preset ID shall remain displayed until a pan, tilt, zoom, manual focus, auto focus select, or another preset command is received.

An 8-point or 16-point compass annotation shall be settable for a true north position. Display shall include North, NE, East, SE, South, SW, West and NW. Position shall be able to be grouped with the site location or separated from site location. Azimuth and elevation position shall be displayed in 0 - 359 degrees and +95 to –95, respectively. All display shall be user selectable for enable/disable, 3-second time out or permanent display. Sector Message of up to 16 sectors in 360° shall be defined with up to 24 characters long.

Low-pressure indicator shall use 1 line with messages displayed in "blinking" or "non-blinking" mode when activated by low internal pressure. Adjustable set points by altitude shall be provided via the serial port to activate low-pressure. Message shall be enabled or disabled. In maintenance mode readings of the internal pressure of the camera housing shall be displayed from 5 down to 1 psi, in 0.1-psi increments.

Internal temperature indicator shall use 1 line with messages displayed in "blinking" or "non-blinking" mode. Message shall be enabled or disabled. In maintenance mode, camera readings of the internal temperature of the camera housing shall be in 1-degree increments.

Video blanked for up to 8 privacy zones shall be provided. One line numeric messages shall be displayed. Message shall be displayed in "blinking" or "non-blinking" mode and be enabled or disabled. Privacy zones shall be programmed through serial communications.

Control and addressing the integrated camera unit shall be done through RS-422 optically isolated serial communications. Additional protocols shall consist of Cohu, American Dynamics, Javelin, Philips/Bosch, Vicon and Pelco-D. The National Transportation Communications for ITS Protocol (NTCIP) 1205 protocol communications protocol shall be included as an option. Refer to NTCIP 1205 protocol for detailed description.

Upon receipt of any given command, the integrated camera unit shall response in not longer than 1.0 second.

All programmable functions including camera last operating position shall be stored in non-volatile memory and shall not be lost if a power failure occurs. Upon power restoration, the camera shall go through a series of self-testing/calibration and return to the same position it left before the power interruption. System configurations such as video privacy zones, preset text and sector I.D. shall be able to be stored in a computer file and a camera personality can be cloned or uploaded into a camera in the event that a camera replacement is necessary.

PHYSICAL AND MECHANICAL REQUIREMENTS

Each integrated camera unit shall not weight more than 20 lbs. Its dimensions shall not exceed 14" in length, 7" in width and 12" in height (Including mounting base.) The integrated camera unit shall be pole mount version. There shall be four equal spaced mounting holes on the mounting base. Each integrated camera unit shall be provided with four stainless steel hex head bolts to secure the integrated camera unit to the camera mounting plate. All fasteners and nuts used in attaching the integrated camera unit to the mounting plate shall be of grade 18-8 stainless steel. A camera-mounting adapter shall be provided as shown on the plans.

POWER REQUIREMENTS

The integrated camera unit shall operate between voltage 89 V(ac) to 135 V(ac), 120 V(ac) nominal voltage and 50 or 60 Hz. (±3.0 Hz). The integrated camera unit shall conform to National Electrical Manufacturers Association (NEMA) standard TS-2 (1998) for traffic control system 2.1.2. The integrated camera unit shall meet the requirements of Section 2.1.6 "transients, power service" of the NEMA standard TS-2 (1998). The line variation and surge performance shall be tested to meet these specifications by an outside agency, other than the camera manufacturer. The tests shall be provided upon request. The power consumption shall not exceed a total of 200 watts, in which 100 watts for camera, receiver, pan/tilt driver and 100 watts for heater on.

ENVIRONMENTAL REQUIREMENTS

The integrated camera unit shall operate in ambient temperature range from -34°C to +74°C, in relative humidity up to 100 percent. The unit shall operate when exposure to sand, dust, fungus and salt atmosphere per MIL-E-5400T, paragraph 3.2.24.7, 3.2.24.8, 3.2.24.9 and with shock for up to 10 Gs, 11 ms, in any axis under non-operating conditions, per MIL-E-5400T, para 3.2.24.6. The unit shall not be damaged with sine vibration from 5 to 30 Hz, 1/2 G, 3 axis in one hour. .

CAMERA PIGTAIL AND CONNECTOR

The camera pigtail cable shall conform to the specifications for "Hybrid Camera Cable" in these special provisions. The length of the camera pigtail cable shall not be less than 32". The terminating connector shall be equivalent to an Am phenol 206036-3 with back shell 206070-1.

The contact pin assignment of the connector shall be:

Position	Function	Position	Function
1	Video, 75 ohm	9	Not Used
2	Video Ground	10	Not Used
3	Data Ground	11	Not Used
4	Tx-	12	115 V(ac) Line, Hot
5	Tx+	13	115 V(ac), Neutral
6	Rx+	14	Not Used
7	Rx-	15	115 V(ac), Ground
8	Not Used	16	Not Used

The Contractor shall furnish a mating connector, Am phenol 206037-1 with back shell 206070-1 and sixteen contact crimping sockets for each integrated camera unit supplied in the contract.

10-3.210 INTERFACE CABLES

GENERAL

All interface cables when required to interface with other equipment as shown on the plan shall be minimum of 6 feet in length. All interface cables shall be commercially made high quality type with appropriate connectors on the cable ends as shown on the plans.

NETWORK STRAIGHT THROUGH DATA CABLE

The network straight through data cable shall be made of Ethernet twisted pair cable (ETPC) and terminated with an 8-conductor, 8P8C modular plug on both ends. ETPC shall consist of 4 unshielded twisted pair (UTP) No. 24 AWG stranded copper conductors insulated with high-density polyethylene (PE). The insulated conductors shall be tightly twisted into individual pairs and jacketed with PE or PVC..

VIDEO PATCH CABLE

The video patch cable shall be RG-59/U coaxial cable terminated at both end with BNC connectors. The coaxial cable shall conform to:

Electrical	Coax
Capacitance (picofarads/ft nominal)	17.3
Impedance (ohms-nominal)	75
Velocity of propagation (nominal)	78 percent
Nominal Diameter (inch)	0.242

The cable attenuation at 20 °C shall measure at maximum as:

Frequency (MHz)	Nominal dB/ 100 ft
1	0.30
10	0.90
50	2.1

The coaxial cable physical measurements:

Component	Nominal O.D. (inches)
Copper center conductor	0.040
Foam polyethylene dielectric	0.146
Sealed APA tape with 0.06-inch overlap	0.216
Bare copper braid	0.241
PVC outer jacket	0.297

(APA = Aluminum polyolefin and aluminum with adhesive)

EIA-232 DATA PATCH CABLE

The EIA-232 data patch cable shall meet EIA-232 standard. The data cable shall have multiple No. 20 AWG conductors with (UL) Type CM shielded or AWM 2464 80C 300 Volts – C (UL). One end of data cable shall be terminated with a DE9 female connector. All contact socket pins shall be gold plated. The contact pin assignment is shown on the plans. The other end of the data cable shall be either terminated with an 8P8C modular plug or not terminated. When there is no connector required on the other end of cable, each conductor's insulation shall be stripped 1/4" long from the end of cable and the bare conductor shall be tinned with solder.

10-3.22 VIDEO ENCODER UNIT

GENERAL

A prototype of the video encoder unit (VEU) is not acceptable. All equipment shall be off-the-shelf production units. All equipment shall be new and not previously used. The Contractor shall provide a Service and Operation manual describing the operation, maintenance of the VEU for each unit provided in the contract. The Contractor shall provide all necessary interface cables to connect communication equipment and the camera control unit (CCU) for a complete and successful installation and operation of the VEU, and as shown on the plans.

ABBREVIATIONS

LED	Light Emitting Diode
AC	Alternating Current
SNMP	Simple Network Management Protocol
TELNET	Network Virtual Terminal
CLI	Command Line Interface
NTSC	National Television System Committee
SIF	Source Input Format
QSIF	Quarter Source Input Format
CIF	Common Intermediate Format
QCIF	Quarter Common Intermediate Format
BNC	Bayonet Nut Connector
RJ	Registered Jack
IP	Internet Protocol
DHCP	Dynamic Host Configuration Protocol
bps	Bits Per Second
fps	Frame Per Second
MPEG	Motion Picture Experts Group
ISO	International Organization for Standardization
IEC	International Electrotechnical Commission
DiffServ (QoS)	DIFFerentiated SERVices (Quality Of Service)
UDP	User Datagram Protocol
RTP	Real-time Transport Protocol
RTSP	Real Time Streaming Protocol
RTCP	Real-time Transport Control Protocol
HTTP	HyperText Transfer Protocol
MIL	MILitary

PHYSICAL AND MECHANICAL REQUIREMENTS

The VEU shall be mountable in a standard EIA-310 equipment rack or can be a stand-alone unit which shall be mounted to a standard EIA-310 equipment shelve. The VEU and shelve if any shall fit in 5.25 inches of a standard EIA-310 equipment rack space. Each VEU shall have all the cable connections on the rear of the unit. A main power switch to turn the unit on/off shall be provided. An LED to indicate the AC power on shall be provided.

ELECTRICAL REQUIREMENTS

The VEU shall be able to be remotely managed, configured and maintained without the use of any third party software with the management and performed using SNMP, TELNET and CLI. The VEU shall operate with both color and black/white video input signal without modification to the hardware.

The input video resolution of the VEU shall be the following:

Video Resolution	NTSC
SIF	352 x 240
QSIF	176 x 128
CIF	N/A
QCIF	N/A
Custom	64 x 48
Custom	128 x 96
Custom	192 x 144
Custom	256 x 192
Custom	352 x 240

The input video formats of the VEU shall be composite NTSC with 525 lines at 60 Hz. The VEU shall have a minimum of one composite video input. The input video connector shall be compatible with SMPTE-170M at 75 ohms impedance with Bayonet Nut Connector (BNC) type.

The network communication interface of the VEU shall be Ethernet 10/100 Mbps through RJ-45 connector port, either in static IP or assigned through DHCP.

The camera control data interface shall include a Maintenance Serial Port for local maintenance and a Control Serial Port for Data transport. The port shall be EIA-232 at a user selectable data rate from 1,200 to 56,000 bps, asynchronous. The connector type for the port shall be a DB9 pin type.

The VEU shall provide bandwidth for camera control within the bandwidth allocated for video only when bandwidth is needed for camera control/status data transmission.

The video compression of the VEU shall meet MPEG 4-ISO/IEC 14496-2 (1999) standard. The MPEG-4 compliant levels are:

1. Level 1 – up to 64 Kbps
2. Level 2 – up to 128 Kbps
3. Level 3 – up to 384 Kbps

The video rates of the VEU shall be scaleable from 1 fps to 30 fps and from 8 Kbps to 2 Mbps. User selectable options are:

1. Constant Bit rate at Constant Frame rate
2. Variable Bit rate at Constant Frame rate
3. Constant Bit rate at Variable Frame rate

The video delivery options of the VEU are either unicast or multicast with protocols DiffServ (QoS), UDP, IP, RTP, RTSP, RTCP, HTTP, SNMP, and TELNET.

POWER REQUIREMENTS

The VEU shall operate between voltage 89 V(ac) to 135 V(ac), 120 V(ac) nominal voltage and 50 or 60 Hz (±3.0 Hz). The VEU shall conform to NEMA standard TS-2 (1998) for traffic control system 2.1.2. The VEU shall meet the requirements of Section 2.1.6 "transients, power service" of the NEMA standard TS-2 (1998). The line variation and surge performance shall be tested to meet these specifications by an outside agency, other than the VEU manufacturer. The test results shall be provided upon request. The power consumption shall not exceed a total 25 watts.

ENVIRONMENTAL REQUIREMENTS

Each VEU shall operate in an ambient temperature environment of –20 °C to +70 °C and up to 90 percent relative humidity. Each VEU shall pass 5 Gs, 11ms, in any axis under non-operating conditions, MIL-E-5400T, para 3.2.24.6 shock test. Each VEU shall pass vibration tests**:**

1. Sine vibration from 5 to 60 Hz with 0.082-inch total excursion without damage.
2. Random vibration from 60 to 1,000 Hz, 5 G's RMS (0.027-G^2/Hz) without damage.

10-3.23 EQUIPMENT SHELF WITH BRACKETS

The Contractor shall furnish and install each equipment shelf as shown on the plans.

Each shelf shall be furnished with 2 mounting brackets.

Each mounting bracket shall extend from the front to back mounting rails of the controller cabinet rack cage. Each bracket shall be designed to support a minimum of 50 lbs. The horizontal side of each bracket shall be a minimum of 3 inches. Each bracket shall be attached to front and rear of the rack cage with four (4) 10-32 stainless steel Phillips round head bolts.

Each shelf shall be fabricated of 0.125-inch cold rolled sheet or 0.125-inch aluminum sheet. Each shelf shall be the width of the control cabinet rack cage and 18 inches deep. Each shelf shall have equally distributed holes or slots throughout the shelf that shall provide 40 percent minimum open area for vertical flow-through ventilation. Each hole or slot shall not exceed 0.75-square inches in area. Each shelf shall be cadmium-plated or zinc-plated after cutting and drilling.

Each shelf shall be attached to the top of its pair of brackets in all four corners with stainless steel hardware, with the front of the shelf abutting against the front rail of the control cabinet rack cage.

10-3.24 RACK-MOUNT POWER STRIP

ELECTRICAL

Each rack-mount power strip shall meet the following requirements:

1. A maximum rating of 15 A, 120 V(ac), 60 Hz.
2. A surge protection with UL 1449 Clamping Level of 400 V, an IEEE Let-Through Voltage rating of less than 336 V, a single-pulse energy rating of 210 J and EMI/RFI noise protection rating of 40 dB.
3. One 15 A circuit breaker.
4. One internally illuminated switch to cut off power to all outlets.
5. Six NEMA 5-15R outlets.

MECHANICAL

Each rack-mount power strip shall meet the following requirements:

1. Dimensions of 2" (H) x 19" (W) x 2-4/5" (D) maximum and shall not weigh more than 4.5 lbs.
2. The front plate of the power strip shall have two cut-off EIA mounting screw holes on each end.
3. Each outlet shall have 1-1/2" minimum spacing center-to-center to its adjacent outlet.
4. The power cord shall enter from the rear with a length of 7 feet minimum.
5. The clearance between the power cord entrance and the nearest outlet shall be 3-3/8" minimum.
6. Both the circuit breaker and the switch shall be front-mounted.
7. Each outlet shall be rear-mounted.

The power strip shall be plugged into the non-GFCI duplex outlet normally labeled with "Controller Unit Receptacle" in the back of the Power Distribution Assembly (PDA). The power strip shall be mounted on the rear of the standard EIA-310 rack cage and across the two vertical back rails with four stainless steel EIA mounting screws, two on each side. The power strip shall not hinder the accessibility to the back of all existing electrical equipment. All power cords for permanently field installed electrical equipment shall be plugged into the power strip.

10-3.25 GENERAL PACKET RADIO SYSTEM WIRELESS MODEM ASSEMBLY

The General Packet Radio System (GPRS) Wireless Modem Assembly shall be configured with the following major components:

A. Modem
B. Power supply
C. Modem mounting bracket and hardware
D. Serial communication cable
E. Antenna

MODEM

All modems shall be configurable remotely through the wireless network and through the modem serial port. The contractor shall configure all modems prior to acceptance. The contractor shall provide the Engineer with the modem serial and IMEI numbers 30 days prior to requiring the PDP context. The Engineer will make available the PDP context comprising the IP (assigned) and APN (obtained from service provider) and configuration parameters (if different from those listed below) after the serial and SIM numbers are provided to the Engineer by the Contractor. All modems shall be complete with all cables, conductors, hardware, antenna and other equipment as required to make the system completely operational. Location and mounting of the equipment shall be directed by the Engineer and details shown on the plans. The modems shall be fully compliant with PCCA STD-101.

Environmental Requirements

The operating temperature of the modem shall range from -30 °C to +70 °C, with humidity from 5 percent to 95 percent (non-condensing) and have transmissions at 10 percent duty cycle above 60 °C.

Physical Characteristics

The modem shall weigh less than 2 lbs and shall have overall dimensions of less than 7 1/8 inches × 3 1/2 inches × 1 1/8 inches. The housing shall be constructed of anodized aluminum.

The modem shall have the following status indicators:

1. Power (on).
2. Channel acquired.
3. Link status.
4. Network registration.
5. Received signal strength indicator.
6. Transmit and receive data.
7. Block errors.

Operational Parameters

The modem shall operate in a dynamic IP addressing environment of GPRS Networks at 1900/850 MHz and meet the following operational parameters:

Transmit power at antenna port	1.0 W for 1900 MHz 0.8 W for 850 MHz
Transmit frequency	1850-1910 MHz and 824-849 MHz
Receiver frequency	1930-1990 MHz and 869-894 MHz
Receiver sensitivity	-107 dBm (2.439 % bit error rate)
Input voltage	10 VDC to 28 V(dc)
Input current	40 mA to 200 mA

Application Interfaces

The modem shall have the following standard interfaces:

1. The AT command serial character stream uses TCP/IP.
2. Host communicates with modem using either UDP or TCP packet modes.
3. Computer terminal platform using Windows 2000/NT/XP and Dial-Up Networking communicates with the modem using PPP.

Features

The modem shall have the following features:

1. 53.6 kbps raw data transfer rate minimum.
2. Full duplex transceiver.
3. 1900/850 MHz dual band networking.
4. Integrated TCP/IP protocol stack with UDP.
5. Security such to prevent unauthorized access.
6. Includes a DC power cable at least 40 inches in length with a connector compatible with the modem power connector.
7. Packet buffering and forwarding feature that provides discipline to the output of the serial port. The packet forwarding time interval shall be configurable from a rate of 0 (undisciplined) to 400ms in increments of 100ms or less.
8. Choice of "Friends Only" access mode.

System Compliance

The modem and associated firmware, software, hardware, protocol, and other features shall be fully and completely compatible with the existing GPRS network currently in use. The existing GPRS network utilizes the AT&T Wireless (now Cingular) cellular system (band compatible with this modem), the AirLink Raven GPRS modem, and the AirLink Gateway. The Contractor shall demonstrate the compatibility to the Engineer by actual installation demonstration or by other means approved by the Engineer.

Installation

The installation of the modem shall be according to the plans, the manufacturer's instructions, and adjusted per field conditions with the Engineers approval.

POWER SUPPLY

The power supply shall be vertically mountable on a 19-inch standard rack rail using two machine screws and two wing nuts. The power supply shall have provisions to attach the modem power cable securely without the need for modifying the modem power cable.

The power supply shall meet the following requirements:

Power Cord	Standard 120 V(ac), 3 prong cord, at least 40 inches in length (may be added by Contractor)
Type	Switching mode type
Power Rated	40 W minimum with no minimum load required
Operating Temperature Range	From -30 °C to +70 °C
Operating Humidity Range	From 5 percent to 95 percent non-condensing
Input Voltage	From 85 V(ac) to 264 V(ac) or 120 V(dc) to 370 V(dc)
Input Frequency	From 47 Hz to 63 Hz
Inrush Current	Cold start, 25 A at 115 V
Output Voltage	12 V(dc), adjustable over a ±10 percent range
Overload Protection	From 105 percent to 150 percent in output pulsing mode
Over Voltage Protection	From 115 percent to 135 percent of output voltage
Setup, Rise, Hold Up Time	800 ms, 50 ms,15 ms at 115 V(ac)
Withstand Voltage	I/P-0/P:3 kV, I/P-FG:1.5 kV, for 60 seconds
Working Temperature*	70°C@30% RH
Safety Standards	UL 1012, TUV EN60950
EMC Standards	EN55022 Class B, EN61000-4-2, 3, 4, 5 and EN61000-3-2, 3

Note: A substitute may be proposed by the Contractor which meets the 70°C environmental rating at a lower load percentage as long as the temperature rating is maintained at the maximum modem load and all other electrical specifications are met.

MODEM MOUNTING BRACKET AND HARDWARE

The mounting bracket and hardware shall be stainless steel. The mounting bracket shall securely hold the modem in a vertical attitude with all cables and conductors installed. The mounting bracket shall contain the modem using a method that allows the removal of the modem without tools or without removing the bracket from its attachment to the cabinet frame.

COMMUNICATION SERIAL CABLE – TYPE D

Where the modem is designed to interface with a Model 170 controller, the Contractor shall provide a communication cable known as the C2 cable. The C2 cable shall interface the Model 170 controller C2 connector and the GPRS modem and include all conductors and connectors required for that purpose. The GPRS modem connector shall meet EIA-232 standard using a 9 pin Type D connector. The Model 170 controller end connector shall comply with AMP 201360-2-ND or equivalent. All pins in both connectors shall be gold plated. The cable shall have four No. 20 AWG conductors with (UL) Type CM shielded or AWM 2464 80C 300 Volts – C (UL) CMG. The cable shall be at least 3 feet long. The cable wiring shall comply with the following:

AMP 201360-2-ND -L to DB9-P - 2
AMP 201360-2-ND -K to DB9-P - 3
AMP 201360-2-ND -N to DB9-P - 5
AMP 201360-2-ND -D to AMP 201360-2-ND - H
AMP 201360-2-ND -J to AMP 201360-2-ND - M

ANTENNA

The antenna shall be the low profile disc type, and shall adhere to the cabinet using a factory installed double-sided waterproof acrylic foam adhesive. The coax cable shall be at least 40 inches in length and shall have a 50 Ω TNC connector on the modem end. In addition, the antenna shall meet the following requirements:

VSWR (at resonant point)	2:1 or less
Frequency	1850-1990 MHz and 824-894 MHz
Nominal Impedance	50 Ω
Gain	2 dB
Radiation Pattern	Omni-directional
Polarization	Vertical
Ground Plane Required	Yes, see note below

Ground plane requirements: The antenna shall require a reflective ground plane to function properly. The required ground plane shall extend beyond the antenna at least 8 inches in all directions.

Certificate of Compliance

The Contractor shall provide the Engineer with a Certificate of Compliance from the manufacturer in accordance with the provisions of Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for all of the modems furnished for the project.

Warranty

The manufacturer shall provide a written warranty against defects in materials and workmanship for modems and power supplies for a period of 12 months after installation for parts and labor. Replacement modems and power supplies shall be provided within 5 days after receipt of failed modem and power supply at no cost to the State, except the cost of shipping the failed modem and power supply. All warranty documentation shall be given to the Engineer prior to installation. Replacement modems and power supplies shall be delivered to Caltrans Maintenance Electrical Shop at 30 Rickard Street, San Francisco, CA 94134.

The software warranty shall be for one (1) year, including upgrades and feature enhancements.

10-3.26 SERVICE MANUAL REQUIREMENTS

The Contractor shall provide to the Engineer a minimum of 5 copies of service manuals for the integrated camera unit, camera control unit (CCU), and video encoder unit (VEU) under these special provisions. Each manual shall contain the following sections and sub-sections.

GENERAL INFORMATION SECTION

a. A list of applicable subassemblies that comprise the specified equipment.
b. Overall description of the equipment design features (including all enhance features if applicable), performance, and applications.
c. Equipment specifications summary.
d. Equipment installation instructions.

THEORY OF OPERATIONS SECTION

a. Theory of operation of the standard equipment, with unique or unusual circuitry described in detail.
b. Theory of operation reflecting any modifications to the standard equipment.

MANINTENANCE SECTION

a. Recommended test equipment and fixtures, or minimum operational and performance requirements for appropriate test equipment.
b. Trouble shooting information and charts.
c. Removal and installation procedures for replacing assemblies and subassemblies, if not obvious or if improper sequencing of steps may result in component damage.

REPLACEMENT PARTS SECTION

a. Each manual shall contain an equipment replacement parts list including electrical parts, mechanical parts and assemblies.
b. All semiconductors shall be identified by the supplier's numbers and by Joint Electron Device Council (JEDEC) numbers if applicable.

DIAGRAM SECTION

a. Schematic diagram(s) identifying all circuit components and showing normal test voltages and levels.
b. An overall functional block diagram.
c. Detailed interconnecting diagram(s) showing wiring between modules, circuit boards and major components.
d. Pictorial circuit board layout diagram(s) showing both component placement and printed wiring detail.
e. Diagram(s) showing location of circuit boards and other subassemblies.
f. Exploded view diagram(s) of complex mechanical assemblies.

PHYSICAL REQUIREMENTS

a. All pages, including latest revisions, shall be securely fastened together between protective covers (loose-leaf ring binding is acceptable).
b. No page shall be subject to fading from exposure to any normal source of ambient lighting (ozalid reproduced pages are not acceptable).

10-3.27 TRAFFIC OPERATIONS SYSTEM EQUIPMENT TESTING

Prior to shipping to the project, the Contractor shall submit the following items to the State of California, Department of Transportation Laboratory, 5900 Folsom Blvd, Sacramento, CA 95819 for acceptance testing:

1. Integrated Camera Unit
2. Camera Control Unit (CCU)
3. Video Encoder Unit (VEU)
4. High Mast Camera Lowering Device System
5. Fiber Optic Transmitter And Receiver
6. Variable Message Sign (VMS) Panels
7. Remote traffic microwave sensor (RTMS) system

Approximately 30 days will be required for the testing. The Contractor will be notified upon completion of the testing and shall arrange for delivery of the equipment to a storage location designated by the Contractor. The Contractor is responsible for the costs of such testing and the transportation to and from the Laboratory.

In addition to the above items, the Contractor shall submit all additional equipment listed elsewhere in these special provisions to the Laboratory for acceptance testing.

Approximately 30 days will be required for the testing. Upon satisfactory completion of the testing, the Contractor shall pick up the equipment from the Laboratory and deliver to a State-owned storage location designated by the Engineer.

The contract lump sum price paid for traffic operations system at various locations shall include full compensation for furnishing all labor, materials (except items covered by other bid items), tools, equipment, and incidentals, and for doing all the work involved in installing traffic operations system, complete in place, including all the foundations (except for the changeable message sign), poles, manuals and testing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract unit price paid for the additional equipment as specified in these special provisions shall be paid for under separate bid items.

The contract unit price paid for each of the following items shall include full compensation for furnishing all materials, tools, equipment, and incidentals, as shown on the plans, as specified in these special provisions, and as directed by the Engineer:

1. Integrated Camera unit
2. Camera control unit (CCU)
3. Video encoder unit (VEU)
4. Dial-up modem
5. Extinguishable message sign radio controller assembly
6. Extinguishable message sign panel (LED)
7. Extinguishable message sign panel
8. Highway advisory radio system
9. General packet radio system (GPRS) wireless modem assembly
10. Master traffic controller unit (MTCU)
11. Analog video routing switcher (AVS -including training)
12. Access node
13. Channel service unit/ data service unit (CSU/DSU)
14. Short haul modem (SHM)

15. Fiber optic transmitters and receivers (FOTS/FORS)
16. Multimode fiber optic transmitters and receivers (MMFORS/MMFOTS)
17. Fiber optic data modem (FODM)
18. Uninterruptible power system (UPS)
19. Maintenance bypass switch (MBS)
20. Long Lead-in cable Loop Detector (LLLD) sensor unit
21. Video image processing system (VIPS)
22. Video monitor
23. Analog data station termination (ADST)

10-3.28 VARIABLE MESSAGE SIGN SYSTEM

Variable message sign (VMS) panels and controller assemblies without cabinet will be State-furnished as provided under "Materials" of these special provisions.

The work to be done at VMS system, as shown on the plans, as a minimum, shall consist of the following:

1. Install VMS panels on the wood post 500' upstream of Portal No.1 of the SB Battery Tunnel and at the structural section of Portal No. 2 of the SB Battery Tunnel.
2. Furnish and install NEMA 3R enclosure, conduits and conductors on the wood post 500' upstream of Portal No.1 of the SB Battery Tunnel and at the structural section of Portal No.2 of the SB Battery Tunnel.
3. Install VMS Controller Assembly on the wood post 500' upstream of Portal No.1 of the SB Battery Tunnel and at the structural section of Portal No.2 of the SB Battery Tunnel. Provide all associated conductors, cables and conduits.

10-3.29 VARIABLE MESSAGE SIGN CONTROL CABLE

The variable message sign control cable (VCC) shall be a Category 5E cable and shall be the unshielded, outdoor rated, non-gel filled type, and shall meet the requirements of TIA/EIA 568B.2, Category 5E Cable, and the following:

A. The cable shall contain 8 conductors, each of which shall be No. 24 , minimum, solid bare copper conductors. Each conductor shall be insulated with polyolefin, polyethylene, polyvinyl chloride or fluorinated ethylene propylene material. Conductors shall be in twisted pairs. Color coding shall distinguish each pair: blue, blue/white; brown, brown/white; green, green/white; orange, orange/white.
B. The cable jacket shall be rated for a minimum of 300 V and 60°C and shall be polyvinyl chloride, polyethylene, polyolefin or fluorinated ethylene propylene. The jacket shall be black, gray, or blue. The jacket shall be marked as required by NEMA. The jacket shall be marked at not more than every meter with the cable identification: manufacturer's name, product identification, number of conductors and conductor size, and voltage and temperature ratings. Cable length markings may be sequentially alternated with the cable identification markings at not more than every other meter.
C. The finished outside diameter of the cable shall not exceed ½".
D. The cable run between components shall be continuous without splices. A minimum of three feet of slack shall be provided at each pull box, junction box or vault, and a minimum of ten feet at each cabinet. The ends of each Category 5E cable shall be terminated with appropriate RJ-type connectors as necessary to connect the equipment shown on the plans, or shall be terminated with crimped and soldered spade type terminals at terminal blocks where shown on the plans.
E. Category 5E Certified installations are required for installed lengths of less than 330 feet of finished cable.

10-3.30 REMOVING, REINSTALLING OR SALVAGING ELECTRICAL EQUIPMENT

Salvaged electrical materials shall be hauled to Caltrans Electrical Station, 30 Rickard Street, San Francisco, CA 94134, (415) 330-6500 and stockpiled.

The Contractor shall provide the equipment, as necessary, to safely unload and stockpile the material. A minimum notice of 2 business days shall be given prior to delivery.

10-3.31 PAYMENT

The contract lump sum price paid for signal and lighting shall include highway lighting at intersections in connection with signals only.

Other roadway lighting on the project shall be considered as included in the contract lump sum price paid for lighting and sign illumination.

Full compensation for hauling and stockpiling electrical materials shall be considered as included in the contract price paid for the item requiring the material to be salvaged and no additional compensation will be allowed therefor.

If any of the fabrication sites for the materials listed are located more than 300 air line miles from both Sacramento and Los Angeles, additional shop inspection expenses will be sustained by the State. Whereas it is and will be impractical and difficult to determine the actual increase in these expenses, it is agreed that payment to the Contractor for furnishing these listed materials from each fabrication site located more than 300 air line miles from both Sacramento and Los Angeles will be reduced $2,000:

1. Variable message signs
2. Service equipment enclosure
3. Closed circuit television cabinets furnished by the Contractor

The contract lump sum price paid for traffic operations system shall include full compensation for furnishing all labor, materials (except items covered by other bid items), tools, equipment, and incidentals, and for doing all the work involved in installing traffic operations system, complete in place, including all the foundations), poles, manuals and testing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract lump sum price paid for base camera system shall include full compensation for furnishing all labor, materials (except items covered by other bid items), tools, equipment, and incidentals, and for doing all the work involved in installing base camera system, complete in place, including all the foundations, poles, manuals and testing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract lump sum price paid for high voltage conduit shall include full compensation for furnishing all labor, materials (except items covered by other bid items), tools, equipment, and incidentals, and for doing all the work involved in installing high voltage conduit, complete in place, including all the foundations, poles, manuals and testing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The contract unit price paid for the additional equipment as specified in these special provisions shall be paid for under separate bid items.

The contract unit price paid for each of the following items shall include full compensation for furnishing all materials, tools, equipment, and incidentals, as shown on the plans, as specified in these special provisions, and as directed by the Engineer:

1. Integrated Camera unit
2. Camera control unit (CCU)
3. Video encoder unit (VEU)
.4. General packet radio system (GPRS) wireless modem assembly
8. Power Strip

10-3.32 BATERY SUBSTATION AND TUNNEL WORK

Install electrical apparatus as called for in basic materials and methods, electrical equipment, grounding, fiber optic, Ethernet networking, serial communications, substation lighting, SCADA, fire alarms, carbon monoxide monitoring, and power distribution as shown on the plans as specified by these special provisions and as directed by the Engineer.

ABBREVATIONS

The following abbreviations are added to those listed in Section 1-1.02, “Abbreviations of the standard Specifications:

24/7	Twenty - Four Hours a Day, Seven Days a Week
AC	Alternating Current
ACL	Access Control List
ALM	Alarm
ARP	Address Resolution Protocol
ATA	Advanced Technology Attachment
BELLCORE	Bell Communications Research
BER	Bit Error Rate
BERT	Bit Error Rate Test
BFOC	Bayonet Fiber Optic Connector
BGP	Border Gateway Protocol
BIOS	Basic Input/ Output System
BIT	Binary Digit
BNC	Bayonet Nut Connector
BootP	Bootstrap Protocol
bps	Bits Per Second
BTU	British Therml Unit
CA	California
CBC	Cipher Block Chaining
CBEMA	Computer and Business Equipment Manufacturers Association
CCITT	International Telegraph And Telephone Consultative Committee
CD or cd	Compact Disc or candelas
CDMA	Code Division Multiple Access
CD-ROM	Compact Disc – Read Only Memory
CDRW	Compact Disc Rewritable
CE	Consumer Electronics
CFR	Code of Federal Regulations
CHAP	Challenge Handshake Authentication Protocol
CIR	Committed Information Rate
CLI	Command Line Interface
CoS	Class of Service
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CRT	Cathode Ray Tube
CSA	Canadian Standards Association
CSMA/CD	Carrier Sense Multiple Access / Collision Detection
C-UL	Canadian Underwriters Laboratories
CWDM	Coarse Wavelength Division Multiplexing
D	Depth
dB	Decibel
dBA or dBa	Decibels adjusted
dBd	Decibels dipole
dBi	Decibels isotropic
dBm	Decibels to a milliwatt reference
DC	Direct Current
DCE	Data Circuit-terminating Equipment
DDC	Display Data Channel
DDC1	Display Data Channel One
DDR	Double Data Rate
DES	Data Encryption Standard
DHCP	Dynamic Host Configuration Protocol
DIMM	Dual In-Line Memory Module
DIN	Deutsche Industrie Norm
DNS	Domain Name System
DOS	Disk Operating System
DPMS	Digital Power Management Signaling or Display Power Management Support.

DRAM	Dynamic Random Access Memory
DSC	Duplex Straight Connector
DSSS	Direct SequenceSpread Spectrum
DTE	Data Terminal Equipment
DVD	Digital Video Disc
ECC	Error Correction Code
Ed	Edition
EEMAC	Electrical Equipment Manufactures Advisory Council
EEPROM	Electrically Erasable Programmable Read Only Memory
EGP	Exterior Gateway Protocol
EIDE	Enhanced Integrated Drive Electronics
EIGRP	Enhanced Interior Gateway Routing Protocol
EMI/RFI	Electromagnetic Interference/Radio Frequency Interference
EN	European Norm
EPA	Environmental Protection Agency
ESO	Electrical Safety Orders of the Division of Industrial Relations, State of California
fc	Cutoff Frequency, carrier frequency, center frequency
FCC	Federal Communications Commission
FCS	Field Control Station
FDDI	Fiber Distributed Data Interface
FEP	Fluorinated Ethylene Propylene
FHSS	Frequency Hoping Spread Spectrum
FIPS	Federal Information Processing Standard
FOTP	Fiber Optic Test Procedure(s) as defined by TIA/EIA-455 standards.
FSK	Frequency Shift Keying
FTP	File Transfer Protocol
G	Gravity
GB	Gigabytes
Gbps	Gigabit Per Second
GFCI	Ground Fault Current Interrupter
GND	Ground
GRMS	Gravity Root Mean Square
GRS	Galvanized Rigid Steel
H	Height
H/V	Horizontal/Vertical
HMI	Human Machine Interface
HSRP	Hot Standby Routing Protocol
Hsync	Horizontal Sync
HTML	Hyper Text Markup Language
HTTP	Hyper Text Transfer Protocol
HV	High Voltage
I/O	Input /Output
IAONA-EU	Industrial Automation Open Networking Alliance-Europe
ICEA	Insulated Cable Engineering Association
ICMP	Internet Control Message Protocol
IDC	Insulation Displacement Connector
IDE	Integrated Drive Electronics
IEC	International Electrotechnical Commission
IETF	Internet Engineering Task Force
IGMP	Internet Group Management Protocol
IGP	Interior Gateway Protocol
IGRP	Interior Gateway Routing Protocol
IKE	Internet Key Exchange
IP	Internet Protocol
IP-##	Ingress Protection (IP) Rating
IPSEC	Internet Protocol Security

IPX	Internetwork Packet Exchange
IR	Infrared
IRDA	Infrared Data Association
ISA	Instrumentation Society of America
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
IT	Information Technology
ITU – T	International Telecommunications Union – Telecommunication
JEDEC	Joint Electron Device Engineering Council
JIS	Japanese Industrial Standard
kb	Kilobit
kB	Kilobyte
k bps	Kilobits Per Second
kHz	Kilohertz
KVM	Keyboard, Video, Mouse
kW	Kilowatt
LAN	Local Area Network
LCD	Liquid Crystal Display
LDAP	Lightweight Directory Access Protocol
LED	Light Emitting Diode
mA	Milliampere
MAC	Media Access Control
MAN	Metropolitan Area Network
MB	Megabyte
Mbps	Megabits Per Second
MIB	Management Information Base
MIS	Management Information System
MPH or m.p.h	Miles per hour
Mpps	Million packets per second
ms	millisecond
MTBF	Mean Time Between Failures
mm	millimeter
mV	Millivolt
MV	Medium Voltage
mW	Milliwatt
NAT	Network Address Transformation
NEC	National Electrical Code
NETA	International Electrical Testing Association Inc.
NEXT	Near End Cross Talk
NFPA	National Fire Protection Association
NIC	Network Interface Card
NTSC	National Television Systems Committee
O.D.	Outside Diameter
OEM	Open Equipment Manufacturer
OLE	Object Linking and Embedding
OSD	On Screen Display
OSHA	Occupational Safety and Health Administration
OSI	Open Systems Interconnect
OSPF	Open Shortest Path First
OTDR	Optical Time Domain Reflectometer
PLC	Programmable Logic Controller
PAP	Password Authentication Protocol
PC	Personal Computer
PCI	Peripheral Component Interface
PDU	Protocol Data Unit
PE	Potential Earth
pF	Pico Farad

PLC	Programmable Logic Control
p-p	Peak to Peak
PPP	Point - to - Point - Protocol
PPS	Packets Per Second
PUB	Publications
PVC	Polyvinyl Chloride
PWR	Power
QoS	Quality of Service
RADIUS	Remote Authentication Dial In User Service
RAID	Redundant Arrays of Inexpensive Disks
RAM	Random Access Memory
RARP	Reverse Address Resolution Protocol
RDRAM	Rambus Dynamic Random Access Memory
REA	Rural Electrification Administration
RFC	Request For Comments
RGB	Red – Green – Blue (color model)
RH, or R.H.	Relative Humidity
RIP	Routing Information Protocol
RMON	Remote Network MONitoring
RMS	Root Mean Square
ROM	Read Only Memory
RPM	Revolution Per Minute
RS	Recommended Standard
RSVP	Resource ReSerVation set up Protocol
RTD	Resistance Temperature Detector
RTP	Real - Time Protocol
RTU	Remote Terminal Unit
RU or U	Rack Unit
Rx	Receiver (port #)
SATA	Serial Advanced Technology Attachment
SC	Straight Connector
SCADA	Supervisory Control And Data Acquisition
SCSI	Small Computer Systems Interface
SDRAM	Synchronous Dynamic Random Access Memory
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SOHO	Small Office Home Office
SQL	Structured Query Language
SRTP	Service Request Transfer Protocol
SSH	Secure Shell (protocol)
SSL	Secure Sockets Layer
STP	Shielded Twisted Pair
SVGA	Super Video Graphic Array
TCP	Transmission Control Protocol
TELCO	Telephone Company
Tf	Time Fall
TFT	Thin Film Transistor
TFTP	Trivial File Transfer Protocol
THD	Total Harmonic Distortion
TIA	Telecommunications Industry Association
TP	Twisted Pair
Tr	Time Rise
TTL	Time To Live
Tx	Transmitter (port #)
UDP	User Datagram Protocol
µm	Micrometers
UPS	Uninterruptible Power Supply

URL	Uniform Resource Locator
µs	microseconds
USB	Universal Serial Bus
UTP	Unshielded Twisted Pair
V. Or v.	Version #
VA	Volt-Ampere
VCCI	Video Codec Communication Interface
VDC or V(dc)	Volts DC
VESA	Video Electronics Standards Association
VGA	Video Graphics Array
VLAN	Virtual LAN
VME	Versa Module Eurocard
VPN	Virtual Private Network
VRMS	Volts Root Mean Square
VRRP	Virtual Redundant Router Protocol
VSWR	Voltage Standing Wave Ratio
VSYNC	Vertical Sync
WAN	Wide Area Network
WFQ	Weighted Fair Queuing
WLAN	Wireless LAN
WSXGA	Wide Super Extended Graphics Array
WWW	World Wide Web
XGA	Extended Graphics Array
YBI	Yerba Buena Island

Any abbreviation shown in the special provisions and not listed above, or any conflict between the abbreviations in this section and the abbreviations shown elsewhere in these special provisions shall be defined or resolved by the Engineer

BASIC MATERIALS AND METHODS

SUBMITTALS

Product Data:

Manufacturer's descriptive data shall include catalog cuts, complete description, performance data and installation instructions for the materials and equipment specified herein.

PRODUCTS

Conduits and Fittings

Galvanized Rigid Steel Conduit, Threads, Couplings and Elbows

A. The conduit, threaded couplings, and elbows shall conform to the Federal Specification WW-C581E, UL standard Number 6, and ANSI specification C80.1. The conduit, threaded couplings, and/or elbows zinc surfaces shall remain intact and undistributed on both the inside and outside throughout the preparation and application processing.
B. The conduit, threaded couplings, and/or elbows shall be hot dipped galvanized inside and out after fabrication with hot dipped galvanized threads. The zinc coating for conduit, threads couplings, and/or elbows will be tested in accordance with ASTM designation: A239.
C. The hot dipped galvanized threads for conduits and/or elbows shall be coated with urethane.
D. The hot dipped galvanized threads for threads coupling shall have an urethane coat of a normal thickness of 50 micron.
E. The conduit, threaded couplings and or elbows interior shall have an urethane coat of nominal thickness of 50 micron.
F. The conduit shall be bendable without damage to the interior urethane coating.

Polyvinyl Chloride Coated Galvanized Rigid Steel Conduit

A. All PVC coated RGS conduit, threads couplings, and elbows shall conform to NEMA standards No. RN-1. The bond between the coatings and the metal shall be greater than the tensile strength of the coatings.
B. All PVC coated RGS threaded couplings exterior shall have a urethane coating of nominal thickness of 50 micron before the PVC coating is applied.

C. All PVC coated GRS conduit, threads couplings, and elbows shall have an exterior PVC coating of with a minimum of thickness of 0.040" applied by the dipping longitudinal ribs to enhance installation. All hubs on PVC coated GRS threaded couplings shall have a PVC sleeve extending one pipe diameter or 53 mm, whichever is less. The I.D. of the sleeve shall be equal to the O.D of the uncoated pipe.
D. The PVC coated GRS shall be bendable without damage to the exterior PVC coating.

Polyvinyl Chloride Coated Galvanized Rigid Steel Conduit Bodies

A. The PVC-coated galvanized rigid steel conduit bodies shall conform to Federal Specification W-C-586D, and UL standard Number 514B. The PVC-coated galvanizes rigid steel conduit bodies zinc surfaces shall remain intact and undistributed on both inside and outside throughout the preparation and application processing.
B. The PVC-coated galvanized rigid steel conduit shall be hot dipped galvanized inside and outside after fabrication with hot dipped galvanized threads. The zinc coating for PVC-coated galvanized rigid steel conduit bodies will be tested in accordance with ASTM Designation: A239.
C. The hot dipped galvanized threads, the exterior and interior for PVC-coated galvanized rigid steel conduit bodies shall have a urethane coated of nominal thickness of 50 micron.
D. The PVC-coated galvanized rigid steel conduit bodies shall conform the following requirements when the PVC coating is applied:

1. All PVC-coated galvanized rigid steel conduit bodies shall conform to NEMA standard No. RN-1.
2. The bond between the coatings and the metal shall be greater than tensile strength of the coatings.
3. All PVC-coated galvanized rigid steel conduit bodies shall have an exterior PVC coating of a minimum thickness of 1 mm applied by dipping in liquid plastisol.
4. All hubs on PVC-coated galvanized rigid steel conduit bodies shall have a PVC sleeve extending one pipe diameter or 53 mm, whichever is less. The I.D. of the sleeve to be equal to the O.D. of the uncoated pipe.
5. Stainless steel encapsulated screws shall be supplied with all form 7 bodies shall form a gasket-like flange of at least 8 mm wide and 1 mm thick covering the top of the conduit body around the opening.
6. The PVC coating on all form 8 conduit body covers shall form a gasket-like flange of at least 8 mm wide and 1 mm thick covering at the bottom of the cover and mating with the flange of the conduit body.
7. All PVC-coated galvanized rigid steel conduit bodies for conduits less than 4" shall be form 7 conduit bodies.

Type 4 Conduit

The Type 4 conduit shall be Non-polyvinyl chloride jacketed liquidtight flexible metal conduit that shall meet the following specifications:

Combustion and Flammability Properties	Test	Value
1) Vertical Burn (Material)	UL94	V-0 Rating No flaming drips
2) Vertical Burn (Conduit)	UL360	Pass No flaming drips
3) Oxygen Index percent	D2863	28.5
4) Flame Spread Index	ASTM E162	4.0 No flaming drips
5) Flame Propagation	ASTM C542	Pass (NFPA-130) No flaming dips
6) Smoke Generation (Flaming)	ASTM E662 (NFPA 258)	Ds 41 @ 1.5 Min Ds 94 @ 4.0 Min
7) Smoke Generation (Non-Flaming)	ASTM E662 (NFPA 258)	Ds 7 @ 1.5 Min Ds 45 @ 4.0 Min
8) Toxic Gas Generation	BOMBARDIER SMP 800-C	Pass
9) Toxicity Index	NES 713	3.9

The Type 4 conduit shall have a flexible inner core made from a spiral wound strip of heavy gauge, hot-dipped galvanized steel. Type 4 conduit trade sizes of less than shall contain an integral bonding strip of copper. Type 4 conduit trade sizes of or larger shall be designed with a fully interlocked strip. The Type 4 conduit outer jacket shall be a thermoplastic black polyurethane jacket that shall have excellent flame resistance and low smoke and toxicity generation characteristics. In addition, the Type 4 conduit outer jacket shall be resistant to ozone, hydrocarbons, moderate chemicals, oils and fuels. The Type 4 conduit shall conform to ANSI/UL-360 for liquidtight flexible steel conduit. The working temperatures for the Type 4 conduit shall be –40ºC to 80ºC in air/ 60ºC wet/ 70ºC in Oil.

Cables and Conductors

The RHW-2 type cable shall be an ethylene propylene rubber insulation per ICEA S-95-658, NEMA WC 70 and UL Standards 44 and 854: with a chlorosulfonated polyethylene (CSPE) jacket per ICEA S-95-658 for CSPE and UL Standards 44 and 854: and with a tin coating per ASTM B-33 annealed Class B compressed stranded copper conductor per ASTM B-8. The maximum voltage rating shall be 600 V(ac). The RHW-2 type cable shall also pass both IEEE 383 (70,000 BTU) for sizes #1 or smaller conductors, and ICEA T-29-210 (210,000 BTU) for sizes #1/0 or larger conductors flame tests. The cable shall be indicated on the plans with the word "RHW-2" in parenthesis shown next to the conductor size (To indicated the size of the RHW-2 cable).

Control Cable

The control cables such as but not limited to the following cables as shown on the plans:

A. 1-30#14 Conductor Cable (Use for 12 kV Controls)
B. 1-25#14 Conductor Cable (Use for 12 kV Controls)
C. 1-37#14 Conductor Cable (Use for 12 kV Controls)
D. 1-40#18 Conductor Cable (Use for SCADA Control and Indication)
E. 1-50#18 Conductor Cable (Use for SCADA Control and Indication)
F. 1-4#8 Conductor Cable (Use for 12 kV Controls)
G. 1-4#6 Conductor Cable (Use for 12 kV Controls)
H. 1-2#8 Conductor Cable (Use for 12 kV Controls)
I. 1-2#6 Conductor Cable (Use for 12 kV Controls)
J. 1-6#14 Conductor Cable (Use for 12 kV Controls)
K. 1-4#18 Conductor Cable (Use for SCADA Control and Indication)
L. 1-18#18 Conductor Cable (Use for SCADA Control and Indication)
M. 1-14#18 Conductor Cable (Use for SCADA Control and Indication)

Shall be a 600 Volt multi-conductor tin coating per ASTM B-33 copper tray cable with a Cross-linked polyethylene (XLPE) Insulation and with a Chlorinated Polyethylene (CPE) Jacket. The number (Number before the dash shall indicate the number of cables and the number after the dash shall indicate the number of conductors in the cable) and size of the cable shall be as shown on the plans.

Electrical Boxes

Stainless Steel Continuous Hinge NEMA Type 4X Junction Box

The stainless steel continuous hinge NEMA type 4X Junction Box shall be a NEMA type 4X 316L stainless steel "CHNFSS" junction box with a continuous hinge use for housing electrical components in highly corrosive environments that shall meet the following:

CONSTRUCTION
A. 16 or 14 gauge stainless steel
B. Seams continuously welded and ground smooth
C. Seamless foam-in-place gasket assures watertight and dust-tight seal
D. Stainless steel screws and clamps assure watertight seal
E. Stainless steel panel screws (#10-32 pan head)
F. Stainless steel continuous hinge pin
G. Door removed by pulling hinge pin
H. Weld nuts provided for mounting steel panel
I. Left side to be hinged
J. Dimensions as shown on the plans

ACCESSORIES
Corrosion Inhibitors
14 gauge steel panel

FINISH
The enclosures shall be unpainted unless otherwise specified.
Cover and sides of body shall have smooth brushed finish.
The steel panel shall be painted white.

INDUSTRY STANDARDS
UL 508 Type 4, Type 4X, and Type 12
NEMA/EEMAC Type 4, Type 4X, Type 12, and Type 13
ANSI/IEC 60529, IP66

Outlet Box

The outlet box shall be a two gang outlet box. The outlet box shall have the following specifications:

GENERAL
A. Capacity (Cu.-in.): 32.0
B. Dimensions (L x W x D): 4.56" L x 4.58"W x 2.0"D
C. Description: Standard
D. Material: Steel

ADDITIONAL EQUIPMENT
The Contractor shall provide a steel cover with screws and assemble each outlet box.

Type 15 Pull Box

The Type 15 pull box shall conform to the Western Underground Committee Recommended Guide No 3.6, "Non-Concrete Enclosures" or latest equal guide. The Type 15 pull box shall be 4' wide x 4' long x 2' deep (nominal inside dimensions). The Contractor shall provide a minimum of three 2' extensions for each type 15 pull box. The Contractor shall provide a steel plate (Size as required for the separations of the power, communication and DC conductors and cables) for each Type 15 pull box in order to separate the power conductors and cables; and the communication and DC conductors and cables. The Contractor shall install the steel plate in the Type 15 pull box. The hold down bolts or cap screws and nuts of the type 15 pull box shall be of brass, stainless steel or other non-corroding metal material. Cover marking of the type 15 pull box shall be "ELECTRIC", "COMMUNICATION" or "DC" as required for the application. The type 15 pull box enclosures, covers and extension shall be concrete gray color.

Utility Pull Box

The utility pull box shall meet the following specifications below:

Enclosure Size:	1371.60 mm X 2590.80 mm X 1828.80 mm
Design Load:	A) Vertical Load shall be 44,092.45 Kg or greater per (ASTM C-857, Rating H-20, heavy traffic) B) Lateral Backfill Load: The enclosure shall be designed per the latest edition ASTM C-857 for full-traffic application.
Utility Company Standards:	Pacific Gas and Electric (PG&E) Document # 062000

Receptacles and Switches

Light Switch

The light switch shall be a heavy duty 3 or 4 way toggle switch used for lighting that shall meet the following specifications:

A. Type: 3 or 4 Way as shown on the plans
B. Style: Toggle
C. AC Current: 20 A
D. Voltage rating: 120-277
E. Rated HP: 1
F. Wiring method: Back or side
G. Color: ivory
H. Grade: Heavy duty industrial

ADDITIONAL EQUIPMENT
A. The Contractor shall provide an industrial grade one gang outlet box to house the Light Switch.
B. The Contractor shall provide an industrial grade one gang cover with an opening for the toggle of the light switch and screws.

INSTALLATION
The Contractor shall assembly the light switch with the one gang outlet box and the one gang cover; connect as shown on the plans; and mounted as shown on the plans.

Emergency Light Switch

The emergency light switch shall be a heavy duty toggle switch use for lighting that shall meet the following specifications:

SPECIFICATIONS

A. Type: One pole
B. Style: Toggle
C. AC current: 20 A
D. Voltage rating: 120-277
E. Rated HP: 1
F. Wiring method: Back or side
G. Color: Red
H. Grade: Heavy duty industrial
I. Pilot light: Included; pilot light on with load on

ADDITIONAL EQUIPMENT

A. The Contractor shall provide an industrial grade one gang outlet box to house the Light Switch.
B. The Contractor shall provide an industrial grade one gang cover with an opening for the toggle of the light switch and screws.

INSTALLATION
The Contractor shall assembly the emergency light switch with the one gang outlet box and the one gang cover; connect as shown on the plans; and mounted as shown on the plans.

Duplex Receptacle

The duplex receptacle shall be a heavy-duty duplex receptacle that shall meet the following specifications:
B. NEMA Configuration: 5-15R
C. AC current: 15 A
D. Voltage rating: 125 V
E. Rated HP: 1/2
F. Number of wires: 3
G. Wiring method: Back or side
H. Color: ivory
I. Grade: Heavy duty industrial

ADDITIONAL EQUIPMENT

A. The Contractor shall provide an industrial grade one gang outlet box to house the duplex receptacle.
B. The Contractor shall provide an industrial grade one gang cover with an openings for the receptacles of the duplex receptacle and screws.

INSTALLATION

The Contractor shall assembly the duplex receptacle with the one gang outlet box and the one gang cover; connect as required for proper operation; and mounted as shown on the plans.

Miscellaneous Materials

12" X 12" Wireway

The 12" X 12" Wireway shall be a 12" x 12" NEMA 1 lay-in wireway that shall meet the following specifications:

FEATURES

A. Flat Cover Design
B. Open top assembly
C. Without knockout
D. Keyhole screw slots on covers

SPECIFICATIONS

A. 16 or 14 gauge galvanized steel covers and bodies
B. Dimensions: 12"W x 12"H x Length as shown on the plans

Finish: Unpainted galvanized steel

Industry standards

A. UL 870 Listed
B. NEMA/EEMAC: Type 1
C. ANSI/IEC 60529, IP30

The Contractor shall provide and install a cover with stainless steel screws for the 12" X 12" Wireway.

Wire Trough

The wire trough shall be a lightweight, temperature and chemical resistant fiberglass trough that shall designed for use in corrosive or dirty indoor or outdoor applications and shall meet the following:

GENERAL

A. Flammability rating of UL 94-5V
B. UL cold impact test for temperatures to –31 ºF
C. NEMA Type 12 and Type 3R
D. ANSI/IEC 60529, IP55
E. Recognized by NEC for indoor and outdoor applications

FEATURES

A. Seams are sealed
B. No holes or knockouts
C. Captivated Monel cover screws
D. Oil-resistant gasket attached with oil-resistant adhesive

SPECIFICATIONS

A. Pultruded fiberglass polyester bodies and covers
B. Finished fiberglass wireway is gray inside and out
C. Dimension (H x W x D): 6” x 6” x 60”

The wire trough shall be a lightweight, temperature and chemical resistant fiberglass trough that shall designed for use in corrosive or dirty indoor or outdoor applications and shall meet the following:

GENERAL

A. Flammability rating of UL 94-5V
B. UL cold impact test for temperatures to –31 ºF
C. NEMA Type 12 and Type 3R
D. ANSI/IEC 60529, IP55
E. Recognized by NEC for indoor and outdoor applications

FEATURES

A. Seams are sealed
B. No holes or knockouts
C. Captivated Monel cover screws
D. Oil-resistant gasket attached with oil-resistant adhesive

SPECIFICATIONS

A. Pultruded fiberglass polyester bodies and covers
B. Finished fiberglass wireway is gray inside and out
C. Dimension (H x W x D): 6” x 6” x 60”

Plywood Backing Board

Plywood backing board for mounting electrical or telephone equipment shall be ¾-inch, APA plywood panels, C-D PLUGGED and touch-sanded, Exposure 1.

INSTALLATION

A. Plywood backing board shall be securely fastened to walls or other vertical framing.
B. Surface to be coated shall be cleaned of all dirt, excess materials, and filler by hand cleaning.
C. Exposed surfaces of plywood backing board shall be coated in conformance with the provisions in Section 59, "Painting," of The Standard Specifications. The color shall match surrounding surfaces, or shall be as directed by the Engineer.
D. Coatings shall be applied in conformance with the manufacturer's instructions. Each coat shall be applied to a uniform finish, free of skips, brush marks, laps or other imperfections.
E. Set cabinets plumb and symmetrical with building lines. Touch-up paint any marks, blemishes, or other finish damage suffered during installation. Replace cabinets, doors or trim exhibiting dents, bends, warps or poor fit that may impede ready access, security or integrity.

Nameplates

Nameplates shall be laminated phenolic plastic with white core and black front and back. Nameplate inscription shall be in capitals letters etched through the outer layer of the nameplate material. The character size shall be 1/4 inch unless otherwise noted.

The nameplates shall be fastened to the enclosure’s exterior surface using stainless steel rivets or stainless steel screws.

Warning Plates

Warning plates shall be laminated phenolic plastic with white core and red front and back. Warning plates inscription shall be in capital letters etched through the outer layer of the nameplate material. The character size shall be 3/8 inch unless otherwise noted.

The warning plates shall be fastened to the enclosure's exterior surface using stainless steel rivets or stainless steel screws.

Equipment Shelf with Brackets

The Contractor shall furnish and install each equipment shelf as shown on the plans.

Each shelf shall be furnished with 2 mounting brackets.

Each mounting bracket shall extend from the front to back mounting rails of the controller cabinet rack cage. Each bracket shall be designed to support a minimum of 50 lbs. The horizontal side of each bracket shall be a minimum of 3 inches. Each bracket shall be attached to front and rear of the rack cage with four (4) 10-32 stainless steel Phillips round head bolts.

Each shelf shall be fabricated of 0.125-inch cold rolled sheet or 0.125-inch aluminum sheet. Each shelf shall be the width of the control cabinet rack cage and 18 inches deep. Each shelf shall have equally distributed holes or slots throughout the shelf that shall provide 40 percent minimum open area for vertical flow-through ventilation. Each hole or slot shall not exceed 0.75-square inches in area. Each shelf shall be cadmium-plated or zinc-plated after cutting and drilling.

Each shelf shall be attached to the top of its pair of brackets in all four corners with stainless steel hardware, with the front of the shelf abutting against the front rail of the control cabinet rack cage.

Stainless Steel Power Stud Anchor Threaded Version

Stainless steel power-stud anchor threaded version shall have a one-piece anchor body shall have a one piece anchor body with length identification code. The anchor bodies shall be manufactured from type 316 stainless steel and shall have expansion mechanism, which consists of a pair of interlocking independent wedges.

Anchor Component	Component Material
Anchor Body	Type 316L Stainless Steel
Nut	Type 316L Stainless Steel
Washer	Type 316L Stainless Steel
Expansion Wedge	Type 316L stainless Steel

Wireways, Channel Struts, Steel Threaded Rods and Brackets

Wireways

The wireways shall meet NEMA 1 requirements and be UL listed. The 8" and 12" wireways shall be fabricated from 14 gauge steel, shall have an open side for lay-in of wiring with screw cover, and shall allow for concentric knockouts capable of handling conduits up to 53C.

All wireways shall have ANSI 61 gray enamel finish inside and out.

Wireways shall be grounded according to the provision of the NEC article 250 and installed according to the provision of NEC article 362.

Channel Struts

The channel strut shall be a 12 gauge hot-dipped galvanized rigid steel strut. The strut shall be coated with zinc after being roll-formed or after all manufacturing operations are completed, conforming to ASTM specification NO.A123 or A 153.

Steel Threaded Rods

The steel threaded rods shall be 41 mm width series channel type. The load carrying capacity of the threaded hot rolled steel shall conform to ASTM 575 and A576.

Brackets

The brackets shall be a 10 gauge hot dipped galvanized rigid steel bracket. The bracket shall be coated with zinc after being roll-formed or after manufacturing operations are completed, conforming to ASTM specification NO. A123 or A153. The face of mounting bracket for the luminaire shall be perpendicular to the plane of the roadway surface. Holes inn the tunnel lining, required for mounting tunnel lighting equipment, shall be drilled with rotary equipment, and the anchoring devices shall be relocated, and drilled holes filled with mortar.

Metal Junction Boxes

Metal junction boxes shall be UL listed for indoor or out door use as applicable, shall also meet NEC article 370 requirements. Junction boxes shall be fabricated from 16-gauge sheet metal and hot-dip galvanized after fabrication.

If used indoors, junction boxes shall meet NEMA type 1 enclosure requirements, have flat removable covers fastened with stainless steel screws, and have gray enamel finish.

If used outdoors junction boxes shall meet NEMA type 4 enclosure requirements, have coated ANSI 61 gray polyester powder finish inside and out over phosphatized surfaces. Doors are secured to the body with a heavy-duty continuous hinge on one side and easy -to-release stainless steel door clamps mounted to other three sides, and the door has a fixed, oil and water-resistant gasket.

Miscellaneous Metal

Miscellaneous metal shall consist of clamps, clamp fasteners, support channels and fittings, threaded conduit extensions, couplings, partitions, and other metal products required to connect, separate, or fasten cable, conduit, or other equipment in conformance with these Special Provisions. Unless otherwise specified in these Special Provisions, miscellaneous metals shall be in accordance with Section 75, "Miscellaneous Metal," of the Standard Specifications.

Other items may be standard commercial products specifically manufactured for the use in electrical installations and shall be galvanized in a manner consistent with the intended application.

Sealants and Compounds

Pulling Compound

All pulls totaling more than 20 meters, involving cables larger than #1/0, or incorporating bends totaling more than 180° shall have the conduit pre lubricated before pulling.

The pulling compound to be used shall be of the non-petroleum type. It may be factory prepared, or field mixed according to the manufacturer's specifications. The pulling compound shall be one of the ready-to-use types listed below, or the manufacturer's equivalent for field mixing:

American Cable Colloid Co. - Sli X-300
Cable Associates, Inc. - Gel-Lube 7/5
Generam Machine Products Co. - No. 7437-PC
Ideal Industries, Inc. - Aqua-Gel II or CW
Mac Products, Inc. - MacLube No. CA-51
Minerallac Electric Co. - Minerallac H-2B
Plymouth Rubber Co. - No. 45 Cable Pulling Lubricant
Polywater Corp. - "A", "G", "J", or "WJ"

Galvanic Inhibiting Compound

A suitable galvanic inhibiting compound shall be applied to the threads of conduits and fittings of devices, which are of dissimilar metals before connections are made.

Anti-Corrosion Compound

All terminations using lugs, terminal blocks, pressure connectors, or where the termination or conductor is exposed, shall be treated with an anti-corrosion compound. The anti-corrosion compound shall be manufactured specifically for use on electrical devices by a manufacturer that specializes in making compounds for electrical applications.

Silicone and Urethane Sealant Compounds

All silicone and urethane sealant compounds shall comply with the following:

Be manufactured specifically for sealing against water or waterproofing.
Provide a positive seal against water after curing.
Cures without shrinkage.
Normal use temperature from at or below -20°F to at or above +200°F.
Cures at room temperature.
Remain pliable after curing.
Completely cure within 72 hours.

Insulating Sealant

The Contractor shall install an insulating sealant into all holes, which are bored. The installation shall be between the conduit and the concrete or masonry. The insulation shall be installed per the plans. The insulation shall fill all voids within the bore, which is not taken up by the conduit. The insulation compound shall be the injected foam type, and shall have an expansion ratio of at least 3:1.

Concrete Anchors

Concrete anchors shall conform to the provisions in section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications.

All concrete anchors shall be of the internally threaded type, made entirely of Type 303 or Type 316 stainless steel. Luminaire mounting anchors shall be undercut type.

Concrete anchors securing conduits shall be 1/4" bolt size minimum, and the hole depth shall be 1-1/4" minimum.

Concrete anchors securing luminaires shall be 3/8" bolt size minimum, and the hole depth shall be 2-3/8" minimum. The anchor body must be consisting of an extension sleeve, a compressing ring, an expander sleeve and an expander cone at the end. The anchor shall be designed for vibration resistance. Other anchors shall be as depicted on the plans or manufacturer's specifications or otherwise spelled out in these Special Provisions.

Installation shall be per the manufacturer's instructions using tools and equipment recommended by the manufacturer.

Concrete anchors shall not protrude from the concrete.

ELECTRICAL EQUIPMENT

SUBMITTALS

Product Data:

Manufacturer's descriptive data shall include catalog cuts, complete description, performance data and installation instructions for the materials and equipment specified herein.

PRODUCTS

Panelboards

3 PHASE 480/277 V PANEL

The 3-Phase 480/277 V(ac) power distribution panel that shall meet the following specifications:

GENERAL

A. Wire: Four Wire
B. Bus: Copper

FEATURES

A. The box of the panel shall be made from code gauge galvanized steel.
B. The trims of the panel shall be made from code gauge galvanized steel and painted ANSI 61 gray.
C. The door of the panel shall have a single point lock.
E. The enclosure of the panel shall be NEMA type 12.
F. The top and bottom gutters of the panel shall be a minimum of 5.5".
G. The side gutters of the panel shall be a minimum of 6".
H. The total number of branch circuit poles including space of the panel shall be 42 poles.
I. The main circuit breaker frame size shall be 400 A with a minimum AIC of 100,000 A at 480 V(ac).
J. The feeder circuit breakers and internal components shall be as required for the equipment connected, per panel manufacturer recommendation and with a minimum AIC of 65,000 A at 480 V(ac).

3 PHASE 208/120 V PANEL

The 3-Phase 208/120 V(ac) power distribution panel that shall meet the following specifications:

GENERAL

A. Wire: Four Wire
B. Bus: Copper

FEATURES

A. The box panel shall be made from code gauge galvanized steel.
B. The trims panel shall be made from code gauge galvanized steel and painted ANSI 61 gray.
C. The door panel shall have a single point lock.
D. The Ground bar (included) of the panel shall be the standard bolted in the box of the panel.
E. The Enclosure of the panel shall be NEMA type 12.
F. The top and bottom gutters of the panel shall be a minimum of 5.5".
G. The side gutters of the 3 panel shall be a minimum of 6".
H. The total number of branch circuit poles including space of the panel shall be 30 poles.
I. The main circuit breaker frame size shall be 400 A with a minimum AIC: 100,000 A at 208 V(ac).
J. The feeder circuit breakers and internal components shall be as required for the equipment connected, per panel manufacturer recommendation and with a minimum AIC: 65,000 A at 208 V(ac).

SINGLE-PHASE 208/120 V PANEL
The Single-Phase 208/120 V(ac) power distribution panel that shall meet the following specifications:

GENERAL

B. Wire: Three Wire
C. Bus: Copper

FEATURES

A. The box of the panel shall be made from code gauge galvanized steel.
B. The trims of the panel shall be made from code gauge galvanized steel and painted ANSI 61 gray.
C. The door of the panel shall have a single point lock.
D. The ground bar (included) of the panel shall be the standard bolted in the box of the panel.
E. The enclosure of the panel shall be NEMA type 12.
F. The top and bottom gutters of the panel shall be a minimum of 5.5".
G. The side gutters of the single-phase 208/120 V panel shall be a minimum of 6".
H. The total number of branch circuit poles including space of the panel shall be 24 poles.
I. The main circuit breaker frame size shall be 300 A with a minimum AIC: 65,000 A at 120 V(ac).
J. The feeder circuit breakers and internal components shall be as required for the equipment connected, per panel manufacturers recommendation and with a minimum AIC: 65,000 A at 208 V(ac).

SINGLE-PHASE 120 V PANEL
The single-phase 120 V(ac) power distribution panel that shall meet the following specifications:

GENERAL

A. Wire: Two Wire
B. Bus: Copper

FEATURES

A. The box of the panel shall be made from code gauge galvanized steel.
B. The trims of the panel shall be made from code gauge galvanized steel and painted ANSI 61 gray.
C. The door of the panel shall have a single point lock.
D. The ground bar (which shall be included) of the panel shall be the standard bolted in the box of the panel.
E. The enclosure of the panel shall be NEMA type 12.
F. The top and bottom gutters of the panel shall be a minimum of 5.5".
G. The side gutters of the panel shall be a minimum of 6".
H. The total number of branch circuit poles including space of the panel shall be 12 poles.
I. The main circuit breaker frame size shall be 225 A with a minimum AIC 65,000 A at 120 V(ac).
J. The feeder circuit breakers and internal components shall be as required for the equipment connected, per panel manufacturers recommendation and with aAIC 65,000 A at 120 V(ac).

Switches

150 HP Fused Disconnect Switch

The 150 HP fused disconnect switch shall be a heavy-duty low-voltage safety switch with the following specifications:

A. Rated for 600 V(ac)
B. Fusible: Class J fuse specified in these special provisions, the amperage rating of the fuse shall be for a 150 HP Motor.
C. Terminals be copper-aluminum
D. The enclosure shall be NEMA type 3R or 4 rain-tight, dust-tight and oil-tight special industry.
E. A metal nameplate shall be mounted on the front cover that contains switch information (etc. type, catalog number, electrical ratings V, A, and HP rating).
F. Handle whose position is easily recognizable and lockable in the "OFF" position
G. Visible blades
H. Reinforced fuse clips
I. Non-teasible, positive, quick-make quick-break mechanisms
J. Switch assembly plus operating handle as an integral part of the enclosure
K. Switch shall be UL listed, HP rated, meet Federal Specification WS-885C, and NEMA specification KS1-2001.
L. Switch shall have defeat able door interlocks that prevent the door form opening when the operating handle is in the "ON" position.
M. Switch shall have line terminal shields

REFERENCES

The 150 HP fused disconnect switch shall be manufactured in accordance with the following standards:

A. UL 98 - Enclosed and Dead Front Switches
B. NEMA 250 - Enclosures for Electrical Equipment

CLASS J FUSE

A. The class J fuse shall be dual-element time-delay current limiting fuse with an interrupting rating of 300,000 A RMS. Amperage rating of the fuse shall be for a 150 HP Motor.
B. The approved agencies shall be for the following: UL listed special purpose, guide JFHR

DC Switch

The two pole fused DC disconnect switch use for connecting batteries to DC buses and DC load disconnect switch the shall meet the following specifications:

D. The switch shall be rated at 250 V(dc).
B. The switch shall be fused with a Class R fuse for rated current of 30 A to 600 A
C. The switch shall be fused with a Class L fuse for rated current of 800 A to 1200 A
E. The switch shall be UL Listed.
F. The switch terminals shall be copper-aluminum
G. The switch enclosure shall be NEMA type 4 dust-tight.
H. The switch shall included nameplate for system identification
I. The switch handle whose position shall be easily recognizable and shall be lockable in the "OFF" position
J. The switch shall included non-teasible, positive, quick-make quick-break mechanisms.
K. The switch assembly plus operating handle shall be an integral part of the enclosure
L. The switch shall have defeatable door interlocks that prevent the door form opening when the operating handle is in the "ON" position.
M. The switch shall have line terminal shields.

REFERENCE

The DC Switch shall be manufactured in accordance with the following standards:

A. UL 98 - Enclosed and Dead Front Switches
B. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

ADDITIONAL EQUIPMENT

A. The Contractor shall provide and install correct Class and rating fuses in the switch.
B. The Contractor shall provide and install in the switch an auxiliary switch for remote monitoring.
C. The Contractor shall provide and install in the switch an auxiliary switch for remote blown fuse indication.

SIZING

The Contractor shall size the switch and fuse per NEC and per manufactures recommendation.

Transformers

10-3 10 kVA 600/240-120 V TRANSFORMER

The 10 kVA 600/240-120 V Transformer shall be a single-phase transformer that shall meet the following specifications:

C. Frequency: 60 Hz
D. High Side Voltage Rating: 600 V
E. Low Side Voltage Rating: 240 V/120 V
G. Enclosure: NEMA 3R
H. Windings: Copper
I. Degree C Rise: 115
J. Dimensions (Not to Exceed): 20" H x 14"W x 11"D
K. Sound Level: Meets NEMA ST-20
L. Short-Term overload capability: As required by ANSI
M. Design: Encapsulated design

10-3 250 VA 600/240/120 V TRANSFORMER

The 250 VA 600/240/120 V Transformer shall be a single-phase transformer that shall meet the following specifications:

C. Frequency: 60 Hz
D. High Side Voltage Rating: 600 V
E. Low Side Voltage Rating: 240 V/120 V
G. Enclosure: NEMA 3R
H. Windings: Copper
I. Degree C Rise: 115
Dimensions (Not to Exceed): 7" H x 5"W x 4"D
J. Sound Level: Meets NEMA ST-20
K. Short-Term overload capability: As required by ANSI
L. Design: Encapsulated design

Load Center

The load center shall meet the following specifications:

GENERAL

A. SCOPE: The Contractor shall furnish and install single-phase general purpose individually mounted mini-power centers of the two-winding type, self-cooled, as specified herein and as shown on the plans
B. REFERENCES: The mini-power center and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI and NEMA
C. SUBMITTALS – FOR REVIEW/APPROVAL: The following information shall be submitted to the Engineer:

1. Dimension drawing weights
2. Technical certification sheet
3. Transformer ratings including:

KVA
Primary and secondary voltage
Taps
Primary and secondary continuous current
Insulation class and temperature rise
Sound level

4. Component ratings including:
   Voltage
   Continuous current
   Interrupting ratings
   Cable terminal sizes
   Product data sheets

D. SUBMITTALS – FOR CONSTRUCTION: The following information shall be submitted for record purposes:

1. Final (as-built) drawings and information, and shall incorporate all changes made during the manufacturing process
2. Connection diagrams
3. Installation information

E. QUALIFICATIONS

1. The manufacturer of the assembly shall be the manufacturer of the secondary distribution equipment.
2. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
3. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

F. DELIVERY, STORAGE AND HANDLING: The assembly and all components shall be U.L. listed.
G. OPERATION AND MAINTENANCE MANUALS Equipment shall be handled and stored in accordance with manufacturer's instructions. 1 copy of these instructions shall be included with the equipment at time of shipment.
H. EXTRA PRODUCTS: Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PRODUCTS
A. RATINGS

1. The load center rated load shall be 3 kVA
2. The load center voltage rating shall be 480V/240V/120V
3. The load center shall be designed for continuous operation of 3 kVA as defined in ANSI C57.96.
4. Transformer sound levels shall not exceed the following ANSI and NEMA levels of 40 db

B. CONSTRUCTION

1. The load center shall include a primary main breaker, an encapsulated dry-type transformer and a panelboard with secondary main breaker.
2. Primary main, secondary main and feeder breakers shall be enclosed with a lockable hinged door.
3. The load center shall be suitable for service entrance application.
4. Insulation Systems

   a. Transformers shall be insulated with a 185 degrees C insulation system and rated at 115 degrees C temperature rise
   b. Required performance shall be obtained without exceeding the above-indicated temperature rise in a 40 degrees C maximum ambient, with a 30 degrees C average over 24 hours
   c. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635

5. Core and Coil Assemblies
   a. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade copper with continuous wound construction.

b. The core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level
c. The core of the transformer shall be grounded to the enclosure
d. Transformer shall have two 2 1/2 percent full capacity taps above and four 2 1/2 percent full capacity taps below normal primary voltage.

C. BUS: Secondary bus shall be copper
D. WIRING/TERMINATIONS

1. All interconnecting wiring between the primary breaker and transformer, secondary main breaker and transformer and distribution section shall be factory installed.
2. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring.

E. MAIN DEVICES: The load center shall include a primary main breaker with an interrupting rating of 65kA at 277/480 volts; and a secondary main breaker with an interrupting rating of 10kA at 120/240 volts, and panelboard.
F. FEEDER DEVICES: The secondary distribution section shall accommodate one-inch, plug-in breakers with 10 kA interrupting capacity.
G. ENCLOSURE

1. The enclosure shall be made of heavy-gauge steel and the maximum temperature of the enclosure shall not exceed 90 degrees C.
2. The enclosure shall be totally enclosed, nonventilated, NEMA 3R, with lifting eyes.

EXECUTION
A. FACTORY TESTING

1. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA.

a. Ratio tests at the rated voltage connection and at all tap connections
b. Polarity and phase-relation tests on the rated voltage connection
c. Applied potential tests
d. Induced potential test
e. No-load and excitation current at rated voltage on the rated voltage connection

B. INSTALLATION: The Contractors shall install all equipment per the manufacturer's recommendations and the on the plans.
C. FIELD ADJUSTMENTS: Adjust taps to deliver appropriate secondary voltage.

Miscellaneous Equipment

19 Inch Computer Cabinet

The 19" computer cabinet shall be a 47 rack unit modular cabinet that provide an idea packaging solution for 19" rack equipment and computer systems and shall meet the following additional specifications:

CONSTRUCTION
A. Rugged die-cast aluminum top and bottom frame connected to four extruded aluminum upright. Each upright shall include two integral mounting flanges.
B. Mounting surfaces on front and rear of frame shall recess 2-3/8" to allow for both equipment mounting and use for all door.
C. Two steel side covers 0.041" thick. Side covers shall be removable via quarter turn fasteners for easy access. Ground studs and foam gasket strips shall be provided and installed. The Contractor shall connect the grounding electrode conductor to the 19" Computer Cabinet using irreversible compression ground tap.
D. Raised Solid Top (0.059" thick steel and finished with a stone gray coating top) shall be mounted on steel spacers (extending the enclosure height 1.26"). Ground studs shall be provided and installed. All mounted hardware shall be furnished and installed.
E. Bottom of the frame shall be closed with covers. The frame shall be provided and installed with die-cast support feet.

F. Frame shall be able to accommodate optional doors, front and rear, in any combination.
G. Holes square in uprights shall accommodate cage nuts for mounting all types of 19” rack equipment and accessories. Front and rear hole spacing shall comply with EIA RS-310/IEC 297-1 wide spacing for 19” mounting.
H. Side mounting holes shall be spaced vertically at wide spacing (same as front/rear) to accommodate accessories.
I. Dimensions in inches: 87.6"(H) x 23.6"(W) x 47.3"(D).

ACCESSORIES
The Contractor shall provide and install the following equipment:

A. Power strips with 8 outlets. The power strips shall be rack-mounted install inside the cabinet as shown on the plans.
B. 19" cable routing panel
C. For use in orderly management of fiber and copper cable through patch panels; 0.06" steel, finished in dark charcoal .
D. Cable trough and 19" cable trough
E. For securing cables in place in zero-U space or across the rack face in conjunction with hook & latch straps; 0.06" steel finished in dark charcoal
F. Radial limits: Used to maintain safe bend radius of fiber and copper cable; 0.06" sheet steel with zinc-power coat light gray .
G. Jumpering brackets: Zinc-passivated steel rings to assist in zero-U cable raceway management.
H. Cantilever arm: Zinc-passivated cable arm for the management of control cables (typically keyboard, video and mouse) on units that are mounted rails and freedom of forward movement is desired.
I. Cable management “lobster claw”: Heavy duty plastic rings, black, field attached to the internal mounting rail T-slot and will support approximately 2" diameter cable bundle. Mounted by inserting into T-slot dimension and turning clockwise 1/4 turn.

FINISH
A. Frame and flush louvered top shall be painted with a durable stone gray textured finish .
B. Side covers shall be textured light gray .

INDUSTRY STANDARDS
A. NEMA Type 1
B. EIA RS-310/IEC 297-1
C. ANSI/IEC 60529, IP40

Console

The console shall be a NEMA Type 12 computer workstation enclosure system the shall meet the following specifications:

A. 14 Gauge steel body
B. 14 and 16 gauge steel doors and covers
C. Seams continuously welded and ground smooth
D. Seamless foam-in-place gasket on all doors and covers
E. Smoke gray 0.25-in-think polycarbonate window on upper front door
F. Quarter-turn latches on the upper front door
G. Solid lower front doors with key locking swing door handles
H. Internal rails facilitate mounting of the console internal components
I. Solid rear covers with screw fasteners
J. Partial Sub-panel
K. Hinges on bottom

FINISH
A. The console cabinet finish shall be textured light-gray polyester powder paint.
B. The console keyboard door finish shall be textured black polyester powder paint.

INDUSTRY STANDARDS
A. UL 508A Listed: Type 12
B. ANSI/IEC 60529, IP55

DIMENSION
Not to Exceed: 60" H x 50"W x 24" D

CONFIGURATION AND ACCESSORIES

A. Configuration
   1. One cabinet
   2. One keyboard compartment: The keyboard compartment shall be on the right side of the console and the cover of the console shall be on the left side.
   3. Four shelves
   4. Upper front window door
   5. Two lower front solid door
   6. Rear cover
   7. Center upright
   8. Two lifting eyes

B. Accessories
   1. Industrial Corrosion inhibitors
   2. Two thermoplastic data pocket: The thermoplastic data pockets shall be installed on both sides of the console.
   3. Two key inserts: One key insert per lower front solid door
   4 3 ft x the length of the console electrostatic mat used for computer rooms. The Contractor shall install the electrostatic mat and connect the grounding conductor to the console.

DC UPS

The DC UPS shall be one of the following or department approved equal:

A. Sola/Hevi-duty SDN10-24
B. PULS-Dimension U-Series UB10.241
C. Allen-Bradley Bulletin 1606 DC UPS MODULE: Cat No. 1606-XLS240-UPS

The Contractor shall provide and install Three (3) Battery Modules: SDN 24-BAT for the Sola/Hevi-duty SDN10-24, One (1) 26 Ah Battery Module: UZK12.261 for the PULS-Dimension U-Series UB10.241 and One (1) 27 Ah Sealed Lead Acid type Battery for the Allen-Bradley Bulletin 1606 DC UPS MODULE: Cat No. 1606-XLS240-UPS.

The Contractor shall provide and install for the junction box in which the DC UPS is located, a Cooling Fan Package which shall included the following: 24 VDC UL 508 Type 1 fan rated at 55 CFM or higher, washable aluminum air filter, composite air plenum, finger guard and a special EMC shielding grille; and a Exhaust Package which shall included the following: washable aluminum air filter, filter retainer with integral finger guard and a special EMC shielding grille. The Contractor shall provide and install with the Cooling Fan Package and Exhaust Package a Temperature control switch set to 70 F and Timing Relay that operates on a repeat cycle start with pause for 3 hours. The contractor shall connect the temperature control switch and timing relay to operate the fan as specified above and as shown on the plans.

INDUSTRIAL DC TO DC CONVERTER

The industrial dc to dc converter shall be a DIN Rail or Chassis Mount (by removing the DIN clip) encapsulated, industrial DC to DC Converter with an output rated of 12 VDC that shall meet the following specifications:

INPUT	
Input Voltage	20 volts to 72 volts
Filtering EMI/RFI:	EN 55011/B, 55022/B
Switching Frequency:	100 kHz

OUTPUT	CONDITION	VALUE
Δ Vout		
(For Output Voltage Accuracy):	V in=48 V, I out =max, 25 C	V1≤ 1%, V2≤ 4%
Δ VNF (For Ripple):	V in =min, I out =max, 25 C	≤ 1%, V out
Δ VHF (For Noise):	V in =min, I out =max, 25 C	≤ 2%
Line Regulation:	V in=min/Max, 25 C,	≤+.5%Iout =max,25C
Load Regulation:	I out =10….90…10%, 25 C	≤ +. 5% Vin =48 V
I max (For Overcurrent Protection):	105	130% I nom
t R (For Load Regulation Timing):	10….90…10%, 25 C	< 4 ms
Temperature Coefficient:	TA= -25….+65 C	.01%/K
Overload/short Circuit:	Continuous	
Derating:	TA > 50 C	5%/K max
Rated Output Voltage:		12 VDC

GENERAL	CONDITION	VALUE
t n (For Holdup Time):	V in=48 V	>10 ms
T A (For Operating temperature):		-25…+ 65 C
T S (For Storage temperature):	T A =25 C	-45…+85 C
Case temperature Rise @Full Load:		45 K max
MTBF @ 25 C (input/output):	acc. MIL-HDBK-217F	800,000 (hrs)
Transient Protection:		EN61000-4-2, 3,4,5
Cooling:		Conventional
Protection:		IP20
Case Material/ Potting:		UL94-VO
Product Level:		Level 3
Dimensions (L X W X D):		(120 X 65 X 33) mm

POWER SUPPLY

The Power Supply shall be one of the following or approved equal:

A. Sola/Hevi-duty SDN 10-24-100C
B. PULS-Dimension C-Series CS10.241
C. Allen-Bradley Bulletin 1606-XLS: Cat No. 1606-XLS240E

The Power Supply shall meet the additional following specifications:

A. Output Voltage: 24 V(dc)
B. Output Current: 10 A

RACK-MOUNTED DC TO DC CONVERTER

The Rack-Mounted DC to DC Converter shall meet the following specifications:

GENERAL

A. Input Voltage:	100 to 160 V(dc)
B. Output Voltage:	23 to 26 V(dc)
C. Default Output Voltage:	24.5 V(dc)
D. Output Current:	40 A
E. Input Power:	980 W
F. Set Output Voltage:	24 V(dc)

RACK-MOUNTED DC TO DC CONVERTER SYSTEM FEATURES OVERVIEW

The Rack-Mounted DC to DC Converter shall be a highly reliable DC-to-DC system, designed with advanced power electronics and galvanic isolation design with the following features:

A. High frequency architecture – The Rack-Mounted DC to DC Converter shall create regulated DC voltage from a DC source incorporating performance for low ripple, high efficiency, lightweight and compact design using high frequency architecture.
B. Efficiency performance – The Rack-Mounted DC to DC Converter shall offer advanced high-frequency design and shall provide operating efficiency of at least 90%.
C. Advanced protection features:

1. Input reverse polarity-proof protection; non-destructive
2. Input over/under voltage protection
3. DC input breaker for short-circuit and power ON/OFF control
4. Output overload protection
5. Output over/under voltage protection
6. Output short circuit protection; non-destructive
7. Output blocking diodes – standard integrated design for parallel operation
8. Fan self-test and thermostatic control with variable speed
9. IEEE C37.90.1 (SWC) rating

RACK-MOUNTED DC TO DC CONVERTER MECHANICAL CHARACTERISTICS

A. The Rack-Mounted DC to DC Converter shall mount in a standard 19 inches rack occupying no more than 2RU spaces (3.5 inches high).
B. User interface:

1. Front panel ON/OFF power – The Rack-Mounted DC to DC Converter shall be equipped with a power input circuit breaker suitable to providing the functions: a) on/off control and b) internal short circuit protection.
2. Digital telemetry display – A switch shall be provided to allow a user to view the operation indications on the display. The digital display on the front panel shall show the following data:

a. output voltage
b. output current

C. Voltage adjustment – The Rack-Mounted DC to DC Converter output voltage shall be adjustable form the front panel using typical standard hand tools.
D. Thermal management and cooling:

1. Forced air-cooling shall flow from front-to-back in the Rack-Mounted DC to DC Converter and operate in a variable speed control mode to maximize fan life.
2. Normal Rack-Mounted DC to DC Converter operation shall be rated for –22 F to 122 F.

E. Earth ground stud shall be integrated into the construction of the chassis.

RACK-MOUNTED DC TO DC CONVERTER ELECTRICAL CHARACTERISTICS

A. Circuit breaker (DC input breaker) – A DC circuit breaker shall be tripped only if there is a “short circuit” condition within the Rack-Mounted DC to DC Converter. The breaker shall be used as input power on/off control.
B. Reverse polarity protection – The input circuit design shall protect the Rack-Mounted DC-to-DC Converter if the incorrect polarity is applied to the input terminal.
C. DC input terminal – The Rack-Mounted DC to DC Converter shall have an appropriate sized input terminal for cabling to support full rated capacity of the Rack-Mounted DC to DC Converter. Hard-wire system shall secure cables using mechanical bare-wire terminals.
D. DC output terminal – The Rack-Mounted DC to DC Converter shall have an appropriate sized output terminal for cabling to support full rated capacity of the Rack-Mounted DC to DC Converter. Hard-wire system shall secure cables using mechanical bare-wire terminals.
E. DC output characteristics:

1. Ripple < 10 mV
2. Voltage regulation +/-1%
3. Efficiency >90%
4. Voltage adjustment – Front panel access

F. Parallel operation –output: Standard equipment configuration shall include blocking diode integrated in the output circuit to facilitate operation of two or more Rack-Mounted DC to DC Converters in parallel

G. Galvanic isolation:

1. The Rack-Mounted DC-to-DC Converter shall be isolated front-to-back such that the input and output terminals are electrically independent.
2. The input and output terminals shall be electrically isolated.

H. Dry contact terminal (normal-open or normal-close) – Dry contact terminal shall be integrated internally and used for exporting status signaling when faults or alarms occur. User shall be able to connect sensor wires for either normal open or normal close operation. The dry contact terminal should be rated for maximum 1A/125VAC.

I .Dry Contact Terminal (Normal-Open or Normal-Close):

1. Three (3) Form C Relays
2. One Form C Relay for Input Fail
3. One Form C Relay for Output Fail
4. One Form C Relay for Overload

CONNECTIONS

A. The Rack-Mounted DC to DC Converter shall be connected as shown on the plans to the following Equipment (With Estimated Loads) as shown on the plans:

1. SCADA System Junction Box

a.	PAC #1:	40 W
b.	PAC#2:	40 W
c.	Self-Healing Multi-Drop Fiber Optic Modem#1	3.6 W
d.	Self-Healing Multi-Drop Fiber Optic Modem#2	3.6 W
e.	Ethernet Switch #1:	8.0 W
f.	Ethernet Switch#2:	8.0 W
g.	Remote I/O Rack:	40W
h.	Misc. Loads:	20 W

2. FCS#1 Junction Box

a.	Field Control Station:	5.0 W
b.	Misc.:	20 W

3. SCADA Submaster & PAC#3 Cabinet

a.	Rack-Mounted Ethernet Switch (Secondary Connection):	27W
b.	PAC #3:	40 W
c.	Expansion I/O Rack:	40 W
d.	Fiber Optic Modem #1:	3.0 W
e.	Fiber Optic Modem#2:	3.0 W
f.	Self-Healing Multi-Drop Fiber Optic Modem:	3.6 W
g.	Telephone Extender:	6.0 W
h.	Lighting Controller	8.0W
i.	Misc. Load:	20 W

4. FO Cabinet for T.O.S

a.	Telephone Extender (Connected only to Converter):	6.0W
b.	Rack-Mounted Ethernet Switch (Secondary Connection):	27W
c.	T1 Fiber Optic Multiplexer#1 (Secondary Connection):	14.4 W
d.	T1 Fiber Optic Multiplexer#2 (Secondary Connection):	14.4W
e.	Ethernet Router #1 (Secondary Connection):	81 W
f.	Ethernet Router #2 (Secondary Connection):	81 W

5. Communication Board
    a. Industrial Router #1 (Connected only to Converter): 31W
    b. Industrial Router #2 (Connected only to Converter): 31W
    c. Fixed Wireless Terminal (Connected only to Converter): 16.2W

6. Tunnel Control Cabinet
    a. Rack-Mounted Ethernet Switch (Secondary Connection): 27W

RACK-MOUNTED INVERTER

The Rack-Mounted Inverter shall meet the following specifications:

GENERAL

Input Voltage: 100-150 V(dc)
Output Voltage: 120 V(ac)
Capacity: 2 KVA/1600W

RACK-MOUNTED INVERTER SYSTEM FEATURES OVERVIEW

The Rack-Mounted Inverter shall be a highly reliable DC-AC inverter system, designed with advanced power electronics and microprocessor technology and shall offering the following features:

A. Self-Diagnosis: The Rack-Mounted Inverter shall be equipped with a self-diagnosis microprocessor, able to identify and show all failure messages on the LED/LCD display, with visual/audio alarm.
B. High Frequency Architecture: The Rack-Mounted Inverter shall be created for high efficiency, lightweight and compact design using high frequency architecture concept.
C. Design: The Rack-Mounted Inverter shall use a reliable design structure, resulting in easy maintenance, and high MTBF greater than 200,000 hours.
D. High Efficiency: The Rack-Mounted Inverter shall offer advanced soft-switching designs and shall provide an operating efficiency greater than 85% and reduce switching noise.
E. Advanced Protection Features:

    1. Input reverse polarity-proof protection – no damage
    2. Internal over temperature protection
    3. Output overload protection
    4. Output over/under voltage protection
    5. Output short circuit protection
    6. DC input short circuit protection: fuse and breaker
    7. AC input short circuit protection: breaker
    8. Input over/under voltage protection
    9. Fan failure detection and protection

F. Safety & Emissions
    1. UL Listed - 60950
    2. FCC Class A Emissions

RACK-MOUNTED INVERTER OPERATIONAL CONSIDERATIONS

A. The Rack-Mounted Inverter shall feature IGBT (Insulated Gate Bipolar Transistor) technology, minimizing weight and dimension, while enhancing output short circuit reliability and overload capacity are the main consideration of this specification.
B. Output voltage is provided in one of two ways:

    1. From AC input bypass mode: (Off-Line Mode)
    In Off-Line mode, AC output power will be supplied through the AC bypass circuit in its “normal” operation. Upon AC input failure, output power will be diverted through the DC to AC Rack-Mounted Inverter circuit. Once AC mains are restored, the unit will revert from inverter mode to bypass mode.
    2. From DC to AC Rack-Mounted Inverter mode: (On-Line Mode)
    In On-Line mode, AC output power will be supplied directly by the Rack-Mounted Inverter from the VDC source. Shall the DC source or Rack-Mounted Inverter fail, the system will transfer its output power through the bypass circuit. Once the DC power source is restored, the system will revert to “inverter” mode operation.

C. Either mode shall be front panel programmable by the user; the selected operational mode will pre-determine the "default" output.
D. Transfer time from inverter to bypass, or bypass to inverter shall be < 4 ms.
E. The Off-line/On-line mode is changed from one to the other by pressing the front panel ON button for approximately 3 seconds when normal output is available.

RACK-MOUNTED INVERTER MECHANICAL CHARACTERISTICS

A. The Rack-Mounted Inverter shall mount in a standard 19-inch rack occupying no more than 2RU spaces (3.5 inches).
B. User Interface
   1. Front Panel ON/OFF Buttons:

      These are the two power buttons for turning on or turning off the Rack-Mounted Inverter. Once the Rack-Mounted Inverter is on, the "ON" button works as the On-Line <=> Off-Line mode switching button.

   2. Display Data/Status Buttons:

      The following data - output voltage, output frequency, load, input dc voltage, bypass ac voltage, bypass ac frequency and system status can be shown sequentially on the LCD display by pressing these two buttons.

C. LED Indicators On the Front Panel
   1. INVERTER ON - Indicates the Rack-Mounted Inverter has been turned on and is working normally (output is available to support load equipment).
   2. OVERLOAD - Means that the Rack-Mounted Inverter is in overload condition, or that there is an output short circuit.
   3. DC ABNORMAL - Means that the input DC voltage is "abnormal" and requires verification.
   4. FAULT - Indicates that the Rack-Mounted Inverter is in "fault" condition.

D. Thermal Management & Cooling
   1. Forced Air-cooling shall flow from front-to-back of the Rack-Mounted Inverter.
   2. Normal Rack-Mounted Inverter operation shall be rated for 0°C to 50°C with integrated thermal protection.

RACK-MOUNTED INVERTER ELECTRICAL CHARACTERISTICS

A. Circuit Breaker (DC Input Breaker):

   The DC circuit breaker will be tripped only if there is a "short circuit" condition within the Rack-Mounted Inverter.
B. Reverse Polarity Protection:

   The DC input circuit and overload protection shall be integrated within the internal circuitry of the Rack-Mounted Inverter. Neither of these faults shall trip the DC breaker.

C. Communication Interface:

   The Rack-Mounted Inverter shall provide integrated communication interfaces such as
   1. RS-232 Interface for Maintenance Access & Status
   2. Dry Contact Terminal (Normal-Open or Normal-Close):

      a. Two (2) Form C Relays
      b. One Form C Relay for DC Abnormal
      c. One Form C Relay for Fault

   3. SNMP/Web Adapter card expansion slot

D. AC Output Receptacles:
   The Rack-Mounted Inverter shall be equipped with NEMA 5-20R× 4 .

E. AC Input Terminal:

1. The Rack-Mounted Inverter shall be equipped with hardwire mounting terminals for bypass VAC input voltage connectivity.
2. The Rack-Mounted Inverter shall be equipped with an AC Input Breaker to protect against short circuit of the bypass AC input.

F. DC Input Terminal:

1. The Rack-Mounted Inverter shall have an appropriate sized input terminal for VDC input voltage cabling to support full rated capacity of the Rack-Mounted Inverter.
2. The Contractor shall provide cable reducers for input DC conductors larger than what the DC Input Terminals can accommodate, connect the input DC conductors to the cable reducers, provide the larger allow conductors for the DC input Terminal and connect the conductors between the DC Input Terminal and the reducer.

G. Dry Contact Terminal:

1. Dry contact terminal shall be connected to internal microprocessor for external signaling when faults or alarms occur.
2. User shall be able to connect for either normal open or normal close operation.
3. The dry contact terminal shall be able to support 5A / 250VAC.

H. Bypass Switching and Grounding
1. Operation = Off – Line Mode:

   AC input supplied from local service panel, AC input neutral to earth connection provided externally. (usually the service panel)
2. Operation = On– Line Mode:
   DC input supplied from battery/DC power system operating with Rack-Mounted Inverter originated AC, therefore neutral to earth connection provided internally to chassis.

CONFIGURATION AND CONNECTIONS

A. Configuration: The Rack-Mounted Inverter shall be configured to On-Line Operation
B. The Rack-Mounted Inverter shall be connected as shown on the plans to the following Equipment (With Estimated Loads)as shown on the plans:

1.	SCADA Submaster server:	600 VA
2.	PAC#3 System (From the 24 V(dc) Power Supply):	290 VA
3.	Rack-Mounted Ethernet Switch (Primary Connection):	35 VA
4.	KVM Switch for Server:	20 VA

REDUNDANT POWER SUPPLY CONTROLLER

The Redundant Power Supply Controller shall be one of the following or approved equal:

A. Sola/Hevi-duty SDN 2.5-20 RED
B. PULS-Dimension Y-Series YRM2.DIODE
C. Allen-Bradley Bulletin 1606 REDUNDANCY MODULE: Cat No. 1606-XLSRED

The Redundant Power Supply Controller shall meet the additional following specifications:

A. Output Voltage: 24 V(dc) for Sola/Hevi-duty SDN 2.5-20 RED
B. 24 V(dc) to 60 V(dc) for PULS-Dimension Y-Series YRM2.DIODE
C. 10 V(dc) to 60 V(dc) for Allen-Bradley Bulletin 1606 REDUNDANCY MODULE: Cat No. 1606-XLSRED
D. Output Current: 20 A

The Contractor shall provide and install 24V(dc) and 12 V(dc) Surge Suppression Diodes to be use for the transient voltage surge suppression as shown on the plans.

10-3.33 FIBER OPTIC CABLE AND EQUIPMENT

FIBER SINGLEMODE FIBER OPTIC CABLES

12 Fiber Singlemode Fiber Optic Cable

The 12 fiber singlemode (SM) fiber optic cable shall be Corning Cable Systems ALTOS Low Smoke Zero Halogen (LSZH) Gel-Free Cable, OFN-LS Listed with Corning ClearCurve Optical Fiber:012EWZ-T4101D20 or AFL Telecommunications Low Smoke Zero Halogen Loose Tube Cable, OFN-LS Listed with SM Futureguide SR-15e Bend Insensitive Optical Fiber: Item Number LL012*C5101N1 or OFS OPTION1 with AllWave Flex Optical Fiber: AT-3BE12ZT-012 or equal. The 12 fiber SM fiber optic cable shall meet the following additional specifications:

Fiber Optic Count:	12
Number of Tubes for Fibers:	1
Fiber Optic Type Cable:	Singlemode Bend

24 Fiber Singlemode Fiber Optic Cable

The 24 fiber SM fiber optic cable shall be Corning Cable Systems ALTOS Low Smoke Zero Halogen (LSZH) Gel-Free Cable, OFN-LS Listed with Corning ClearCurve Optical Fiber:024EWZ-T4101D20 or AFL Telecommunications Low Smoke Zero Halogen Loose Tube Cable, OFN-LS Listed with SM Futureguide SR-15e Bend Insensitive Optical Fiber: Item Number LL024*C5101N1 or OFS OPTION1 with AllWave Flex Optical Fiber: AT-3BE12ZT-024 or equal. The 24 fiber SM fiber optic cable shall meet the following additional specifications:

Fiber Optic Count:	24
Number of Tubes for Fibers:	2
Fibers per Tube:	12
Fiber Optic Type Cable:	Singlemode Bend Insensitive.

36 Fiber Singlemode Fiber Optic Cable

The 36 fiber SM fiber optic cable shall be Corning Cable Systems ALTOS Low Smoke Zero Halogen (LSZH) Gel-Free Cable, OFN-LS Listed with Corning ClearCurve Optical Fiber:036EWZ-T4101D20 or AFL Telecommunications Low Smoke Zero Halogen Loose Tube Cable, OFN-LS Listed with SM Futureguide SR-15e Bend Insensitive Optical Fiber: Item Number LL036*C5101N1 or OFS OPTION1 with AllWave Flex Optical Fiber: AT-3BE12ZT-036 or equal. The 36 fiber SM fiber optic cable shall meet the following additional specifications:

Fiber Optic Count:	36
Number of Tubes for Fibers:	3
Fibers per Tube:	12
Fiber Optic Type Cable:	Singlemode Bend Insensitive.

48 Fiber Singlemode Fiber Optic Cable

The 48 fiber SM fiber optic cable shall be Corning Cable Systems ALTOS Low Smoke Zero Halogen (LSZH) Gel-Free Cable, OFN-LS Listed with Corning ClearCurve Optical Fiber:048EWZ-T4101D20 or AFL Telecommunications Low Smoke Zero Halogen Loose Tube Cable, OFN-LS Listed with SM Futureguide SR-15e Bend Insensitive Optical Fiber: Item Number LL048*C5101N1 or OFS OPTION1 with AllWave Flex Optical Fiber: AT-3BE12ZT-048 or equal. The 48 fiber SM fiber optic cable shall meet the following additional specifications:

Fiber Optic Count:	48
Number of Tubes for Fibers:	4
Fibers per Tube:	12
Fiber Optic Type Cable:	Singlemode Bend Insensitive.

72 Fiber Singlemode Fiber Optic Cable

The 72 fiber SM fiber optic cable shall be Corning Cable Systems ALTOS Low Smoke Zero Halogen (LSZH) Gel-Free Cable, OFN-LS Listed with Corning ClearCurve Optical Fiber:072EWZ-T4101D20 or AFL Telecommunications Low Smoke Zero Halogen Loose Tube Cable, OFN-LS Listed with SM Futureguide SR-15e Bend Insensitive Optical Fiber: Item Number LL072*C6101N1 or OFS OPTION1 with AllWave Flex Optical Fiber: AT-3BE12ZT-072 or equal. The 72 fiber SM fiber optic cable shall meet the following additional specifications:

Fiber Optic Count:	72
Number of Tubes for Fibers:	6
Fibers per Tube:	12
Fiber Optic Type Cable:	Singlemode Bend Insensitive.

RACK-MOUNTED FIBER OPTIC PATCH PANEL

The rack-mounted fiber optic patch panel shall be a Corning Cable Systems Closet Connector Housing (CCH): CCH-04U or AFL Telecommunications LightLink LANSystem CON144P Fiber Termination Patch Panel or American Tech Supply: Part No.UFE12-B or equal. The rack-mounted fiber optic patch panel shall meet the following additional specifications:

Number of Connector Panels:	12
Number of Connectors per Panel:	12
Type of Connectors:	Ultra Polish ST sleeve single-mode
Loading Character:	Pre-terminated with an OSP loose tube cable stub
Cable Stub Length:	6 ft
FO Cable Splice Connection to Connector Panel:	heat-shrink fused splices

The Contractor shall provide a cable strain-relief kits for each cable terminated on the patch panel. The Contractor shall attach the fiber optic cables to the interior surface of the rack-mounted fiber optic patch panel. The strain-relief kit shall contain a bracket that provides a means for attaching cables ties and a bracket to strain relief the cable central member, if required.

RACK-MOUNTED FIBER OPTIC SPLICE ENCLOSURE

The rack-mounted fiber optic splice enclosure shall be a Corning Cable Systems Closet Splice Housing (CSH): CSH-05U or AFL Telecommunications LightLink LANSystem SPL4U or Multilink Broadband FRM-4RU-SS or equal. The rack-mounted fiber optic splice enclosure shall have the following number of splice trays/drawers:

A. Six telescoping splice drawers for the AFL Telecommunications LightLink LANSystem SPL4U.
B. Five Type 2S Long Splice Trays for the Corning Cable Systems Closet Splice Housing (CSH): CSH-05U.
C. Eight 24 Fiber Splice Trays for the Multilink Broadband FRM-4RU-SS.

WALL-MOUNTED FIBER OPTIC PATCH PANEL/BOX

Wall-Mounted 24-Connector Fiber Optic Patch Panel

The wall-mounted 24-connector fiber optic patch panel shall be a Corning Cable Systems Premium Wall-Mountable Housing (PWH): PWH-02P or AFL Telecommunications LightLink Customer Premise System CPS012 Interconnect Enclosure or American Tech Supply: Part Number WAC-2X or equal. The wall-mounted 24-connector fiber optic patch panel shall meet the following additional specifications:

Number of Connector Panels:	2
Number of Connectors per Panel:	12
Type of Connectors:	Ultra Polish ST sleeve singlemode
Loading Character:	Pre-terminated with an OSP loose tube cable stub
Cable Stub Length:	6 ft
FO Cable Splice Connection to Connector Panel:	heat-shrink fused splices

The Contractor shall provide a cable strain-relief kits for each cable terminated on the patch panel. The Contractor shall attach the fiber optic cables to the interior surface of the wall-mounted 24-connector fiber optic patch panel. The strain-relief kit shall contain a bracket that provides a means for attaching cables ties and a bracket to strain relief the cable central member, if required.

Wall-Mounted 72-Connector Fiber Optic Patch Box

The wall-mounted 72-connector fiber optic patch box shall be a Corning Cable Systems Premium Wall-Mountable Housing (PWH): PWH-06P or AFL Telecommunications LightLink Customer Premise System CPS012 and CPS-24 Interconnect Enclosures or American Tech Supply: Part Nos. WAC-2X and WAC-4X enclosures or equal. The wall-mounted 72-connector fiber optic patch box shall meet the following additional specifications:

Number of Connector Panels:	6
Number of Connectors per Panel:	12
Type of Connectors:	Ultra Polish ST sleeve singlemode
Loading Character:	Pre-terminated with an OSP loose tube cable stub
Cable Stub Length:	6 ft
FO Cable Splice Connection to Connector Panel:	Heat-shrink fused splices

The Contractor shall provide a cable strain-relief kits for each cable terminated on the patch box. The Contractor shall attach the fiber optic cables to the interior surface of the wall-mounted 72-connector fiber optic patch box. The strain-relief kit shall contain a bracket that provides a means for attaching cables ties and a bracket to strain relief the cable central member, if required.

WALL-MOUNTED NEMA 4X FIBER OPTIC PATCH BOXES

The wall-mounted NEMA 4X fiber optic patch boxes shall meet the following specifications:

Industrial Interconnection Hardware	ANSI/TIA/EIA-568 and ANSI/TIA/EIA-569
References/Performance: Commercial Building Telecommunications Cabling Standard Commercial Building Standard for Telecommunications Pathways and Spaces Administration Standard for the Telecommunications Infrastructure of Commercial Buildings Commercial Building Grounding and Bonding Requirements for Telecommunications	 ANSI/TIA/EIA-568 ANSI/TIA/EIA-569 ANSI/TIA/EIA-606 ANSI/TIA/EIA-607
Ratings:	UL 508A Listed; Type 4, 4X, 12, 13 (File No. E61997) CUL Listed per CSA C22.2 No 94; Type 4, 4X, 12, 13 (File No E61997) NEMA/EEMAC Type 4, 4X, 12, 13 CSA File No. 42186; Type 4, 4X, 12, 13 IEC 60529, IP66

Hardware Characteristics

Mounting.--The wall-mounted NEMA 4X fiber optic patch boxes shall contain the equipment required for wall mounting.

Material.--The wall-mounted NEMA 4X fiber optic patch boxes shall be constructed from compression-molded fiberglass and meeting Low Smoke Zero Halogen (LSZH) requirements. The material of the wall-mounted NEMA 4X fiber optic patch boxes shall allow punching, drilling, filing, or sawing for the field-installation of cable entry holes.

Cable Strain Relief.--The Contractor shall provide a cable strain-relief kit and the Contractor shall attach the fiber optic cables to the interior surface of the wall-mounted NEMA 4X fiber optic patch boxes. The strain-relief kit shall contain a bracket that provides a means for attaching cables ties and a bracket to strain relief the cable central member, if required

Cable Termination.--The wall-mounted NEMA 4X fiber optic patch boxes shall be capable of terminating field cables using NEMA 4 rated conduit fittings, standard (non-rated) conduit fittings, and watertight cord compression fittings.

Cable Slack Storage.--The wall-mounted NEMA 4X fiber optic patch boxes shall contain radius guides to direct slack cable to prevent violation of the cable's minimum bend radius.

Weather Protection.--The wall-mounted NEMA 4X fiber optic patch boxes shall be constructed of a UV-stabilized material, exhibit chemical and temperature resistance and demonstrate weatherability sufficient for outdoor deployment in all climates.

Security.--The following shall be provided for the security of the wall-mounted 24-connector NEMA 4X fiber optic patch box:

Cover	Capable of being secured with two captive Type 316 stainless steel screws or quick-release latches with corrosion-resistant polyester.
Hinged Cover	Attach to the housing with a Type 316 stainless steel hinge pin.
Padlock	Each latch shall have a padlock.

Wall-Mounted 24-Connector NEMA 4X Fiber Optic Patch Box

Hardware Characteristics

The wall-mounted 24-connector NEMA 4X fiber optic patch box shall be constructed of one unit, utilized in an indoor or outdoor environment, and be capable of terminating and protecting inside and outside fiber optic cables. The wall-mounted 24-connector NEMA 4X fiber optic patch box shall be configured as follows:

Number of Connector Panels:	2
Number of Connectors per Panel:	12
Type of Connectors:	Ultra Polish ST sleeve singlemode
Loading Character:	Pre-terminated with an OSP loose tube cable stub
Cable Stub Length:	6 ft
FO Cable Splice Connection to Connector Panel:	Heat-shrink fused splices

Wall-Mounted 72-Connector NEMA 4X Fiber Optic Patch Box

The wall-mounted 72-connector NEMA 4X fiber optic patch box shall be constructed of one unit, utilized in an indoor or outdoor environment, and be capable of terminating and protecting inside and outside fiber optic cables. The wall-mounted 72-connector NEMA 4X fiber optic patch box shall be configured as follows:

Number of Connector Panels:	6
Number of Connectors per Panel:	12
Type of Connectors:	Ultra Polish ST sleeve singlemode
Loading Character:	Pre-terminated with an OSP loose tube cable stub
Cable Stub Length:	6 ft
FO Cable Splice Connection to Connector Panel:	Heat-shrink fused splices

SELF-HEALING MULTI-DROP FIBER OPTIC MODEM

The self-healing multi-drop fiber optic modem shall meet the following specifications:

A. Data rate.--Async RS-232, RS-422 and RS-485 (2/4 Wire): Up to 38.4 kbps.
B. Optical:

1. Transmitter: Laser.
2. Receiver: PIN Diode.
3. Wavelength: 1300/1550 nm Singlemode.
4. Fiber Optic Connectors: ST Connectors.
5. Number of Fiber Optic Connectors: 4 Connectors;Tx1, Rx1, Tx2 and Rx2.
6. Loss Budget: 15 dB Singlemode @ 9/125 µm

C. Electrical:

1. Connector: DB25.
2. Interface: As shown on the plans.

D. System:

1. Bit Error Rate: 1 in 10^9 or better.
2. Type of Topologies:

   a. Multi-Drop Ring.
   b. Multi-Drop Self-healing Ring.

3. Maximum Number of Channels: Two.
4. Protocol Transparent.
5. Multiple Master Capable.
6. All-Digital Design.

E. Diagnostic Functions:

1. Local and Remote Loopback (Testing).
2. Loop Monitor (Optical Loop Integrity Test).
3. Signal Generator.
4. Disable Alarm.
5. Anti-Streaming (Anti-Jabber).

F. Visual Indicators.--MSTR, SLAV, Sync-A, Sync-B, Vcc, PWRA, PWRB, BRD-1, BRD-2, RSP-1, RSP-2, LPA, LPB, A2B and B2A.

G. Alarm.--Dry Contact Normal Open (N.O.).

H. Power.--Input Voltage: 24 V(dc) at 50 mA.

I. Temperature:

1. Operating: From -40 °C to 80 °C.
2. Storage: From -40 °C to 90 °C.
3. Humidity: 95 percent non-condensing.

J. Physical (Dimensions shall not to exceed):

1. Height: 1.5".
2. Width: 7.5".
3. Depth: 7.0".

K. Configuration:

1. Master Units:

a. Modem in SCADA system junction box for the Southbound Tunnel.
b. Modem in SCADA system junction box for the Northbound Tunnel.
c. Modem in the SCADA submaster and PAC#3 cabinet for the tunnel fire control panel junction box system.

2. Remote Units.--All other modems not specified.
3. Topology Configuration.--All modem shall be configured in a multi-drop self-healing ring.

L. Additional Equipment.--RS-232 to RS-485/RS-422 converter shall be provide if required for two channel operation.

10-3.34 FIRE ALARMS

ADDRESSABLE RELAY OUTPUT DEVICE

DESCRIPTION

Addressable Relay Output Device shall be an addressable output module for control of auxiliary equipment for control of auxiliary equipment such as air handlers, door release and elevator recall. The addressable relay output device (AO) connects directly to a compatible control unit's signaling line circuit and contains a SPDT relay to control auxiliary equipment. All of the electronics are contained in a small high impact polymer case.

Addressable Relay Output Device shall be field programmable with a unique four digit address and a 40 character owner location message. AO relay may be set or reset on command from the control unit. AO shall be programmed for real time clock operation. The real time clock programming permits the AO to be activated and deactivated by the time of day, calendar date and day of the week.

GENERAL

Internal Supervision

An internal set of relay contacts provides a feedback signal that confirms the activation of the addressable relay output. If the relay fails to operate at the appropriate time, the device transmits a trouble report for display by the control unit. AO is continuously monitored for:

A. Internal power supply voltages
B. Faulty entering of data into AO's memory
C. Relay state equals command state

Status LED

A status LED shall be mounted on the unit and indicates relay set or reset status by a tow or nine second flash interval. A trouble condition inhibits the status LED completely.

Installation

The Addressable relay output device shall be mounted in a North American 11/2" deep 1 gang box , or standard 4" square box 11/2" deep with a cover. The terminal block will accept #14 and 18 AWG wire. Sizes #16 and #18 are preferred.

Specifications

A. Input Voltage 16.5-27.5 VDC
B. Standby Current: 400micro Amp, Typical
C. Alarm Current: 400 micro Amp, Typical
D. Resistive Contact Rating: 2Amp @30VDC
E. Inductive Rating: 1.0 Amp @120 VDC, 0.35 PF
F. Pilot Duty: 0.6 Amp @ 30 VDC, 0.35 PF
G. Line Circuit: 255 (all can be activated)
H. Operating Temperature: -31F –151F
I. EMI Immunity: meets UL 864
J. Dimensions: 2.3" x1.8" x0.8" nominal
K. LED Pulse Modes:

1. Normal: 9 second interval
2. Trouble: LED is off
3. Alarm: 2 second interval

ADDRESSABLE CONTACT INPUT DEVICE

The addressable contact input device shall be an intelligent field device with its own microprocessor, 4K of memory any electronics necessary to interface 4 N/O or N/C un-powered contacts. All of the electronics shall be contained in a high impact polymer case, creating a very small durable device for installation. The device can be located up to 2500 ft from the monitored device with 18 AWG wiring. An end-of-line-resistor shall be required for supervision of the wiring to the device. The system address shall be a 4-digit number that uniquely identifies each device. The user location message shall be a 40-character, alpha numeric message that describes the location of the device.

The addressable contact input device shall continuously monitor the integrity of the following:

A. Continuity of supervised wiring’
B. Power/communications circuit voltage
C. Internal power supply
D. Memory data
E. Faulty entering of data into device memory

Shall there be a failure in the communication link between the device and the microprocessor that controls its signaling line circuit, the device shall be capable of reporting a Zone Alarm for the signaling line circuit and initiating a general alarm signal. During a general alarm, all outputs programmed for fail-soft operation shall activate.

The addressable contact input device shall be mounted in 2-1/2” deep, 1-gang box with cover. The terminal block shall accept 14, 16 and 18 AWG wire.

Specifications:

A. Input voltage: 16.5 – 27 VDC
B. Standby current: 450 uA Max.
C. Alarm current: 450 uA Max.
D. Max. No. of devices per communication circuit: 255
E. Operating temperature: -31 F – 151 F and 0-95% HR
F. LED pulse modes:

1. Normal: 9 second interval
2. Trouble: LED shall be off
3. Alarm: 2 second interval

G. Maximum 25 ohm per conductor / 50 ohm per circuit
H. Maximum 10 VDC @ 1 mA
I. Rating of LED circuit: 26 VDC max., 7 mA max
J. N/O and N/C initiating device circuit shall be NFPA class B/Style B

FIRE ALARM CABLE

The fire alarm cable shall be a multi-conductor 300 volts power-limited fire alarm cable use indoor applications that shall meet the following specifications:

DESCRIPTION
A. ASTM Bare Copper
B. Ceramifiable Silicon Rubber (CSR)
C. Twisted pair
D. Overall Flame Retardant Polyethylene (FRPE) Low Smoke, Non-Halogen Jacket

CABLE SPECIFICATIONS
A. Number of Conductors: 1 twisted pair (Two (2) conductors)
B. Conductor type: 14 AWG
C. Insulation Type and Thickness: CSR 0.034”
D. Jacket Type and Thickness: FRPE Low Smoke, Non-Halogen Jacket 0.045”
E. Nominal Outside Diameter: 0.360”
F. Nominal Capacitance: 21 pf/ft between conductors

RATING
A. NEC Type Fire Power-Limited Riser Rated –Circuit Integrity (CI)
B. UL Listed
C. Meet 300V requirements as specified in the NEC-105C
D. Direct Burial
E. Flame Rating UL1685, Flame Rating UL 2196-Two Hour Flame Test

FIRE ALARM POWER SUPPLY

The Fire Alarm Power Supply shall meet the following specifications:

DESCRIPTION

Power Supply/Charger shall be multi-agency approved single output power supply/charger convert a 115 VAC/60Hz input into one (1) 12VDC or 24VDC non-power limited output.

SPECIFICATIONS
A. 12 V(dc) or 24 V(dc) selectable output
B. 6-amp supply current.
C. Input 115V(ac)/60Hz, 1.45amp.
D. Input fuse rated@3.5 amp/250V.
E. Filtered and electronically regulated output.
F. Short circuit and thermal overload protection.
G. Built-in charger for sealed lead acid or gel type batteries.
H. Maximum charge current 0.7amp.

I. Automatic switchover to stand by battery when AC fails (zero voltage drop).
J. Relay Contact Indications

1. AC fail supervision (Form C contacts).
2. Low battery supervision (Form C contacts).
3. Battery presence supervision (Form C contacts).

K. AC input and DC output LED indicators.
L. Enclosure
1. Combination knockouts are ½" and ¾"
2. Accommodates up to two12V(dc)/7Ah batteries.

AGENCY APPROVALS
A. UL APPROVALS

1. UL 294: UL Listed for Access Control System Units.
2. UL 603: UL Listed Standard for Power Supplies for Use with Burglar-Alarm Systems.
3. UL 1069: UL Listed Hospital Signaling and Nurse Call Equipment.
4. UL1481: UL Listed Standard for Safety for Fire Protective Signaling Systems.
5. CUL Listed - CSA Standard C22.2 No.205-M1983, Signal Equipment.

B. OTHER AGENCY APPROVALS

1. MEA-NYC Department of Building Approved.
2. CSFM-California State Fire Marshal Approved.
3. FM-Factory Mutual Approved.

ADDITIONAL EQUIPMENT AND CONFIGURATION
A. ADDITIONAL EQUIPMENT

1. The Contractor shall provide two (2) 12 V(dc) 7 AH Sealed Lead Acid Batteries.
2. The Contractor shall provide and install for the junction box in which the Fire Alarm Power Supply is located, a Cooling Fan Package which shall included the following: 24 VDC UL 508 Type 1 fan rated at 55 CFM or higher, washable aluminum air filter, composite air plenum, finger guard and a special EMC shielding grille; and a Exhaust Package which shall included the following: washable aluminum air filter, filter retainer with integral finger guard and a special EMC shielding grille. The Contractor shall provide and install with the Cooling Fan Package and Exhaust Package a Temperature control switch set to 70 F and Timing Relay that operates on a repeat cycle start with pause for 3 hours. The contractor shall connect the temperature control switch and timing relay to operate the fan as specified above and as shown on the plans.

B. CONFIGURATION

1. The Contractor shall configure the Fire Alarm Power Supply.

FIRE ALARM SIREN

The fire alarm siren shall be code-3 Horn and Tone, which comply with ANSI/NEPA/ISO temporal pattern for standard emergency evacuation signaling. The siren shall be listed for UL 1971, emergency devices for the hearing impaired, and UL 464, audible appliance and in addition have the following specification:

Alarm tones	500-1200 Hz Sweep (1.0 sec. On repeat)
Operating voltage	24 V(dc)
Current consumption	23 mA

FIRE CONTROL DISPLAY STATION

The fire control display station shall be one of:

A. Vartech System Inc; VTPC150PSS NEMA 4X Panel Mount Computer
B. HMW Enterprises 3515P-G4E

C. C-more: EA7-T15C
or equal that shall meet the following specifications:

A. Input Voltage: 24 V(dc)
B. Operating System: Microsoft Windows XP Professional.

ADDRESSABLE PULL STATION

The addressable pull station shall meet the following specifications:

DISCRIPTION

A. The addressable pull station shall be an intelligent initiating device that shall contains it own "Addressable Contact Input" as specified in these special provisions and shall interface directly to the "Tunnel Fire Alarm Panel" as specified in these special provisions. The addressable pull station circuit shall be wired as NFPA Class B.
B. The addressable pull station shall be constructed of heavy die-cast aluminum for long life and shall use an internal toggle switch for reliable operation.
C. The addressable pull station shall be field programmable using the control panel keypad or hand-held programmer. A status LED shall be mounted on the addressable pull station and shall indicate the status by a 2 or 9 second flash interval. A trouble condition shall inhibit the status LED completely.
D. The addressable pull station shall be designed for quick, efficient emergency response, its double action PUSH/PULL levers shall prevent accidental operation. The addressable pull station shall be mounted in a 2-1/2 in. deep single gang box.
E. The addressable pull station terminal block on the Addressable Contact Input shall accepts 14, 16 and 18 AWG wire.

SPECIFICATIONS

A. Station type: Double action, with integral an Addressable Contact Input
B. Initiating device circuit: Style B (Class B) wiring
C. End of Line (EOL) Resistor value: 10 K ohm
D. Max. circuit resistance: 50 ohm
E. Max. circuit capacitance: 0.1 uF
F. Operating temperature range: -40 F to 150 F
G. Operating humidity range: 0-95% RH
H. Construction: Die-cast metal housing
I. Electrical box: 2-1/2 in. deep single gang box

ADDITIONAL EQUIPMENT

A. The Contractor shall provide and install in the DC Switch Class R Fuse for current rating of 30A to 600 A at 250 VDC or the Contractor shall provide and install in the DC Switch Class L Fuse for current rating of 800A to 1200 A at 250 VDC.
B. The Contractor shall provide and install in the DC Switch an auxiliary switch for remote monitoring.
C. The Contractor shall provide and install in the DC Switch an auxiliary switch for remote blown fuse indication.

ADDITIONAL EQUIPMENT

A. The Contractor shall provide six heavy-duty Lexan self-adhesive labels with each addressable pull station
B. The Contractor shall provide a 2-1/2 in deep single gang box for the addressable pull station.

FIRE PULL STATION

The pull station shall be within PDA 2 Kg pull force when used without break-tube and shall be highly visible (red color with white lettering) and have handle latch in down position to clearly indicate that the station has been operated. The pull station shall be listed UL 38, manually activated signaling box, and have the following specification:

Size	140 mm X 100 mm X 35 mm
Operating voltage	24 VDC
Current consumption	20 mA

LINEAR HEAT DETECTOR

The linear heat detector shall consist of the linear heat detector interface module, the linear heat detector sensor cable and the end-of-line junction box. The linear heat detector shall include a 6"L x 4"'W x 4"D stainless steel continuous hinge NEMA type 4X junction box with the bolts inside the junction box to house the linear heat detector interface module. The linear heat detector shall include 1-1/2" conduit with hangers or channel struts, nylon cable ties and nylon cable clamps that shall be use for the mounting of the linear heat detector sensor cable. The linear heat detector shall meet the following specifications:

LINEAR HEAT DETECTOR INTERFACE MODULE

A. The linear heat detector interface module shall be a microprocessor-based initiating device that communicates with the tunnel fire alarm control panel via the signaling line circuit (SLC) cable. The linear heat detector interface module shall be a low-profile-type, intelligent device that monitors one zone of up to 3,200 feet of linear heat detector sensor cable.
B. The linear heat detector interface module shall monitor its linear heat detector zone shown on the plans for over-temperature fire signatures as well as both open and short circuit conditions. Non-fire related short circuit conditions should not cause a false alarm condition.
C. The linear heat detector interface module shall be addressable and fully field-programmable to issue pre-alarm, alarm and trouble signals directly via the SLC cable to the tunnel fire alarm control panel. The linear heat detector interface module functionality and address shall be stored in its non-volatile memory. Tunnel fire alarm control panel and linear heat detector type systems that store linear heat detector interface module functionality in the tunnel fire alarm control panel shall not be considered as equivalent. The linear heat detector interface module shall be reset through the tunnel fire alarm control panel or through the remote display and control module (RDCM).
D. The Contractor shall install the linear heat detector interface module inside the junction box and connect the SLC cable from the tunnel fire alarm control panel and the linear heat detector sensor cable to the linear heat detector interface module.
E. The Contractor shall install a weather-tight connector where the linear heat detector sensor cable enters the 6"L x 4"'W x 4"D stainless steel continuous hinge NEMA type 4X junction box.
F. The linear heat detector interface module shall meet the following additional specifications:

1. Supply Voltage: From the tunnel fire alarm control panel via the SLC, 16.5 V(dc) to27.5 V(dc)
2. Current Consumption, Standby: 425 µA or less
3. Current Consumption, Alarm: 440 µA or less
4. Current Consumption, Fault: 425 µA or less
5. Noise Performance: Withstands 5% rms 60 Hz supply noise or 1 Vrms 60 Hz sensor noise with negligible performance loss. RFI immunity at 10V/meter field strength over the band of 20 MHz to900 MHz.
6. LED Pulse Modes:

    a. Normal: Slow flash GREEN every 9 seconds
    b. Pre-Alarm: Slow flash RED every 9 seconds.
    c. Alarm: Fast flash RED every 2 seconds.
    d. Trouble: Off

7. Operating Temperature Range: -40 ºF to 140 ºF
8. Approvals: Factory Mutual Research Center (FM) Approved, Underwriters Laboratories (UL) Listed, and California State Fire Marshall (CSFM) listed.

LINEAR HEAT DETECTOR SENSOR CABLE

A. The linear heat detector sensor cable shall be an integrating or averaging type detector cable that detects a localized hot spot or a low-level temperature increase over its entire length. Fixed temperature sensor cable shall not be acceptable.
B. Changes in temperature shall produce a change in resistance between the linear heat detector sensor cable conductors. This resistance change shall be monitored by the linear heat detector interface module to detect an alarm condition. Such a change in resistance beyond the alarm set point shall be communicated to the tunnel fire alarm control panel.
C. The linear heat detector sensor cable shall be capable of self-restoration when temperature drops below its set point, provided it has not been heated above 257° F.

D. The linear heat detector sensor cable shall consist of four 26 AWG solid copper conductors each insulated with a negative temperature coefficient material. The conductors shall be twisted at a rate of approximately thirty turns per foot to cancel out potentially high voltage inductance. The conductor insulation shall be color coded for ease of installation.
E. Linear heat detector sensor cable shall be designed for wet, oily or corrosive or outdoors, and shall be design for an ambient temperature expected to be in the range of -40 °F to 212 °F, the linear heat detector sensor cable shall have an additional outer extrusion of nylon.
F. The Contractor shall install the length as shown on the plans of linear heat detector sensor cable (LHD Cable).
G. The Contractor shall provide the length of 1-1/2" conduit with hangers or channel strut supports equal to the length of the linear heat detector sensor cable to be installed. The Contractor shall install the 1-1/2" conduit with hangers or channel strut supports equal to the length of the linear heat detector sensor cable to be installed on the ceiling and the linear heat detector sensor cable shall be mounted on the 1-1/2" conduit or channel strut supports.
H. The Contractor shall provide nylon cable ties and nylon cable clamps required to mount the linear heat detector sensor cable on the 1-1/2" conduit or channel strut supports. The Contractor shall install the linear heat detector sensor cable on the 1-1/2" Conduit or channel strut supports.
I. The Contractor shall install the linear heat detector sensor cable run as a continuous loop with no T-taps allowed.
J. The linear heat detector sensor cable shall meet the following additional specifications:

1. Tensile strength: 445 lbf
2. Dielectric material: Specially doped polymer
3. Standard outer jacket material: High temperature PVC
4. Voltage proof between PVC jacket and a conductor: 10 kV
5. Service life:

    a. Up to 212 ºF shall be 30 years or longer.
    b. At 257 ºF shall be 24 hours or longer.
    c. Shall be self-restored below 257 ºF or higher.

6. Max approved spacing (between parallel runs): 30 ft

LINEAR HEAT DETECTOR SENSOR CABLE MOUNTING

A. The linear heat detector sensor cable shall be mounted in a professional manner, in accordance with applicable codes and requirements.
B. The linear heat detector sensor cable using the items specified in section C shall be attached to a 1-1/2" conduit with hangers or channel struts that shall allow minimal movement.
C. The linear heat detector sensor cable shall be installed with nylon cable ties to the 1-1/2" Conduit with hangers or channel struts at an interval of every 3 feet per tie to ensure proper support and adequate distance away from metal surfaces. The nylon cable ties that are attached to the 1-1/2" conduit with hangers or channel struts shall use nylon cable clamps to fasten the linear heat detector sensor cable to the nylon cable ties and the1-1/2" conduit with hangers or channel struts at an interval of every 3 feet.
D. The distance from the ceiling of the linear heat detector sensor cable and the 1-1/2" conduit with hangers or channel struts with nylon cable ties and nylon cable clamps shall be as shown on the plans for the linear heat detector cable.

MOUNTING MATERIAL

A. The 1-1/2" conduit shall be Type 1 conduit with one end capped facing traffic.
B. The hangers and channel struts shall be stainless steel.
C. The screws and bolts shall be stainless steel.
D. The nylon cable ties and nylon cable clamps shall be designed to be use with the linear heat detector sensor cable and the 1-1/2" conduit.

END-OF-LINE (EOL) JUNCTION BOX

A. The end-of-line junction box shall be a two gang outlet box. The end-of-line junction box shall have the following specifications:

2. Capacity (Cu.-in.): 32.0
3. Dimensions: 4.56" L x 4.58"W x 2.0"D
4. Description: Standard
5. Enclosure: NEMA Type 4, UL 508 Type 4, Flammability rating UL 94-5V, ANSI/IEC 60529, IP66

B. Additional Equipment
   1. The Contractor shall provide a weather-tight connector for the linear heat detector sensor cable. The Contractor shall install the Weather-tight Connector where the linear heat detector sensor cable enters the end-of-line junction box.
   2. The Contractor shall provide a linear heat detector sensor cable heat pad as a test point at the end of each linear heat detector sensor cable zone. The Contractor shall install the linear heat detector sensor cable heat pad inside the end-of-line junction box.
   3. The Contractor shall provide and install if required an end-of-line resistor inside the end-of-line junction box.

SETTINGS

The linear heat detector shall be set to a maximum ambient temperature of 115 F for the length shown on the plans of the linear heat detector sensor cable for that linear heat detector.

TUNNEL FIRE ALARM CONTROL PANEL

The Tunnel Fire Alarm Control Panel shall be an addressable, distributed-intelligence control unit and fire alarm/suppression system; that shall meet the following specifications:

GENERAL

The Tunnel Fire Alarm Control Panel shall perform fire alarm, supervisory, and trouble event initiation; occupant notification; event annunciation; local control functions; fire extinguishing system release, and off premises transmission.

The Tunnel Fire Alarm Control Panel's distributed intelligence shall extend to the following devices: Addressable Pull Stations, Addressable Relay Outputs, Addressable Contact Inputs, Remote Release Modules and Linear Heat Detectors (LHD) on the signaling line circuit cable. Each device shall have a microprocessor capable of independently determining whether or not a fire signature at its monitored location is of sufficient magnitude to warrant the issuance of an alarm signal to the Tunnel Fire Alarm Control Panel.

CODES AND COMPLIANCE

A. The design, installation, testing and maintenance of the Tunnel Fire Alarm Control Panel shall be in accordance to the following codes and standards:

   2. UL864, 9th Edition
   3. NFPA 13, Standard for the Installation of Sprinkler Systems
   4. NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection
   5. NFPA 70, National Electrical Code
   6. NFPA 72, National Fire Alarm Code
   7. NFPA 75, Standard for the Protection of Electronic Computer/Data-Processing Equipment
   8. NFPA 76, Fire Protection of Telecommunications Facilities
   10. Factory Mutual Approval Guide
   11. Design and installation practices set forth by system manufacturer
   12. Requirements of the Local Authorities Having Jurisdiction (AHJ)

B. All of the components of the Tunnel Fire Alarm Control Panel shall have the following listings and approvals:

   1. FM Approved: Factory Mutual Research Center
   2. UL Listed: Underwriters Laboratories
   3. California State Fire Marshall (CSFM)

SYSTEM DESIGN CRITERIA

A. The Tunnel Fire Alarm Control Panel shall be supplied by the factory and shall be installed by the Contractor with the factory's authorization. The Contractor shall be trained by the manufacturer to design, install, test and maintain the Tunnel Fire Alarm Control Panel and shall be able to produce a certificate stating such.
B. All materials and equipment shall be new and unused.

QUALIFICATIONS

A. Manufacturer:

1. The manufacturer/supplier of the Tunnel Fire Alarm Control Panel hardware and components shall have a minimum of fifteen years experience in the design and manufacture of systems of similar type.
2. The manufacturer/supplier of the Tunnel Fire Alarm Control Panel shall be certified to ISO 9001 for a minimum period of five years for the design, production and distribution of fire detection, fire alarm and fire suppression systems.
3. The name of the manufacturer/supplier and manufacturer part numbers shall appear on all major components.
4. All devices (Addressable Pull Stations, Addressable Relay Outputs, Addressable Contact Inputs, Remote Release Modules and Linear Heat Detectors (LHD)), components and equipment shall be the products of the same manufacturer/supplier.
5. The Tunnel Fire Alarm Control Panel manufacturer/supplier shall have the ability to provide multiple suppression system arrangements to accommodate the performance criteria required by the project.
6. All devices (Addressable Pull Stations, Addressable Relay Outputs, Addressable Contact Inputs, Remote Release Modules and Linear Heat Detectors (LHD)), components and equipment shall be listed by the standardizing agencies (Underwriters Laboratory or Factory Mutual).

B. Contractor:

1. The Tunnel Fire Alarm Control Panel shall be supplied and installed by the Contractor. The Contractor shall be trained by the manufacturer to calculate/design, install, test and maintain during construction of tunnel; the Tunnel Fire Alarm Control Panel and shall be able to produce a certificate stating such.
2. The contractor shall employ a person who can show proficiency at least equal to a NICET level IV certification in special hazards design.
3. The Contractor shall confirm in writing that he stocks a full complement of spare parts and offers 24-hour emergency service for all equipment being furnished.

WARRANTY

The manufacturer shall warranty the Tunnel Fire Alarm Control Panel for 60 months from date of shipment.

SUBMITTALS

A. The Contractor shall provide all required installation drawings that shall include the following details:

1. Plan and riser drawings showing the location of the Tunnel Fire Alarm Control Panel and the locations of all field devices such as Addressable Pull Stations, Addressable Relay Outputs, Addressable Contact Inputs (N.O.), Remote Release Modules and Linear Heat Detectors (LHD). Include all necessary installation and mounting details. Conduit routings shall be shown, with number of conductors, type of wire, and wire sizes indicated for each conduit segment.
2. Point-to-point wiring diagram showing the termination points for all field-wiring circuits to the internal Tunnel Fire Alarm Control Panel Printed Circuit Board (PCB). All internal wiring and communications cabling shall be shown.
3. A primary-power calculation that details the power requirements for the Tunnel Fire Alarm Control Panel and all field devices such as Addressable Pull Stations, Addressable Relay Outputs, Addressable Contact Inputs, Remote Release Modules and Linear Heat Detectors (LHD). Include the required capacity of the main AC power-line feed from power panel in the substation.
4. A secondary-power calculation that shows the quiescent- and alarm-power requirements for the Tunnel Fire Alarm Control Panel and all field devices such as Addressable Pull Stations, Addressable Relay Outputs, Addressable Contact Inputs, Remote Release Modules and Linear Heat Detectors (LHD). Include the periods of time for which the quiescent- and alarm-power requirements shall be supported in order to determine the necessary standby-battery capacity.

B. The contractor shall provide the following supporting materials for the equipment being utilized in this project:

1. A complete component and equipment list with model numbers and Tunnel Fire Alarm Control Panel part numbers.
2. Product information sheets for each item of equipment
3. A theory of operations, with a description of system functionality
4. A detailed matrix of all the initiating points, control modules, and field circuits that identifies the labeling of all components and shows the relationships and activation sequences among the various initiating points and the control modules and/or field circuits.

5. The Engineer will review all submittals for conformance to the plans and the special provisions. The contractor shall be required to resubmit any materials, with appropriate modifications, that are found to be in non-conformance with the requirements of the plans and these special provisions after review by the Engineer. Approval of the submittals by the Engineer shall not relieve the contractor of his responsibility to meet the requirements of the plans and special provisions.

C. The contractor shall submit a test plan that describes how the system shall be tested. This shall include a step-by-step description of all tests and shall indicate type and location of test apparatus to be used. Tests shall not be scheduled or conducted until the Engineer of record approves the test plan.
D. Five copies of the Tunnel Fire Alarm Control Panel Installation, Operation and Maintenance Manual shall be submitted after complete installation.

SYSTEM CONFIGURATION

A. Activation of the extinguishing system (Sprinkler System) in a given zone shall be via the Remote Release Module for that zone when the Addressable Contact Inputs use for the SCADA control of the zone's water release by the Addressable Contact Input that represent that zone indicates an on condition from the SCADA Control and Indication Relay contact connected to the Addressable Contact Input operated by the field control station (FCS) in which that Addressable Contact Input is located or by the Linear Heat Detector (LHD) in a given zone indicating a fire condition when heat is detected by the Linear Heat Detector (LHD) for fifteen minutes.
B. Deactivation of the extinguishing system (Sprinkler System) in a given zone shall be via the Remote Release Module in that zone; when the Tunnel Alarm Control Panel in the substation or the Remote Display and Control Module (RDCM) reset the system.
C. The Tunnel Fire Alarm Control Panel shall be programmed to operate the Addressable Relay Outputs (As Shown on the plans) in a given zone when the following occur:

1. Activation of the extinguishing system (Sprinkler System) in a given zone to operate the Jet Fans, and deactivates when the Tunnel Alarm Control Panel in the substation or the Remote Display and Control Module (RDCM) turn off the extinguishing system (Sprinkler System) and reset the system.
2. Activates when each addressable pull station, and each Linear Heat Detector (LHD) indicates a fire condition and deactivates when each addressable pull station, and each Linear Heat Detector (LHD) does not indicates a fire condition from resetting the system.
3. When each Addressable Contact Input use for the supervisory switch for the extinguishing system (Sprinkler System) in a given zone indicates an on condition and deactivates when each Addressable Contact Input use for the supervisory switch for the extinguishing system (Sprinkler System) in a given zone indicates an off condition from resetting the system.

D. The Tunnel Fire Alarm Control Panel shall be programmed to operate in a redundant ring use the RS-232 serial communications ports connected to the Tunnel Fire Alarm Control Panel for the Northbound Tunnel and the Main Post Tunnels.
E. See Section G of the "CONTROL PANEL" for additional system configuration.

POWER SUPPLIES

A. The Control Panel of the Tunnel Fire Alarm Control Panel shall operate on 120 VAC 50/60 Hz Mains Supply.
B. The battery backup system shall consist of 24 VDC, maintenance free, sealed lead acid batteries of 1.2 AH capacity such as to provide for 24 hours of Standby operation followed by five (5) minutes of Alarm operation in the case of AC Mains failure. The battery charger shall be capable of providing a charging current of 0.48 Amperes.

CONTROL PANEL

A. The control-unit of the Tunnel Fire Alarm Control Panel configuration shall consist of a printed-circuit board (PCB) with the main microprocessor, an integral display/control assembly, and terminations for all field circuits, a primary power supply and an enclosure with removable door and viewing window.
B. The PCB shall contain the main-system microprocessor, the real-time clock, the history buffers, the watchdog timer, one USB device port, and two RS-232 serial communications ports. It shall also provide terminations for the following field circuits:

1. One signaling line circuit (SLC)
2. Two notification-appliance circuits (NACs)
3. Two combination NAC / releasing circuits (Combos)

4. Two releasing circuits
5. Three programmable relays
6. One trouble relay
7. One RS-485 communications circuit
8. Battery charging circuit
9. AC input power connections

C. The SLC shall serve as the hardware and software interface between the intelligent initiating and control devices and the Tunnel Fire Alarm Control Panel. The SLC shall be capable of communicating with up to 255 automatic detectors, monitor modules, and control devices, in any combination, without restrictions on the numbers of each type of field device.

D. The two releasing circuits shall be capable of actuating either an electro-explosive initiators, control heads, or solenoid valves. Each releasing circuit shall be independently programmable to activate any of the following configurations of extinguishing-system actuators:

1. Electro-explosive initiators, supervised and activated in series, subject to the constraints below:

    a. Maximum of twelve Initiator for Spherical Agent Storage Containers
    b. Maximum of six Initiator for Bottom Discharge Cylinders

2. One control head or solenoid valve
3. Two control heads or solenoid valves, supervised in series and activated in parallel. It shall not be necessary to use identical solenoid valves when two valves are activated on one releasing circuit.
4. The releasing circuits shall be capable of actuating Factory Mutual System classified valves (Groups A, B, D, E, G).

E. The two notification-appliance circuits (NACs) shall be independently programmable and configurable for either Class-A or -B operation.

1. The input power to the NAC shall be filtered and regulated. The NAC shall be capable of delivering a current of up to 1.5 A @ 24 VDC to the notification appliances.
2. It shall be possible to field-configure each Class-B, Style-Y NAC to activate notification appliances with any and all of the following parameters via a personal-computer-based configuration program:

    a. 20-character location
    b. Drill activation
    c. Silenceable / non-silenceable operation
    d. Walk-test activation
    e. Master-coded operation (60 bpm, 120 bpm, temporal per ANSI S3.41, continuous)
    f. Cutoff delay (5, 10, 15 minutes)
    g. Silence inhibit (1, 3, 5 minutes)

3. It shall be possible to override one master code with another depending on the state (i.e., pre-alarm, prerelease, release, or time-limit-cutout) of the particular suppression zone. It shall also be possible to shut off and re-activate a NAC as required by the approved system operating sequence. No supplemental equipment shall be required to perform this functionality.
4. It shall not be necessary to use external synchronization modules to synchronize the audible and visual notification signals created by any NAC.
5. Terminals for connection of field conductors to the NACs shall be large enough to accommodate #12 AWG wiring.

F. The basic power-supply / charger assembly shall consist of an AC to DC switching power unit. The power-supply / charger assembly shall be configurable to accept either 120 or 240 VAC input voltage, and shall provide 5.4 A at 24 VDC of filtered and regulated power to operate the system and charge the system's standby battery. The charger assembly shall be capable of charging batteries of capacities up to 70 AH. Two user-configurable auxiliary-power circuits shall be provided on the PCB to power peripheral devices. The auxiliary-power circuits shall be software programmable for either continuous or interruptible power output, and shall be rated for 1.0 A at 24 VDC. It shall not be necessary to set jumpers or dip switches on the PCB to make these outputs continuous or interruptible.

G. The Tunnel Fire Alarm Control Panel shall include an Intelligent Communications Module (ICM). The ICM shall be a device server that provides Internet access to the Tunnel Fire Alarm Control Panel via any standard Web browser such as Internet Explorer or Netscape Navigator. Also, the ICM shall be able to operate using a dedicated Local Area Network (LAN)/Wide Area Network (WAN). The ICM and the Tunnel Fire Alarm Control Panel shall be configured to perform the function specified in section C of the "SYSTEM CONFIGURATION" using the Modbus TCP/IP communication protocol to the **SCADA** Submaster Server without operating the Addressable Relay Outputs. The ICM shall provide the following client services:

1. Dial-up control-unit monitoring and status reporting
2. Automatic event detection and reporting via e-mail
3. Web-browser-based
4. Emulated display for the control unit
5. Access to items in the control unit's List Menu

CONDUCTORS

All wiring shall be of the proper size to conduct the circuit current, but shall not be smaller than #14 AWG unless permitted by the National Electrical Code (NEC) and NFPA 502. Wiring for the signaling line circuit (SLC) cable (length as shown on the plans for one tunnel) shall be in accordance with the Tunnel Fire Alarm Control Panel Installation, Operation, and Maintenance Manual and shall be a Non-PVC wire use for tunnel installations in accordance with NFPA 502. Wire that has scrapes, nicks, gouges, or crushed insulation shall not be used. The manufacturer's minimum wire-bending radii shall be observed in all enclosures, raceways, and conduits. Aluminum wire shall not be used.

EXECUTION

A. Electrical System Installation
   1. The contractor shall install the system in accordance with the appropriate Tunnel Fire Alarm Control Panel installation, operation and maintenance manual.
   2. Locations of all electrical equipment, the Tunnel Fire Alarm Control Panel, and all system components are subject to the approval of the Engineer.
   3. All final-acceptance tests shall be performed in the presence of the architect and the authority having jurisdiction. The contractor shall record all equipment, tests and system configurations in a format approved by the manufacturer and/or the local Authority Having Jurisdiction. A copy of the commissioning tests and results shall be provided to the Engineer, the authority having jurisdiction, and the end-user.

B. Training Requirements
   1. The contractor shall be certified and trained by the manufacturer on installation, design and maintenance of the Tunnel Fire Alarm Control Panel and shall be able to produce a certificate stating such.

SUBSTATION FIRE ALARM CONTROL PANEL

Fire alarm control panel shall be as specification on the plans, in addition to but not limited to the following:

AC POWER

A. 120 VAC, 60 Hz, 1.2 A
B. Wire size: 14 AWG minimum with 600 V insulation

INITIATING CIRCUITS

A. Power-limited circuitry
B. Operation: Style B (Class B)
C. Standby voltage: 24 VDC (ripple = 10 mV peak-to-peak)
D. Alarm current: 15 mA minimum
E. Short circuit current: 40 mA maximum
F. Maximum detector current in standby: 2 mA (peak) per zone
G. Maximum loop resistance: 200 ohm
H. End-of-line resistor: 4.7 k, ½ W
I. Detector loop current is sufficient to ensure operation of one alarmed detector per zone
J. Super visor current: 5 mA

NOTIFICATION CIRCUITS

A. Power-limited circuitry
B. Maximum voltage drop due to wiring: 2 VDC
C. Voltage: 24 VDC rms regulated (not filtered)
D. Total current to all external devices: 2.25 A maximum
E. Fuses: 2 AG, 4 A
F. Maximum signaling current per circuit: 1.5 A
G. End-of-line resistor: 4.7 K, ½ W

SUBSTATION SMOKE DETECTOR

The ionization smoke detector shall quickly respond to fast flaming fires as specified in UL 266 and have the following specification:

Current consumption	Standby (max): 100 uA Alarm current (max): 41 mA
Operation voltage range	20 to 29 VDC
Visual LED local alarm	
Remote LED annunciator	
Relay contact ratings, resistive or inductive (60% power factor) load	Alarm contacts: 2 A @ 30 VAC/DC Auxiliary contacts: 0.6 A @ 110 VDC 2.0 A @ 30 VDC A @ 125 VAC 2.0 A @ 30 VAC
Size	Base diameter: 14 cm Cover height: 8 cm Cover diameter: 8.4 cm
Weight	310 grams
Mounting	102 mm^2 box (41 mm min. depth) 91 mm or 103 mm octagonal box (41 mm min. depth)
Operating temperature range	0 to +49 C
Relative humidity	10% to 93% (non-condensing)
Maximum air velocity	360 m per minute
Locking alarm	Reset by momentary power interruption

ANNUNCIATOR DRIVER

The annunciator driver shall be a relay driver module that shall meet the following specification:

DESCRIPTION

The annunciator driver shall provide the tunnel fire alarm control panel with up to thirty-two programmable outputs for remote relays. The annunciator driver shall provide for six system-level relays and 5 system-level functional switches.

The system-level relays shall correspond to the following general conditions of the Tunnel Fire Alarm Control Panel:

A. Module Power
B. Alarm
C. Pre-Alarm
D. Alarm Silence
E. Supervisory
F. Trouble

The functional switches provide for the following operator intervention of the Tunnel Fire Alarm Control Panel:

A. System Reset
B. Event Acknowledgment
C. Alarm Silence
D. Fire Drill
E. Lamp Test

The annunciator driver shall communicate with Tunnel Fire Alarm Control Panel via an external RS-485 communications circuit, with the most-remote annunciator driver capable of being located up to 4,000 feet from the Tunnel Fire Alarm Control Panel. Up to sixteen annunciator driver shall be able to be connected to the Tunnel Fire Alarm Control Panel via the external RS-485 communications circuit and shall be able to connect in a bus configuration to the RS-485 communications circuit.

SPECIFICATIONS

A. Operating Voltage: 16.0 to 28.8 V(dc)
B. Standby Current: 0.045 or less
C. Output Activation: Common Positive Individual-output negative pull downs
D. Annunciator Driver Output: 0.080 A maximum or higher
E. Communications: RS-485; with RS-485 Cable
F. 24 VDC Input Power connection wire size: #14or larger to #18 AWG or smaller
G. Functional Switches connection wire size: #18 AWG
H. Audible Appliance connection wire size: #18 AWG
I. Power Supply Supervised
J. Initiating Circuit connection wire size: #18 AWG
K. Relays connection wire size: #18 AWG

FIBER OPTIC MODEM

The fiber optic modem shall be for connecting a variety of RS-233 synchronous (internal or external clock) or asynchronous communications devices to a host computer.

DATA RATES

Async:	up to 115 kbps
Sync:	up to 128 kbps

INTERNAL CLOCK

User-selectable: 2.4k, 4.8k, 9.6k, 19.2k, 38.4k, 64k, 128k

OPTICAL

Transmitter:	Edge Light Emitting Diode (ELED)
Receiver:	Positive-Intrinsic-Negative (PIN) Diode
Wavelength:	1300/1550 nm Singlemode
Fiber optic connectors:	ST Connectors
Loss budget:	15 dB Singlemode @ 9/125 µm

ELECTRICAL

Connector:	DB25 female
Interface:	(DCE only) RS-232

SYSTEM

Bit error rate: 1 in 10^9 or better

VISUAL INDICATORS

LEDs: DC, RxD, TxCLK, TxD, and Sync

POWER

Input Voltage: 12 V(dc) @ 250 mA

TEMPERATURE

Operating:	4 °F to 158 °F
Storage:	-40 °F to 194 °F
Humidity:	95 percent non-condensing

DIMENSIONS (Not to Exceed)

Height:	1"
Width:	4.5"
Depth:	3.5"

ADDITIONAL EQUIPMENT

Null Modems shall be provide if required for interfacing of the equipment to the modem.

REMOTE DISPLAY AND CONTROL MODULE

The Remote Display and Control Module shall provide an additional point of event reporting and operator intervention/control for the Tunnel Fire Alarm Control Panel. The Remote Display and Control Module 80-Character LCD display shall duplicate all the information on the Tunnel Fire Alarm Control Panel display.

The Remote Display and Control Module shall contain the following functional keys:

A. Event Acknowledgement
B. Alarm Silence
C. System Reset
D. Display Scroll

The Remote Display and Control Module shall have twelve digit/navigation keys that enable full menu functionality

The Remote Display and Control Module shall have a six system level LEDs corresponding to the following general conditions:

A. Module Power
B. Alarm
C. Pre-Alarm
D. Alarm Silence
E. Supervisory
F. Trouble

The Remote Display and Control Module shall meet the following specifications:

FEATURES

80-Character LCD Display
Up to 15 Remote Display and Control Module per Tunnel Fire Alarm Control Panel
Located up to 4000 feet from the Tunnel Fire Alarm Control Panel
Full Complement of Functional Keys and LEDs

ELECTRICAL

Network Wiring:	Style 4, Supervised and Power-Limited
Maximum Network Wiring Distance:	4000 feet
Communications:	Per RS-485 Standard
Operating Voltage:	24 V(dc) (Nominal)
Standby Current:	0.064 A or less
Alarm Current:	0.085 A or less
Maximum Number of Modules per Tunnel Fire Alarm Control Panel:	15.

MECHANICAL

Dimensions (Not to Exceed): 13" W x 7.5"H x 2.5"D
Color: Red

ENVIRONMENTAL

Operating Temperature:	32 °F to 120 °F
Relative Humidity:	85 percent at 90 °F (non-condensing)

INSTALLATION

The Remote Display and Control Module shall be supplied in an enclosure that shall be suitable for both surface and semi-flush mountings.

SELF-HEALING MULTI-DROP FIBER OPTIC MODEM

The self-healing multi-drop fiber optic modem shall meet the following specifications:

DATA RATES

Async RS-232, RS-422 and RS-485 (2/4 Wire): up to 38.4 Kbps

OPITICAL

Transmitter:	LASER
Receiver:	PIN Diode
Wavelength:	1300/1550 nm Single Mode
Fiber Optic Connectors:	ST Connectors
Number of Fiber Optic Connectors:	4 Connectors;Tx1, Rx1, Tx2 and Rx2
Loss Budget:	15 dB Single Mode @9/125um

ELECTRICAL

Connector:	DB25
Interface:	As shown on the plans

SYSTEM

Bit Error Rate:	1 in 10^9 or better
Type of Topologies:	A) Multi-Drop Ring B) Multi-Drop Self-healing Ring
Maximum Number of Channels:	Two(2)

Protocol Transparent
Multiple Master Capable
All-Digital Design

DIAGNOSTIC FUNCTIONS

Local & Remote Loopback (Testing)
Loop Monitor (Optical Loop Integrity Test)
Signal Generator
Disable Alarm
Anti-Streaming (Anti-Jabber)

VISUAL INDICATORS

MSTR, SLAV, Sync-A, Sync-B, Vcc, PWRA, PWRB, BRD-1, BRD-2, RSP-1, RSP-2, LPA, LPB, A2B and B2A

ALARM

Dry Contact Normal OPEN (N.O.)

POWER

Input Voltage: 24 Vdc@150 mA

TEMPERATURE

Operating:	-40 degree C to 80 degree C
Storage:	-40 degree C to 90 degree C
Humidity:	95% non-condensing

PHYSICAL

Dimensions (not to exceed):	A) Height:1.5" B) Width: 7.5" C) Depth: 7.0"

CONFIGURATION

Modem in SCADA System Junction Box for the Southbound Tunnel.
Modem in SCADA System Junction Box for the Northbound Tunnel.
Modem in the SCADA Submaster and PAC#3 Cabinet for the Tunnel Fire Control Panel Junction Box System.

REMOTE UNITS

All other modems not specified above.

TOPOLOGY CONFIGURATION

All modem shall be configured in a Multi-Drop Self-healing Ring.

ADDITIONAL EQUIPMENT

RS-232 to RS-485/RS-422 Converter as specified in the special provisions shall be provide if required for two channel operation.

REMOTE RELEASE MODULE

The remote release module shall be a field device that shall provide the ability to remotely activate extinguishing-system control devices such as sprinkler water release systems. The connection shall be via the "Tunnel Fire Alarm Control Panel" as specified in Signaling Line Circuit (SLC) Cable." A maximum of 64 remote release modules shall be support by the Tunnel Fire Alarm Control Panel Signaling Line Circuit (SLC) Cable. Up to 16 remote release modules shall be able to be configured for simultaneous group activation, with a maximum of 4 groups.

The remote release module shall provide internal supervision of communication with the Tunnel Fire Alarm Control Panel, connections to external power supply and memory status.

The remote release module release circuits shall be power-limited and supervised for short circuit by using an In-line Releasing-Circuit Device. In the event of a ground fault, open, short or a relay contact failure, the In-line Releasing-Circuit Device shall transmit a trouble status to the Tunnel Fire Alarm Control Panel.

The remote release module both auxiliary circuits shall be able to be wired together to obtain 2 A at 24 V(dc).

FEATURES

Supports Both Gaseous and Pre-Action/Deluge Sprinkler Systems
Triple R Protection Against Inadvertent Extinguishing-System Activation
5 year Warranty
UL Listed and FM Approved
Internal Communication and External Power Supervision
Dual Control Heads Activation

PROGRAMMING

The remote release module, addressing shall be able to be implemented from a hand-held programming device, from the Tunnel Fire Alarm Control Panel keypad menu or from the "Remote Display and Control Module" as specified in these special provisions keypad menu.

STATUS LED

The remote release module status LED shall be mounted on the remote release module shall indicated the remote release module's following status:

Normal, Standby:	Flash at 9-second repetition rate
Output Active:	On steady
Trouble:	Off

SPECIFICATIONS

SLC Wiring Configuration

Class B, Style-4
Class A, Style-6
Class A Style-7

Activation

Up to 64 remote release modules per SLC (Activated Consecutively)
Up to 4 Groups of 16 remote release modules per group (remote release modules in a group activate simultaneously, groups activate consecutively)

Releasing Circuit Output Current
2.4 A Max @ 24.0 V(dc)

Operating Voltage
24 V(dc) Nominal
Trouble Circuit Input
4.7 K End of Line Resistor
"Open" contact = normal condition
Power Consumption
From Power Supply

Normal, Standby:	6.1 mA
Alarm:	45 mA

From SLC

Normal, Standby:	410 µA
Alarm:	410 µA

Environmental Criteria
Indoor/Dry location use only

Operating Temperature range:	32 °F to 120 °F
Humidity:	93 percent ±2 percent RH at 90 °F ±3 °F

Terminal Connections
The remote release module shall support wires from No. 18 AWG to No.12 AWG.
Construction
The remote release module shall be made of high impact polymer faceplate with 16 gauge aluminum bracket.

ADDITIONAL EQUPMENT

One 4" square x 2-1/8" deep Steel Outlet Box (Double Gang).
One In-Line Releasing-Circuit Device.

INSTALLATION AND CONNECTION

The Contractor shall install the remote release module in the 4" square x 2-1/8" deep Steel Outlet Box and connection required for proper operation.

The Contractor shall install the In-Line Releasing-Circuit Device and connect as required for proper operation.

10-3.35 SCADA EQUIPMENT

SCADA CONTROL AND INDICATION RELAYS

The SCADA control and indication relays shall be Cutler-Hammer D7 Series control relays with wall/panel-mounted relay socket per relay, or Square D Class 8501 Type R control relays with wall/panel-mounted relay socket per relay, or equal. Each relay shall include a pilot light, and shall be a four (4)-pole double throw (4PDT) contact control relay. The coil voltage for each SCADA control and indication relay shall be shown on the plans. The SCADA control and indication relays shall be specified and shown on the plans as follows:

A. For The Secondary Unit Substation
   1. SCT – Trip Control SCADA control and indication relay
   2. SCC – Close Control SCADA control and indication relay
   3. SCR – Reset Control SCADA control and indication relay
   4. SCRS – Reset System SCADA control and indication relay
   5. R1 – MV Circuit Breaker charging Indication SCADA control and indication relay
   6. SCCPT – Control Power Test Control SCADA control and indication relay

B. For The Motor Control Center (MCC)
   1. BMC- Backup Motor Control Relay
   2. 43L - Local Control Indicator Relay
   3. 43L# - The # Jet Fan Local Control Indication Relay
   4. BPA - AUX BY-PASS Contractor
   5. FR - Fault Relay
   6. LX1 - Lighting Control Circuit #1
   7. LX2 - Lighting Control Circuit #2
   8. ON - ON Indication Relay
   9. ON# - # Jet Fan On Indication Relay
   10. RCR - Run Control Relay
   11. SC - SCADA Lighting Control Relay
   12. STP - Back-Up Motor Control Indication Relay
   13. STP1 - First Back-Up Motor Control Indication Relay
   14. STP2 - Second Back-Up Motor Control Indication Relay
   15. STP4 - Fourth Back-Up Motor Control Indication Relay
   16. SCRC - SCADA Control ON/OFF of Motor Relay

FIELD CONTROL STATION

The field control station shall meet the following specifications:

FEATURES

A. Programmable relay, AC or DC inputs, analog inputs, relay or DC outputs
B. Expandable up to 44 I/O
C. 20-point
D. Analog inputs, 10-bit resolution, 0-10 V(dc)
E. Analog input expansion, 10-bit resolution 0-10 V(dc) or 4 – 20 mA
F. 265 V(ac)/30 V(dc) relay outputs, 8 A resistive load (isolated)
G. With or without keypad/display
H. 4-line, 12-character LCD backlit display
I. 17 custom user screens
J. 8 programming keys
K. Retentive flash memory
L. Built-in real-time clock
M. Program from front of controller or software
N. Software supports simulator mode

FIELD CONTROL STATION INSTALLED (AS SHOWN ON THE PLANS)

The field control station shall include but not be limited to the following equipment to be installed by the Contractor for the field control stations (as shown on the plans):

A. field control stations in junction boxes #1, 6, 7 and 8
   1. Controller: Twenty-four point 24 V(dc) power source, twelve point 24 V(dc) inputs, eight outputs (relay, 8 A), four analog input, expandable, with LCD/Keypad. Shall support Modbus remote on port.
   2. Three expansion module: 24 V(dc) power source, four 24 V(dc) in, four out (relay, 8 A)
   3. Eight SCADA control and indication relays for Zone 3, Zone 4, Zone 5, Zone 6, Zone 7, Zone 8, Zone 9 and Zone 10 relays in field control station (FCS) junction boxes #6, 7 and 8.
   4. Sixteen power control relays non-latching type relays for high aux's, low aux's, CBI aux's and CBC aux's relays in FCS junction boxes #6, 7 and 8.
   5. Two power control relays latching type relays for fire relays in FCS junction boxes #6 and 7.
   6. Field control station programming and simulation software; including PC to FCS programming cable.
   7. Terminal blocks (number as shown on the plans)
   8. Conductors and cables required for the installation of field control station in FCS junction boxes #1, 6, 7 and 8 shown on the plans.

B. Field control stations in junction boxes #3, 4 and 5
   1. Controller: Twenty-four point 24 V(dc) power source, twelve point 24 V(dc) inputs, eight outputs (relay, 8 A), four analog input, expandable, with LCD/Keypad. Shall support Modbus remote on port.
   2. Three expansion module: 24 V(dc) power source, four 24 V(dc) in, four out (relay, 8 A)
   3. One Analog Expansion Module: 24 V(dc) power source, four analog inputs, voltage or current.
   4. Six SCADA control and indication relays for Zone 1, Zone 2, Jet 1, Jet 2, Jet 3 and Jet 4 relays in FCS junction boxes #3, 4 and 5.
   5. Sixteen power control relays non-latching type relays for high aux's, low aux's, CBI aux's and CBC aux's relays in FCS junction boxes #3, 4 and 5.
   6. One power control relays latching type relays for fire relays in FCS junction box #3.
   7. Field control station programming and simulation software; including PC to FCS programming cable.
   8. Terminal blocks (number as shown on the plans)
   9. Conductors and cables required for the installation of field control station in FCS junction boxes #3, 4 and 5 shown on the plans.

GENERAL SPECIFICATIONS

	Item	Specification
Environmental	Operation temperature	32 ºF – 131 ºF
Specifications	Storage temperature	-40 ºF – 158 ºF
	Operation humidity	20 – 90% RH, no frost
	Environmental gas	No corrosive gas exists
	Vibration resistance	IEC 60068-2-6 standard 0.003” amplitude/0.002lb
	Impact resistance	IEC 60068-2-27 standard 0.03lb peak, 11 ms duration
Noise-proofing	ESD	Contact ±6 KV, air discharge ±8 KV
	EFT	Power DC/AC: ±2 KV
	CS	0.15 – 80 MHz, 10 V/m
	RS	80 – 1000 MHz, 10 V/m
	EMI	EN 55011 class B
Installation	Enclosure protection	IP20
	Installation method	Panel-mount or DIN rail
	Mounting orientation	Any
Size of cable		AWG 12
Agency approval		UL
Dimension		2.83”x3.54”x2.35” DIN rail 2.83”x4.17”x2.35” direct
Input power voltage range		24 VAC (20.4 – 28.8 VAC)
Power consumption		24 VDC: 20 point, 150 mA
Wire size (all terminals)		26 to 14 AWG

FUNCTIONAL SPECIFICATIONS

Programming	
Programming languages	Ladder/Function block
Program memory	200 lines or 99 function blocks
Programming storage media	Flash
Execution speed	10 ms/cycle
LCD display	4 lines x 12 characters
Timers	
Maximum number	15
Timing ranges	0.01 s – 9999 min
Counters	
Maximum number	15
Highest count	999999
Resolution	1
Real time clock	
Number available	15
Resolution	1 min
Time span available	Week, year, month, day, hour, min
Compare instructions (Analog, Timer or Counter Values)	
Number available	15
Compare versus other inputs	Timer, counter, or numeric values

I/O SPECIFICATIONS

Discrete inputs	
Current consumption	4 ma @ 12 V(dc) 3.2 ma @ 24 V(dc) 1.3 ma @ 100-240 V(ac)
Input signal "OFF" threshold	<5 V(dc); <40 V(ac)
Input signal "ON" threshold	>15 V(dc); >79 V(ac)
Input On delay	DC: 5ms; 240 V(ac): 50ms; 120 V(ac): 90ms
Input Off delay	DC: 3ms; 240 V(ac): 50ms; 120 V(ac): 90ms
Transistor type	3-wire PNP sensor compatible
High speed input frequency	1 KHz
Standard input frequency	<40 H
Required protection	Inverse voltage protection required
Analog inputs (built into controller)	
Resolution	10 bit
Voltage range acceptable	Analog input: 0-10 V(dc), 24 V(dc) when used as discrete input

Input signal “OFF” threshold	<5 V(dc) (as 24 V(dc) discrete input)
Input signal “ON” threshold	>9.8 V(dc) (as 24 V(dc) discrete input)
Isolation	None
Short circuit protection	Yes
Total number available	A1 – A8
Analog inputs expansion	
Resolution	10 bit
Number of channels	4
Input range acceptable	Analog input: 0-10 V(dc), 4-20 mA
Isolation	None
Short circuit protection	Yes
Relay outputs	
Contact material	Ag alloy
Current rating	8 A
HP rating	1/3 HP @ 120 V, 1/2 HP@ 250 V
Maximum load	Resistive: 8A/point; inductive: 4A/point
Maximum operating time	15 ms (normal condition)
Life expectancy (rate load)	100 K operations
Minimum load	16.7 mA

SCADA SUBMASTER SERVER

The SCADA Submaster Server shall be a Crystal RS112 Rugged 1U Server or an Augmentix A+200 1U Rugged Server or Themis RES-12XR3 Rugged Enterprise Server or equal, and a 1U form factor rack-mounted 15-inch TFT monitor/Keyboard drawer that shall meet the following specifications below:

HARDWARE

A. 1st Processor: Quad-Core3.00 GHz or faster/ Two (2) 6 MB Level 2 Cache, 1333 MHz Front Side Bus (FSB) processor.
B. 2nd Processor: Quad-Core3.00 GHz or faster/ Two (2) 6 MB Level 2 Cache, 1333 MHz Front Side Bus (FSB) processor.
C. Memory: Minimum 8 GB 667 MHz DDR2 ECC SDRAM Dual Ranked DIMMs
D. 1st and 2nd Hard Drives: Two (2) 300 GB, Serial Attached SCSI (SAS) Hot Plug Hard Drives
E. Network Adapter: Dual Port copper Gigabit Network Adapter
F. CD-ROM Drive: Combo DVD-ROM/CD-RW Drive
G. HD Configuration: RAID 1 with 2 drives
H. Bezel: Included
I. Power Supplies: Hot-Plug or Swap AC Power supply.
J. Input Voltage: 110/220 VAC
K. Power Cords: Power Cord 1 Meters minimum.
L. Environmental Specifications: The SCADA Submaster Server shall be independently-test to and shall meet MIL-STD-810F for Humidity, Vibration and Shock.

SOFTWARE AND CONFIGURATION

A. Operating System: Microsoft Windows Server 2008 Standard x64 Edition or equal.
B. Additional Software:

1. SCADA system software shall be compatible with the SCADA System software at the Caldecott Tunnel (Wonderware HMI) with unlimited I/O point support.
2. Any additional software not specified, but shall be required to perform the functions specified in the “network communication system” specification for the SCADA submaster server as specified in these Special Provisions.

SCADA SUBMASTER SERVER SUPPORT SERVICES

A. 3 years Parts and Labor
B. 3 years 4 hour on-site 7x24

15-INCH TFT MONITOR/KEYBOARD DRAWER SPECIFICATIONS

A. Mounting: Rack mount, 19-inch
B. Display Type: LCD, TFT panel display with built-in power saving and back light protection functions.
C. Display Size: 15-inch diagonal
D. Viewing Area (W x H) Not to exceed: (12" x 9")
E. Dimensions (W x H x D) Not to exceed: (17.5" x 2" x 20")
F. Contrast Ratio: 300:1 (typical)
G. Viewing Angle:

    1. Horizontal: 70/70 degrees from center
    2. Vertical: 55/60 degrees from center

H. Display Colors: 16 million
I. Maximum Resolution: XGA (1024 x 768) @ 85Hz
J. Brightness: 200 nits
K. Response Time:

    1. Tr: 10 ms
    2. Tf: 35 ms

L. Interface: Analog RGB
M. Scanning Frequencies:

    1. Vsync: 60 to 75 Hz
    2. Hsync: 48.36 to 60 kHz
    3. Main: 65 to 80 MHz

N. Pixel Pitch (H x V) Not to Exceed: (0.012" x 0.012")
O. LCD panel protection: Tempered glass to protect LCD Panel Not to Exceed (0.08" x 10" x 13.5").
P. Cable Connector: 15-pin mini DSUB
Q. Monitor Control Type: Digital microprocessor OSD control
R. VESA Plug-n-Play Level: DDC1 and DCC2B
S. Screen Adjustment Controls:

    1. Menu
    2. Auto adjustment
    3. Brightness
    4. Contrast
    5. Phase
    6. H/V position
    7. Pitch
    8. Zoom
    9. Color
    10. Language
    11. OSD position

T. Power Management:
    1. VESA DPMS
    2. EPA/Energy Star compliant

U. Keyboard: PS/2, 83-key
V. Keyboard Dimensions (W x H x D) Not to Exceed: (5.5" x 0.8" x 15")
W. Integrated Trackball: PS/2, high-quality 16 mm trackball
X. Construction: SPCC with Ni-coating
Y. Housing: Meets EIA RS-310C 1U 19-inch rack mount standard
Z. Color: Black
AA. Mean Time Between Failures (MTBF): 25,000 hours or longer
BB. Power Adapter:

1. Input: 115 to 230 VAC, 1.8A, 50/60 Hz, 2/1A
2. Output: 12 VDC @ 3A, 2.5 W per channel
3. Type: AC PSU auto-switching
4. Input Impedance: 10K ohms
5. Power Consumption: 26.25 W (Typical), 36W (Maximum)

CC. Operating Environment:

1. Temperature: 0 to 45 deg C
2. Humidity: 20 to 90% @ 40 deg C, non-condensing
3. Attitude: 3048 Meters
4. Shock: 10g, 11 ms duration, half sine/six axis
5. Vibration: 10 to 58 Hz, + 0.075 mm; 58 Hz to 500 Hz, 1g

DD.Non-Operating Environment:

1. Temperature: -40 to 70 deg C
2. Humidity: 5 to 95% @ 40 deg C, non-condensing
3. Attitude: 15,240 Meters
4. Shock: 15g, 11 ms duration, half sine/six axis
5. Vibration: 10 to 58 Hz, + 0.015 mm; 58 Hz to 500 Hz, 2g

EE. Agency Approvals:

1. FCC Conformity with: Part 15, Subpart B
2. UL recognized to: UL 1950, 3rd Ed.
3. CE conformity with: UL equally standards

FF. Support:

1. Pre- and Port sales technical support
2. Two year limited warranty

GG.Ship Kit:

1. 1U 15-inch TFT monitor/keyboard drawer
2. Two (2) set of L-brackets for rear mount (screws included).
3. keys for key lock.
4. AC power cord
5. User's guide

HH.Accessories: Adapts PS/2 keyboard to AT connector

SOLATING SIGNAL CONVERTER

The full 3 port isolation shall be standard as isolated transmitter supply that shall use to power any standard 2-wire 4-20 mA transmitter. The input type and range shall be user selectable DIL switches inside the unit. All RTD and thermocouple inputs shall be fully linearized.

INPUTS

A. DC/AC current and voltage:

1. 0-20 mA, 4-20 mA, 0-10 mA into 15 Ω
2. 0-1 V, 0-10 V, 1-5 V into 1 MΩ

B. Min. and max. full scale ranges:

DC current	0-1 mA	0-60 mA
Bipolar DC current	± 5 mA	± 10 mA
DC voltage	0-1 V	0-300 V
Bipolar DC voltage	± 5 V	± 10 V
2 wire pot	0-125 Ω	0-1 kΩ
3 wire pot	0-1 kΩ	0-100 kΩ

THERMOCOUPLES

Type E, J, K, N, R, S, T, B linearized or non-linearized ranges:

A. Cold junction compensation (can be turned off)
B. Upscale or downscale t/c burnout options

RESISTANCE THERMOMETERS

A. 2, 3 or 4 wire PT100 or PT1000, linearized or non-linearized
B. Ranges: wide range of inputs
C. Upscale or downscale RTD burnout options

OUTPUTS

DC current and voltage:

A. 0-20 mA, 4-20 mA, 0-10 mA into max. 1 kΩ
B. 0-10 V, 1-5 V into a min 7 kΩ

SPECIFICATION

Parameter	Min.	Typ.	Max.	Comments
Supply voltage	12 V	24 V	36 V(dc)/32 V(ac)	90 to 264 for ac input
Supply current (mA)		45	85	For 24 V(dc) (260 mA for 50 ms on startup)
Input impedance (V)		1 Mohm		Dependent on range (typ.= 10 V)
Input impedance (mA)		15 ohm		Dependent on range (typ. =20 mA)
Volt drop (mA input)		0.3		At 20 mA input
Output linearity error		± 0.01	± 0.05	
Temperature coefficient			± 50 ppm/C	
Time constant (10-90%)	25 ms (fast)	60 ms (normal)		Selectable fast/normal response
Operating ambient	32 ºF		131 ºF	
Relative humidity	0%		90%	
Isolation voltage	1 kV			
Surge voltage		2.5 kV for 50 us		Transient of 10 kV/us

SIGNAL CONVERTER

The signal converter shall meet the following specifications:

DISCRIPTION

The signal converter shall be a full 3 port isolation that shall be standard as isolated transmitter supply that shall use to power any standard 2-wire 4-20 mA transmitter. The input type and range of the signal converter shall be user selectable DIP switches inside the unit. All RTD and thermocouple inputs of the signal converter shall be fully linearized.

INPUTS

DC current	0-1 mA	0-60 mA
Bipolar DC current	5 mA	10 mA
DC voltage	0-1 V	0-300 V
Bipolar DC voltage	5 V	10 V
2 wire pot	0-125 Ω	0-1 kΩ
3 wire pot	0-1 kΩ	0-100 kΩ

THERMOCOUPLES

Type E, J, K, N, R, S, T, B linearized or non-linearized ranges:

A. Cold junction compensation (can be turned off)
B. Upscale or downscale t/c burnout options

RESISTANCE THERMOMETERS

A. 2, 3 or 4 wire PT100 or PT1000, linearized or non-linearized
B. Upscale or downscale RTD burnout options

OUTPUTS

DC current and voltage:

A. 0-20 mA, 4-20 mA, 0-10 mA into 1 kΩ Max
B. 0-10 V, 1-5 V into a 7 kΩ Min

SPECIFICATIONS

Parameter	Min.	Typ.	Max.	Comments
Supply voltage	12 V	24 V	36 VDC/32 VAC	90 to 264 for ac input
Supply current (mA)		45	85	For 24 V(dc) (260 mA for 50 ms on startup)
Input impedance (V)		1 Mohm		Dependent on range (typ.= 10 V)
Input impedance (mA)		15 ohm		Dependent on range (typ. =20 mA)
Volt drop (mA input)		0.3		At 20 mA input
Output linearity error		+/- 0.01	+/- 0.05	
Temperature coefficient		+/- 50 ppm/ºC		
Time constant (10-90%)	25 ms (fast)	60 ms (normal)		Selectable fast/normal response
Operating ambient	32 ºF		131 ºF	
Relative humidity	0%		90%	
Isolation voltage	1 kV			
Surge voltage		2.5 KV for 50 µs		Transient of 10 kV/µS

PROGRAMMABLE AUTOMATION CONTROLLER

The programmable automation controller shall be a control system that shall meet the following specifications:

PROJECT OBJECTIVES

A. This specification describes the functional requirements, design features, hardware, software, system performance, services, and documentation required for a control in a scalable discrete or hybrid control system.
B. The control system shall perform as a minimum the following functions as defined in the specific sections of this document:

1. Control system must comply with the requirements for a programmable automation control.
2. System must be open architecture with the control functions being modular and scalable
3. Shall provide for optional redundancy for servers, controllers, networks, and I/O
4. High speed , deterministic, peer to peer communications between control systems
5. Ability to communicate with 3rd party devices and controllers with field bus connections
6. Integrated environment for all applications (discrete, process, motion, MMI) development, configuration, commissioning, monitoring, and maintaining with one database
7. Complete management system for all access levels to control application for necessary security requirements
8. Either integrated in the control system or through standards based connections (Ethernet, OPC), interface and share database with high level HMI/SCADA system with historian, trending, and additional functionality
9. Integrated alarms and events
10. Web connectivity for interface to control for monitoring and maintaining
11. Compliant with safety and environmental regulations

PROGRAMMABLE AUTOMATION CONTROLLER DEFINITION

A. The requirements for a programmable automation controller (PAC) are:

1. Multi-domain functionality, including logic, motion, and HMI for discrete and process control on a single platform
2. Will allow users & OEMs to deploy multiple control applications on a single platform
3. Common development platform for the design and integration of multi-domain automated systems
4. Will facilitate open, modular control architectures that enable highly distributed automated factory environments
5. Employ de-facto standards for network interfaces, languages, etc., allowing data exchanges as part of networked multi-vendor systems

B. Other Definitions:

1. The programmable automation controller (PAC) shall a portable engine built on standards, that shall allows the same application to be run on multiple platforms.
2. Ethernet: A very high performance local area network standard providing the two lower levels of the ISO/OSI seven layer reference model, the physical layer and the data link layer.
3. TCP/IP: a protocol widely used across Ethernet networks for connecting computers and programmable controllers.
4. Web Browser: A client application that provides a user interface via the World Wide Web..
5. Communications protocol: A formal set of conventions governing the control of inputs and outputs between the two communicating processes.
6. Network: An interconnected group of nodes, a series of devices, nodes or stations connected by communications channels.
8. Operating System: A program that controls the entire overall operation of the system hardware / software. The programmable automation controller shall use standard operating systems to allow program portability and application flexibility.

MANUFACTURER'S QUALIFICATIONS

A. Manufacturer's Standards: The manufacturer shall have shown high commitment to product, manufacturing and design process quality. It shall have attained ISO9001 registration.

B. Design and Manufacture:

1. All of the components within the family of controller products shall be offered by a company who regularly manufactures and services this type of equipment.
2. The programmable controller and all of the corresponding components within the family of controller products shall be offered by a company who regularly manufactures and services this type of equipment.
3. All products shall be designed, manufactured, and tested in accordance with recognized UL, and IEC mark industrial standards. The system shall be operational during and after testing.
4. The manufacturer shall have a fully operational quality assurance and quality control program in place and shall comply with ISO9001 standards for "Quality Systems- Model for Quality Assurance in Design/Development, Production, Installation, and Servicing."
5. Complete documentation describing installation, operation, programming and simple field maintenance shall be available in paper format and on CD-ROM.

C. Support:
   1. The manufacturer or its authorized representative shall provide complete global technical support for all of the products. This shall include headquarters or local training, regional application centers, and local or headquarters technical assistance. A toll-free (800) number hot-line shall be available for emergency support.
   2. Product shall have a warranty period of at least 1 year from the date of purchase and an optional extended warranty. The contractor shall maintain the warranties of the product to the completion of the project.

STANDARDS

The standards requirements for the programmable automation controller shall be as follows:

AGENCY APPROVALS OVERVIEW		Comments
Quality Assurance in Design/ Development, Production, Installation & Servicing	ISO9001	Certification by Underwriters Laboratories and BSI Quality Assurance
Safety for Industrial Control Equipment	UL508, ,	Certification by Underwriters Laboratories
Safety for Hazardous Locations Class I, Div II, A, B, C, D	UL1604, with , FM3611,	Certification by Underwriters Laboratory for selected modules, Certification by Factory Mutual for selected modules, Certification by Canadian Standards Association for selected modules

STANDARDS OVERVIEW		Conditions
ENVIRONMENTAL		
Vibration	IEC 68-2-6	1 G @ 40-150 Hz, 0.012 in p-p @ 10-40Hz
Shock	IEC 68-2-27	15 G .11 ms
Operating Temperature		0°C to 60 °C:[inlet], 0°C to 55 °C:[ambient]
Storage Temperature		-40°C to +85°C
Humidity	IEC 529	5% to 95%, non-condensing
Enclosure Protection		Steel cabinet per IP54: protection from dust & splashing water
EMC EMISSIONS		
Radiated Conducted	CISPR 11, FCC	part 15, subpart J, Class A
EMC IMMUNITY		[applies to CE Market modules]
Electrostatic Discharge	IEC 1000-4-2	8 kVAir, 4 kV Contact
RF Susceptibility	IEC 1000-4-3	10 V_{rms}/m 80 MHz to 1000 MHz, 80% AM
Fast Transient Burst	IEC 1000-4-4	2 kV: power supplies, 1KV: I/O, communications
Surge Withstand	ANSI/IEEE, C37.90a, IEC255-4	Ring Wave, 2.5 kV: Power supplies, I/O [12,240V], Ring Wave, Class II: Power supplies, I/O[12,240V]
Conducted RF	IEC 1000-4-6	10 V_{rms}, 150 kHz to 80 MHz, 80%AM: communication modules with cables>30 m
ISOLATION		
Dielectric Withstand	UL 508, UL 840, IEC 664	1.5 kV for modules rated from 51 V to 250 V
POWER SUPPLY		
Input Dips, Variations	IEC 1000-4-11	During Operation: Dips to 30% and 100%, Variation for AC ±10%, Variation for DC ±20%

A. Hardware

1. General:

    a. The system shall consist of rugged components designed specifically for industrial environments. A complete system shall consist of one or more racks containing I/O modules, interconnected by signal cables.

2. Packaging:

    a. All components shall be housed in structurally secure enclosures.
    b. The controller CPU shall be modular. It shall be fully enclosed within a durable plastic shroud. When mounted on the system base, the modular CPU shall not occupy more than two available slot.
    c. The I/O system shall be modular. Each module shall be fully enclosed within a durable plastic shroud. When mounted on the system base, each I/O module shall not occupy more than one available slot. Loops shall be part of the module for securing field wiring.
    d. There shall be at least two sizes of I/O bases available. One shall hold up to 12 I/O modules and the other shall hold up to 16 I/O modules. The base shall support a high speed serial bus and a high speed PCI bus.
    e. I/O modules shall be retained in their slot by a hinge on the upper rear edge and snap on the lower rear edge of the baseplate. Removing the module shall require no tools.
    f. I/O modules shall be installed in any available slot in the CPU or expansion baseplates, and shall require no tools for insertion and extraction.
    g. I/O modules shall connect electrically to the baseplate via a pin and socket connector.
    h. I/O modules shall be fully enclosed in a plastic covering protecting the electronic circuitry from exposure.

3. Durability:

    a. All components within the controller family shall be manufactured with a high degree of durability.
    b. All switches and other operator-controlled devices shall be of the size and durability for the intended use as is normally offered for industrial applications.
    c. All signal cables furnished by the manufacturer shall be constructed so as to withstand, without damage, all normal use and handling.

4. Parts Interchange:

    a. In order to minimize spare parts stocking requirements, the controller family shall have a high degree of interchange capability. The power supply, battery, EEPROM Chips should all operate equally well regardless of the CPU being used.
    b. The system shall incorporate a modular design using plug-in assemblies with pin and socket connectors.
    c. Wherever possible, all assemblies and sub-assemblies performing similar functions shall be interchangeable.
    d. The system design shall accommodate the replacement of assemblies without having to disconnect field wiring. Wherever possible, removable connectors shall be used to connect field wiring to the individual circuit board assemblies.
    e. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings each of which indicates the manufacturer's catalog number, product manufacturing date code, UL and C-UL certifications.

B. Environmental Conditions:

1. All components of the controller system, except CRT terminals and programming workstations, shall meet the following environmental specifications:

    a. Storage Conditions: Temperature from -40ºC to 85ºC.
    b. Operating Conditions: Temperature from 0ºC to 60ºC.
    c. Humidity: From 5 percent to 95 percent relative humidity, non-condensing.

C. Power Supply Module:

1. The Contractor shall provide the number of power supplies for each Programmable Automation Controller as shown on the plans.

    a. The Power Supply for the Programmable Automation Controller shown on the plans shall be a DC power supply operating from a 12 VDC to 30 VDC voltage source. provide 40 Watts of power.
    b. Power supply shall be a single wide module.

2. Specifications

    a. The power supply shall contain internal diagnostics to detect over temp and over load conditions.
    b. LEDs on the power supply shall indicate over temp and over load. This diagnostic information will also be available to the CPU.
    c. The power supply shall support hot insertion.
    d. Multiple power supplies shall be supported on the base to support redundant power supplies or for more capacity.
    e. The power supply shall be modular in design, separate from the CPU and baseplate for easy replacement in the unlikely event of failure.
    f. The power supply shall have a ON/OFF switch

D. Central processing unit (CPU)

1. Types of CPU

    a. The CPU shall be a modular type. The CPU shall possess the capability to solve application logic, store the application program, store numerical values related to the application processes and logic, and interface to the I/O systems. The CPU shall need no additional modules to provide at least the following advanced programming features: floating point math, PID, modulo, math, double precision math, logical functions, subroutines, data array move and indirect addressing.

2. Modular CPU

    a. The modular type CPU shall contain: A minimum 586 class microprocessor operating at speeds no less than 300 MHz as the main processing element, memory mounted on the board. A minimum of 10 Meg-bytes of memory shall be on board for user configurable application, data storage and documentation storage.
    b. The modular type CPU shall contain a real-time calendar and clock that can be accessed by the user program. This time of day clock and calendar shall be battery-backed and maintain seven time functions: year (2 digits), month, day of month, hour, minute, second, and day of week.
    c. The modular CPU shall execute Boolean functions at a rate of 0.3 microseconds per instruction or lower.
    d. The modular CPU shall be capable of controlling up to 79 I/O slots.
    e. The modular CPU shall be able to provide special functions such as High Speed Counter function, Axis Positioning function, and Local Area Networking function.
    f. The CPU shall be able to provide 2 serial ports, one 9 pin RS232 and one 15 pin RS485 for communications.
    g. The modular CPU shall contain a battery slot to support backup power for the SRAM
    h. A RUN ENABLED/RUN DISABLED/STOP switch shall be on the CPU behind a door for security.
    i. LEDs on the CPU shall indicate the following:

        CPU OK
        RUN mode
        Outputs Enabled
        Battery condition
        System faults
        Comm 1 activity
        Comm 2 activity

E. System Diagnostics

1. Visual Diagnostics

a. Status of low or dead battery shall be indicated by a red battery LED on the power supply module.
b. The diagnostic status of the fuses, for those discrete I/O modules containing fuses, shall be indicated by a red LED mounted on the top of the module. The red LED shall illuminate when a blown fuse condition is present.

2. Alarm Processor

a. The CPU shall contain an alarm processor that is special PAC feature designed to receive and process faults. The diagnostics shall provide information on the configuration and CPU, memory, communications and I/O status.
b. The alarm processor function shall log I/O and system faults in two fault tables that shall be accessible for display on the PC compatible programming software screen or uploaded to a host computer or other coprocessor.
c. The alarm processor shall maintain the states of up to 128 discrete system diagnostic bits to be read by a host or incorporated as contacts into the ladder program for customized diagnostic routines.
d. Each fault table shall have a total capacity of 32 faults. The last 16 entries shall maintain the latest 16 faults. The first 16 shall be kept unchanged.
e. Faults may be cleared by the user by way of a programmer. Provision shall be made by way of passwords to protect these faults from unauthorized clearing.

3. Alarm Features

a. The alarm processor shall report three types of fault action; fatal, diagnostic, or informational, and the CPU shall respond as follows:

Fault Action	Fatal	Diagnostic	Informative
CPU enters STOP mode	YES	NO	NO
Set diagnostic bit	YES	YES	NO
Logged in fault table	YES	YES	YES

b. When an I/O fault occurs, the alarm processor shall report the rack and slot location of the fault, the condition, the address and the circuit number if appropriate.
c. The modular CPU alarm processor function shall have the capability to time-stamp system faults for future references.

F. System Security

1. Programmable Logic Controller Memory Protection

a. The Programmable Automation Controller shall have 4 levels of security or password privilege levels to prevent unauthorized changes to the contents of the Programmable Automation Controller. These built-in privilege levels shall be set in the programming software or with the Hand-Held Programmer and shall impose the following constraints:

Level	Constraint
1.	Read PLC data only (except passwords)
2.	Write to any data memory
3.	#2 and write to all configuration or logic in STOP mode
4.	#3 and write to logic in STOP or RUN mode (on-line change) and password level access.

b. There shall be one password, one to four ASCII characters in length, for each privilege level in the programmable automation controller, and the same password can be used for more than one level.
c. Any attempts to access or modify information in the programmable automation controller without the proper password privilege level shall be denied.

2. Subroutine Password

    a. The programmable automation controller shall have a software OEM key that allows users to control access to each subroutine in the relay ladder program.

3. OEM Program Protection

    a. The programmable automation controller shall have a software OEM key that allows users to protect the resident program from unauthorized reads and writes.

G. CPU Memory

1. Memory Capacity

    a. The programmable automation controller shall supply a modular design CPU that contains at least the following:

    10Megbytes for application programming
    Configurable up to 5 Meg 16-bit registers for register and data usage
    Up to 32K control relays internal battery backed
    Up to 32K bits for discrete inputs
    Up to 32K bits for discrete outputs
    Configurable up to 32K 16-bit registers for analog inputs
    Configurable up to 32K 16-bit registers for analog outputs

    b. All application memory shall be available to the user program. Executive level operations performed by the CPU shall not consume application memory.

2. Memory Storage

    a. The register values and the application program shall be stored in a battery backed, CMOS static RAM memory. The application program and system configuration shall be stored in FLASH memory.
    b. There shall be a long-life Lithium battery used to maintain the contents of the CMOS RAM memory in the CPU.
    c. There shall be an easily accessible battery compartment in the power supply with dual battery connectors. The battery shall be replaceable with power applied to the Programmable Automation Controller and without removing the CPU.
    d. An LED shall provide visual indication of the battery condition. Additionally, a low battery condition shall be alarmed with a system diagnostic bit.
    e. The modular CPU shall allow the resident user program to be maintained in the CPU without power applied. Two levels of maintainability shall be provided, short duration and long duration.
    f. For short duration, the program shall be maintained by a hi-capacity capacitor for a period of no less than 1 hour. This allows adequate time for replacing the battery in the power supply module, should the external supply to the CPU be interrupted.
    g. For long duration, the CPU module shall maintain its contents by using the battery. This allows the CPU module to be shipped via surface mail where power supply to the module is not available. This method may be achieved by providing internally mounted battery. If the CPU module does not have an internal battery then an external battery board may be used.
    h. The CPU shall calculate the application program checksum at the end of every sweep. A complete checksum calculation for a program may take several sweeps. A fixed number of program memory checksum shall be calculated each sweep. This number is configurable by the user. If the calculated checksum does not equal the reference checksum, a fault shall be recorded, and the CPU mode will change to STOP.

H. Programming Environment

1. Programming Devices

a. A software programming package, for development of application programs, shall be furnished. The software programming package shall be capable of running on a PC compatible laptop or desktop computer.
b. On-line and off-line, CPU and I/O configuration and application program development shall be achieved with a PC compatible computer and programming and documentation software.
c. The PC compatible computer shall be connectable to the Programmable Automation Controller via a built-in serial communication port. In addition to the serial communications, the PC compatible computer shall be connectable to the Programmable Automation Controller via Ethernet TCPIP supporting the SRTP application protocol. A separate module providing Ethernet communications through 10baseT connection.
d. The programming devices shall have access to the application program, the CPU and I/O system configurations, all registers, CPU and I/O status, system diagnostic relays, and I/O over-ride capabilities.

2. Operator Interface

a. The programming port and its protocol shall be open in architecture. The protocols of this communication port shall be published such that a user may develop their own operator interface device, software or hardware, to access Register, I/O status, I/O override and system diagnostic memory data.
b. Through an open nature of this communications protocol, a wide variety of operator interface shall be made available. These may be manufacturer's own brand or they may be manufactured by 3rd party vendors.

I. Instruction Set

1. Programming Language

a. The CPU shall be capable of solving an application program whose source format shall be relay ladder diagram. The language shall support relay, timers and counters, arithmetic, relational, bit operation, data move, conversion, and control functions

Normally Open Contact
Normally Closed Contact
Coil
Negated Coil
Retentive Coil
Negated Retentive Coil
Positive Transition Coil
Negative Transition Coil
Set Coil (Latch)
Reset Coil (Unlatch)
Retentive Set Coil
Retentive Reset Coil

b. The CPU shall be capable of solving an application program whose main program format is in Sequential Function Chart (SFC) with underlying code in relay ladder diagram.

2. Relay Functions

a. Relay ladder operations shall consist of the following contacts and coils:
b. Positive transition coils and negative transition coils shall function as leading and trailing edge one-shot coils respectively.
c. Contacts may be referenced any number of times within the application program.
d. A single rung may contain more than one coil.
e. There shall be a service that allows user programs to be checked for multiple coil use. This flag may be set to:

Disallow more than one coil in a single rung
Allow multiple coil use but generate warning messages
Allow multiple coil use without warnings

3. Timers And Counters

a. Timer and counter operations shall consist of the following functions:

Retentive On-Delay Timer (ONDTR)
Simple Off- Delay Timer (OFDT)
Simple On-Delay Timer (TMR)
Up Counter (UPCTR)
Down Counter (DNCTR)

b. The retentive on-delay timer shall behave as a stop-watch that increments time when enabled and holds the current timed value until receiving power flow to the reset input.
c. The simple on-delay timer shall increment while it receives power flow and reset to zero when power flow stops.
d. The simple off-delay timer shall increment while it power flow stops and reset to zero when power flow is present.
e. There shall be at least 10,666 programmed timers and/or counters available for use in application programs
f. Each timer or counter requires the use of three 16-bit registers within %R memory for storage of the preset, the current value and a control word. g. These three registers shall be accessible to the user via a register reference.

The timers and counters shall not require an output reference, the output of a timer or counter can be used to energize a coil, or enable another function, such as a math function, or another timer or counter.

h. The time/count limit shall be either a programmed constant or shall be programmable via a register reference value.
i. The time shall be counted in tenths of seconds or hundredths of seconds, and the range for the timers and counters is 0 to 32,767 time units.

4. Arithmetic

a. The arithmetic operations shall support two data types, Signed Integer (INT), and Double Precision Integer (DINT). On the modular CPU, the Floating Point data type shall also be supported via floating point emulation. Arithmetic functions shall consist of the following types:

Addition
Subtraction
Multiplication
Division (quotient)
Modulo (remainder)
Square Root

b. Signed integers data shall be stored in 16 contiguous bits of memory, in 2's complement notation. The range for signed integer data shall be -32,768 to +32,767.
c. Double precision integer data shall be stored in 32 contiguous bits of memory, double precision data is always signed. The range for double precision integer data shall be -2,147,483,648 to 2,147,483,647.
d. The arithmetic function blocks shall consist of 3 inputs and 2 outputs. The enable input shall begin the execution. When the function is enabled, the two data inputs are operated upon and the result is output. There shall also be an OK output that is always true when the function is enabled, unless an overflow or other error exists.
e. All of the Arithmetic functions shall be such that they can be cascaded together in a single rung.

5. Relational Functions

   a. Relation Functions which are used to compare two numbers, shall operate on Signed Integer and Double Precision Integer data types, and shall consist of the following types:

      Equal To Not Equal To
      Greater Than Greater Than or Equal to
      Less Than Less Than or Equal to

6. Bit Operation Functions

   a. Bit Operation Functions shall perform comparison and movement operations on word data that is specified as a continuous string of data in 16-bit increments, with the first bit of the first word being the least significant bit, and the last bit of the last word being the most significant bit.
   b. Bit Operation Functions that are used to perform Boolean operations on corresponding bits of two bit strings of the same length shall consist of the following types:

      Logical AND
      Logical OR
      Logical Exclusive OR

   c. Bit Operation Functions used to create an output string that is a copy of an input bit string, but with its bits inverted, shifted, or rotated shall consist of the following types:

      Logical Invert (NOT)
      Shift Left
      Shift Right
      Rotate Left
      Rotate Right

   d. The shift functions shall allow for the user to specify the number of places that the array is to be shifted as an input, and provide the state of the last bit shifted out, and a copy of the shift register as outputs.

7. Data Move Functions

   a. Basic data movement capabilities shall be provided by the following list of functions:

      Move
      Block Move
      Block Clear
      Shift Register
      Bit Sequencer
      Range
      Communications Request

   b. The movement of data (16 bit integer or word), as individual bits, from one location to another shall be accomplished by the Move function. The user shall be able to specify the length of the move.
   c. The Block Move function shall provide the functionality to move a block of 7 constants (integer or word) to a specified location.
   d. The ability to fill a specified block of data (word) with zeros shall be accomplished by the Block Clear function. The user shall be able to specify the length of the block.
   e. The Shift Register function shall provide the functionality to shift one or more data words from a reference location into a specified memory location. All of the data within the Shift Register shall be accessible throughout the program from logic addressed memory.
   f. A method of shifting a bit sequence through an array of bits shall be provided by a Bit Sequencer function. The function shall provide the ability to reset the sequence, change the direction of the bit pattern, or access the step location within the array.
   g. A method of checking for a value to be contained within a group of values shall be provided in a Range function.

h. Provisions to initiate communications with a specialized communication module shall be made through the use of a Communication Request function. This function shall allow the Programmable Automation Controller to behave as a master on a serial communication link, thus providing the ability to communicate master/slave or peer to peer with any controller or computer using the same serial communication protocol.

8. Table

a. Table operations shall consist of moving data into or out of tables and searching for data of values equal to, not equal to, greater than, greater than or equal to, less than and less than or equal to a specified value as listed below:

Array moves
Search Equal
Search Not Equal
Search Greater Than
Search Greater Than or Equal to
Search Less Than
Search Less Than or Equal to

b. The array move feature shall be capable of implementing indirect addressing applications.

9. Conversion Functions

a. Two conversion functions shall be provided to convert a data item from a 4 digit binary coded decimal (BCD-4) data type to a 16 bit signed integer and vice versa.

10. Control Functions

a. Control functions shall be provided to limit program execution, alter the way the CPU executes the application program, or provide special programmable automation controller services. The following control functions shall be provided:

CALL
Immediate I/O update (DO I/O)
Comment rung (COMMNT)
Master Control Relay (MCR, END MCR)
Jump to a label (JUMP, LABEL)
Special Service Requests (SVCREQ)

b. An immediate I/O update function shall be provided for the update of all or a portion of the inputs or outputs for one scan while the program is running, or to update I/O during the program in addition to the normal I/O scan.
c. Additionally, the function shall provide a mean to read inputs into memory auxiliary to the true input table, and execute outputs from discrete memory alternate to the true output table.
d. A comment rung function shall be provided to enter a rung explanation in the program. The rung explanation shall have the capacity to hold 2048 characters of text. The memory required for the comment shall be independent of the program storage memory. The comment shall have the ability to be edited via the PC compatible programming software.
e. A master control relay function shall allow all rungs between the MCR and its subsequent END MCR function to be executed without power flow.
f. A method for structuring the ladder program shall be provided with the use of a JUMP Function. This will cause the program execution to jump to a specified location in the logic targeted by the location of the LABEL function.
g. Seven different special Programmable Automation Controller service requests shall be accessible by the programmer by utilizing one of the Service Request Functions listed below:

Change/Read Checksum Task State and
Logical Number of Words to Checksum
Change/Read Time of Day Clock
Shut Down the PLC
Clear Fault Tables
Read Last Fault Table Entry
Read Elapsed time Clock
Read I/O Override Status

h. The Data written by these service request functions shall be in BCD or Packed ASCII format, and written into user definable register locations.

11. PID Function

a. A single PID function block instruction must be provided by the CPU without any additional module. Two versions of this closed loop control algorithm (Proportional/Integral/Derivative) shall be available.
b. The standard ISA PID algorithm, which applies the proportional gain to each of the proportional, derivative, and integral terms.
c. The independent algorithm that applies the proportional gain only to the proportional gain term.

12. Subroutine Function

a. A single function block must be available to allow repetitive call of a function. A password to protect the integrity of the subroutine must also be available.
b. A Subroutine may be called from within another subroutine. The nesting must be at least 8 deep.
c. A Periodic Subroutine shall be available that is executed once a programmable interval. The interval shall be between 1 and 10 milliseconds. The accuracy of the subroutine execution shall be 50 nanoseconds. Discrete I/O shall be available to update during the execution of the subroutine.

J. Discrete I/O

1. Modularity

a. Interface between the Programmable Automation Controller and user supplied input and output field devices shall be provided by rack type I/O modules.

2. Configuration

a. The Programmable Automation Controller shall be an expandable system.
b. An expandable I/O system shall be supported by a single slot modular CPU, and shall accommodate up to 8 total racks or 79 I/O slots up to a total distance of 50 feet with the standard expansion racks and 700 feet with the remote expansion racks.
c. Serial expansion I/O racks shall be connected to the CPU rack via a high speed serial interface cable. The receiver shall be contained within the expansion baseplates eliminating the requirement for additional communication modules.
d. Ethernet expansion racks shall be connected via a 10/100Mbs Ethernet, RJ-45 connection. The Ethernet network interface unit shall reside in the rack using the same I/O that is compatible with the controller. The Ethernet network interface unit shall support the following:
e. Built-in switch to allow daisy chain connection to the next Ethernet network interface unit.
f. Support redundant controllers with automatic switch over.
g. Ethernet network interface unit shall support up to 79 I/O modules per drop with local expansion.

3. I/O Addressing

   a. I/O reference addressing for each I/O module shall be assigned through the use of the PC compatible configuration and programming software or the hand held programmer. There shall be no jumpers or DIP switch settings required to address modules.
   b. The circuit status of each I/O point on a module shall be indicated by a green LED mounted at the top of the module. These LED's must be visible through a clear plastic lens. Each LED shall illuminate a letter and number which corresponds to the energized I/O circuit.
   c. Addressing of all references including I/O must be represented as a Decimal Based number.

4. Construction

   a. Terminal blocks shall be easily removable, and common to all discrete and analog I/O to allow for convenient pre-wiring of field devices.
   b. Each I/O module shall contain a hinged, clear plastic, terminal block cover (door) with a removable label.
   c. The inside of the label shall have the module description, catalog number, and circuit wiring diagram for that module type, and the outside of the label shall have a user legend space to record circuit identification information.
   d. The label shall have color coding for quick identification of the module as high voltage (red), low voltage (blue), or signal level (gray) type.

5. Electrical Specifications

   a. I/O modules shall be designed for 1500-volt isolation between the field wiring and the system backpanel.

6. Input Specifications

   a. The 120 Volt AC input module shall accommodate an input voltage range from 0 to 132 volts.
   b. The 240 Volt AC input module shall accommodate an input voltage range from 0 to 264 volts.
   c. The 24 Volt DC positive and negative logic input modules shall accommodate an input voltage range from 0 to +30 volts DC.
   d. The 125 Volt DC input module shall accommodate an input voltage range from 0 to 150 volts.

7. Availability Of Input Modules: As a minimum, the following discrete input modules shall be available

Description	Points/Module
Input Simulator	8, 16
120 V(ac) Isolated Input	8
240 V(ac) Isolated Input	8
120 V(ac) Input	16
24 V(ac)/V(dc) Negative Logic Input	16
24 V(dc), Positive/Negative Logic Input	8,16.32
24 V(dc) Positive/Negative Logic Input, (1ms response): To be use as the Input Module	16
125 V(dc) Positive/Negative Logic Input	8
5/12 V(dc) Positive/Negative Logic Input (TTL)	32

8. Output Specifications

   a. Discrete AC output modules shall have separate and independent commons allowing each group to be used on different phases of AC supply.
   b. Each discrete AC output shall be provided with an RC snubber to protect against transient electrical noise on the power line.
   c. Discrete AC outputs shall be suitable for controlling a wide range of inductive and incandescent loads by providing a high degree of inrush current (10x the rated current).
   d. Discrete DC output modules shall be available with positive and negative logic characteristics in compliance with the IEC industry standard.

e. Discrete DC output modules shall be provided with at least eight output points in a group with a common power input terminal per group.
f. Discrete DC output modules shall be compatible with a wide range of user-supplied load devices, such as: motor starters, solenoids, and indicators.
g. A 2 Amp relay output module shall be capable of supplying 2 Amps resistive maximum load per output and 4 amps resistive maximum load per group of 4 outputs.
h. A 4 Amp relay output module shall have 8 isolated outputs per module and shall be capable of supplying 4 amps resistive maximum load per output and 32 amps resistive maximum load per module.

9. Availability Of Output Modules: As a minimum, the following discrete output modules shall be available

Description	Points/Module	Fuse Rating	# Fuses/Module
120 V(ac), 0.5A (2 groups)	12,16	3A	2
120/240 V(ac), 1A (2 groups)	8	3A	2
120/240 V(ac) Isolated, 2A	5	3A	5
12/24 V(dc) Positive Logic, 2A	8	5A	2
12/24 V(dc) Positive Logic, 0.5A	8.16,32	N/A	0
12/24 V(dc) Negative Logic, 2A	8	5	2
12/24 V(dc) Negative Logic, 0.5A	8,16	N/A	0
125 V(dc) Positive/Negative Logic, 1A	6	N/A	0
5/12/24 V(dc) Negative Logic, 0.5A	32	N/A	0
Relay, Normally Open, 2A (4 groups)	6	N/A	0
Relay, Normally Open, 4A Isolated To be use as the Output Modules	8	N/A	0
Relay, Isolated, 4 Normally Closed	8	N/A	0
4 Normally Open (Form B & C) 8A			

10. Availability Of Mixed I/O Modules: As a minimum, the following discrete output modules shall be available

Description	Points/Module
24 V(dc) Input, Relay Output	8 in, 8 out
120 V(ac) Input, Relay Output	8 in, 8 out

K. Analog I/O

1. For the conversion of analog to digital and digital to analog conversion required by an application, the following shall be available.
2. Analog Voltage Input

a. The analog voltage input module shall be capable of converting 4 or 16 channels of inputs in the range of -10 to +10 volts.
b. Resolution of the converted analog voltage input signal shall be 12 bits binary or 1 part in 4096.
c. All of the channels of converted analog voltage input signals shall be updated each scan into a dedicated area of data registers in a 16-bit 2's complement format.
d. The conversion speed for all of the analog voltage input channels shall be no less than 2 milliseconds and no greater than 13 milliseconds.
e. The analog voltage input module shall be configurable for a 4 to 20 mA analog current input via an external resistor.

3. Analog Current Input

a. The analog current input module shall be capable of converting 4 or 16 channels of inputs in the range from 4 to 20 mA or 0 to 20 mA.
b. Resolution of the converted analog current input signal shall be 12 bits binary or 1 part in 4096.

c. All of the channels of converted analog current put signals shall be updated each scan into a dedicated area of data registers in a 16-bit 2's complement format.
d. The conversion speed for all analog current input channels shall be a minimum of 2 ms and no greater the 13 ms.

4. Analog Voltage Output

a. The analog voltage output module shall be capable of converting 2 or 8 channels of digital data to analog outputs in the range from –10 V to +10 V.
b. Resolution of the converted output signal shall be 13 bits or 16 bits.
c. All channels of analog output data shall be updated each scan from a dedicated area of data registers in a 16-bit 2's complement format.
d. The analog voltage outputs shall be configurable to default to 0 mA, 4 mA or hold-last-state in the event of a CPU failure.

5. Analog Current Output

a. The analog current output module shall be capable of converting 2 or 8 channels of digital data to analog outputs in the range from 0 mA to 20 mA or from 4 mA to 20 mA.
b. Resolution of the converted output signal shall be 12 bits or 16 bits.
c. All channels of analog output data shall be updated each scan from a dedicated area of data registers in a 16-bit 2's complement format.
d. The analog current outputs shall be configurable to default to 0 volts or hold-last-state in the event of a CPU failure.

6. Analog Combination

a. The analog combo module shall be capable of converting 4 channels of analog inputs to digital data and 2 channels of digital data to analog outputs.
b. All channels are configurable for 0 mA to 20 mA, 4 mA to 20 mA, 0 V to +10 V, and –10 V to +10 V. Resolution of the converted input signals shall be 12 bits and output signals shall be 16 bits.
c. All channels of analog data shall be updated each scan from a dedicated area of data registers in a 16-bit 2's complement format.
d. The analog outputs shall be configurable to default to 0 volts or hold-last-state in the event of a CPU failure.

7. Module Availability: As a minimum, the following analog modules shall be available

Description	Channels/Module
Current Analog Input	4, 16
Voltage Analog Input	4, 16
Current Analog Output	2, 8
Voltage Analog Output	2, 8
Combo Analog Inputs/Outputs	4/2

L. Specialty Modules

1. Temperature Control Module

a. A specialized temperature control module shall be available to accommodate applications where precise temperature control is needed.
b. The temperature control module shall support auto-tuning, closed looped PID control, and open looped manual control
c. The temperature control module shall provide eight thermocouple inputs, 1 RTD input, and 8 PID-controlled output channels for controlling heaters.
d. The temperature control module shall provide alarms indications for each status zone, voltage failure, open or reversed thermocouple, compensation temperature error, high or low temperature, high or low temperature deviation, and open channel short circuit.

2. Motion Control

    a. Specialized analog and digital motion control modules shall be available to perform 1 or 2 axes of closed or open loop servo control. These modules shall support encoder feedback with analog output for velocity command.
    b. The positioning mode shall support linear and S curve acceleration and deceleration.
    c. The modules shall provide user-defined control inputs and outputs for application such as torque follower and flying cut-off applications.
    d. The modules must have user defined inputs and outputs, an English-language programming software, and automatic data transfer of data between PLC and axis positioning module with no user programming.
    e. The positioning mode shall have a powerful instruction set, that includes absolute or incremental move, wait to move, dwell, conditional jump and subroutine functions.
    f. The modules shall provide non-volatile program storage without the use of battery or super capacitor.
    g. The follower mode shall provide either parallel or cascade operation from a single master.
    h. The follower mode shall provide a selectable master source of encoder, analog, or internal time base.
    i. The single axis module shall have a position loop update time of not more than 1 ms. The dual axis module shall have a position loop update time of not more than 2 ms per axis.

3. High Speed Counter

    a. A specialized high speed counter option module shall be available to accommodate applications where pulse input rates exceed the input capability of the Programmable Automation Controller.
    b. The high speed counter module shall provide direct processing of rapid pulse signals up to 80 kHz in frequency.
    c. The high speed counter module shall be configurable as four independent counters counting either up or down, two independent bi-directional counters, or one counter that can calculate the difference between two changing count values.

M. Third-Party Modules: Specialty I/O And Communications

1. Based on open architecture specifications of the vendor and explicit permission of the vendor, specialty module shall be available such as PID, Co-processor, stepper, etc.
2. Complete documentation, kits for building modules, and engineering resource shall be available for the 3rd party based on the type of development.

N. Communications:

1. Peer/Peer Communications

    a. A specialized option module shall be available that will allow the Programmable Automation Controller to communicate on a token passing peer-to-peer, noise immune network providing high-speed transfer of control data.
    b. The specialized communication module shall be configurable to broadcast data to and receive data from up to 31 other devices on a network automatically and repeatedly from a shared and dedicated database in RAM memory.
    c. The communication medium for this specialized network shall be a high energy and noise immune single shielded twisted pair cable transmitting data at an adjustable rate of up to 153.6 k baud. The distance of the communication shall be up to 7500 ft-at a lower baud rate.

2. Master/Slave Communications

    a. There shall be modules (such as a Modbus RTU protocol module) that allows the programmable automation controller to act as a master in a communication scheme that allows programmable automation controller to interrogate other PLCs, programmable automation controller's and devices for data.
    b. Programmable automation controller and CNC I/O Interface
    c. The I/O interface shall provide an interface between the programmable automation controller and a CNC, allowing a CNC to control 64 I/O points on the programmable automation controller

3. Client/Server Interface

    a. There shall be a module that provides client/server with peer to peer communications over Ethernet TCP/IP.
    b. The modular CPU system and special module shall support up to 16 simultaneous connections.

PROGRAMMABLE AUTOMATION CONTROLLER INSTALLED (AS SHOWN ON THE PLANS)

A. The programmable automation controllers shall include but not be limited to the following equipment to be installed by the Contractor for the programmable automation controllers (as shown on the plans):

1. Programmable automation controller #1

    a. Two power supplies (To be configured for redundancy with programmable automation controller #1)
    b. One Ethernet module
    c. Two Modbus RTU master modules
    d. One 12-slot I/O Rack
    e. Terminal blocks (number as shown on the plans)
    f. Conductors and cables required for the installation of programmable automation controller #1 shown on the plans.

2. Programmable automation controller #2

    a. Two power supplies (To be configured for redundancy with programmable automation controller #2)
    b. One Ethernet module
    c. Two Modbus RTU master modules
    d. One 12-slot I/O rack
    e. Terminal blocks (number as shown on the plans)
    f. Conductors and cables required for the installation of programmable automation controller #2 shown on the plans.

3. Programmable automation controller #3

    a. Four power supplies (two power supplies to be configured for redundancy with programmable automation controller #3, One each for the 5-slot remote I/O rack and for the 5-slot expansion I/O rack)
    b. One Ethernet module
    c. One 12-slot I/O rack
    d. One 5-slot remote I/O rack; to be installed inside the SCADA system junction box
    e. Remote I/O cable (Length as shown on the plans)
    f. One 5-slot expansion I/O rack
    g. Expansion I/O cable (length as required for connect to programmable automation controller #3)
    h. Nine 24 V(dc) positive/negative logic input, (1ms response) modules: To be use as the input modules.
    i. Two relays, normally open, 4A isolated modules: To be use as the output modules.
    j. Terminal blocks (number as shown on the plans)
    k. One SCADA control and indication relay specified in these special provisions for the PEU Relay.
    l. Conductors and cables required for the installation of programmable automation controller #3, the 5-slot expansion I/O rack and the 5-slot remote I/O rack shown on the plans.

MODBUS RTU MASTER MODULES

A. The Modbus RTU Master Modules shall support the Modbus protocol and shall be compatible with the CPU. The ModbusRTU Master Modules shall provides four independent, isolated serial ports. Up to six ModbusRTU Master Modules can be located in the main Programmable Automation Controller backplane.
B. Each port shall be configured for Modbus master, Modbus slave, or serial I/O protocol. Modbus master mode shall exchanges with up to 64 individual slaves are set up during module configuration, and easily controlled from the application program with no special messaging required. The Modbus RTU master modules shall automatically supplies the Modbus message structure including device address, function code, and error check information, based on the configuration of the exchange. Broadcast messaging may not be supported.

C. Modbus slave mode exchanges shall be able to be set up for automatic mapping to CPU memory, so that no application programming is necessary for a port used as a Modbus slave.
D. The Modbus RTU master module shall included but not be limited to the following:

1. Port-to-port isolation and port-to-backplane isolation
2. RS-232, RS-485/422 communication, software-selected
3. Hardware handshake: RTS/CTS (for RS-232 only)
4. Selectable Baud Rates: 1200, 2400, 4800, 9600, 19.2K, 38.4K, 57.6K, 115.2K
5. Module fault status reporting (Watchdog, Ram Fail, Flash Fail)
6. Module identity and status reporting, including LED status indicators
7. Hot insertion/extraction
8. Meets UL 508 and 1604, and ATEX requirements
9. Flash memory for future upgrades and protocol additions
10. Function codes: 01, 02, 03, 04, 05, 06, 07, 08, 15, 16, 17, 20, and 23

VENDOR REQUIREMENTS

A. Development Life Cycle

1. The vendor must have an established documented development procedure. This procedure must track customer requirements, development risk, and corrective action. The procedure must include a product validation cycle.
2. The vendor must have a formal and documented set of quality assurance procedures that are applied to the engineering design, development, and documentation of the software. The presence of a formal quality assurance department shall be required.
3. The vendor must also demonstrate that it's source code for the product is regularly archived with suitable backup.
4. The vendor must follow a documented configuration management system.

B. Product Life Cycle

1. The vendor must have an established product life cycle policy. Documentation of the product life cycle shall be available.

C. Manufacturer Qualifications

1. The manufacturer shall have shown a high commitment to product, manufacturing and design process quality. The manufacture shall be ISO9000 registered.
2. The manufacture shall have fully operational quality assurance and quality control programs in place. Complete documentation describing the quality assurance and quality plan shall be available.
3. A company who regularly manufactures and services this type of equipment shall offer the controller and/or I/O system and all of the corresponding components.
4. Vendor needs to be certified under the ISO 9001-2000 guidelines.

REDUNDANT POWER SUPPLY CONTROLLER

The Redundant Power Supply Controller shall be Sola/Hevi-duty SDN 2.5-20 RED or PULS-Dimension Y-Series YRM2.DIODE or Allen-Bradley Bulletin 1606

REDUNDANCY MODULE: Cat No. 1606-XLSRED or Equal. The Redundant Power Supply Controller shall meet the additional following specifications:

GENERAL

A. Output Voltage:

1. 24 V(dc) for Sola/Hevi-duty SDN 2.5-20 RED 24 V(dc) to 60 V(dc) for PULS-Dimension Y- Series YRM2.DIODE
2. 10 VDC to 60 VDC for Allen-Bradley Bulletin 1606 REDUNDANCY MODULE: Cat No. 1606-XLSRED

B. Output Current: 20 A

The Contractor shall provide and install 24VDC and 12 VDC Surge Suppression Diodes to be use for the transient voltage surge suppression as shown on the plans.

REMOTE DISPLAY AND CONTROL MODULE

The Remote Display and Control Module shall meet the following specifications:

FEATURES

A. 80-Character LCD Display
B. Up to 15 Remote Display and Control Module per Tunnel Fire Alarm Control Panel as specified in these special provisions
C. Located up to 4000 feet from the Tunnel Fire Alarm Control Panel
D. Full Complement of Functional Keys and LEDs

DESCRIPTION

The Remote Display and Control Module shall provide an additional point of event reporting and operator intervention/control for the Tunnel Fire Alarm Control Panel. The Remote Display and Control Module 80-Character LCD display shall duplicate all the information on the Tunnel Fire Alarm Control Panel display. The Remote Display and Control Module shall contain the following functional keys:

A. Event Acknowledgement
B. Alarm Silence
C. System Reset
D. Display Scroll
E. The Remote Display and Control Module shall have twelve digit/navigation keys that enable full menu functionality

The Remote Display and Control Module shall have a six system level LEDs corresponding to the following general conditions:

A. Module Power
B. Alarm
C. Pre-Alarm
D. Alarm Silence
E. Supervisory
F. Trouble

ELECTRICAL

A. Network Wiring: Style 4, Supervised and Power-Limited
B. Maximum Network Wiring Distance: 4000 feet
C. Communications: Per RS-485 Standard
D. Operating Voltage: 24 VDC (Nominal)
E. Standby Current: 0.064A or less
F. Alarm Current: 0.085A or less
G. Maximum Number of Modules per Tunnel Fire Alarm Control Panel shall be 15.

MECHANICAL

A. Dimensions (Not to Exceed): 13” W x 7.5”H x 2.5”D
B. Color: Red

ENVIRONMENTAL

A. Operating Temperature: 32F to 120F
B. Relative Humidity: 85% at 90F (Non-Condensing)

INSTALLATION

The Remote Display and Control Module shall be supplied in an enclosure that shall be suitable for both surface and semi-flush mountings.

REMOTE RELEASE MODULE

The remote release module shall meet the following specifications:

FEATURES

A. Supports both gaseous and pre-action/deluge sprinkler systems
B. 5 year warranty
C. UL Listed and CSFM approved
D. Internal communication and external power supervision
E. Dual control heads activation

DESCRIPTION

A. The remote release module shall be a field device that shall provide the ability to remotely activate extinguishing-system control devices such as sprinkler water release systems. Connection shall be via the "Tunnel Fire Alarm Control Panel" signaling line circuit (SLC) cable. A maximum of 64 remote release modules shall be support by the tunnel fire alarm control panel SLC. Up to 16 remote release modules shall be able to be configured for simultaneous group activation, with a maximum of 4 groups.
B. The remote release module shall provide internal supervision of communication with the tunnel fire alarm control panel, connections to external power supply and memory status.
C. The remote release module release circuits shall be power-limited and supervised for short circuit by using an in-line releasing-circuit device. In the event of a ground fault, open, short or a relay contact failure, the in-line releasing-circuit device shall transmit a trouble status to the tunnel fire alarm control panel.
D. The remote release module both auxiliary circuits shall be able to be wired together to obtain 2 A at 24 V(dc).

PROGRAMMING

The remote release module, addressing shall be able to be implemented from a hand-held programming device, from the tunnel fire alarm control panel keypad menu or from the "Remote Display and Control Module".

STATUS LED

The remote release module status LED shall be mounted on the remote release module shall indicated the remote release module's following status:

A. Normal, Standby: Flash at 9-second repetition rate
B. Output Active: On steady
C. Trouble: Off

SPECIFICATIONS

A. SLC wiring configuration

    1. Class B, Style-4
    2. Class A, Style-6
    3. Class A Style-7

B. Activation:

    1. Up to 64 remote release modules per SLC (activated consecutively)
    2. Up to 4 Groups of 16 remote release modules per group (remote release modules in a group activate simultaneously, groups activate consecutively)

C. Releasing circuit output current: 2.4 A Max@ 24.0 V(dc)
D. Operating Voltage: 24 V(dc) nominal
E. Trouble Circuit Input:

    1. 4.7K End of Line Resistor
    2. "Open" contact = normal condition

F. Power Consumption:
   1. From Power Supply:

      a. Normal, Standby: 6.1 mA
      b. Alarm: 45 mA

   2. From SLC

      a. Normal, Standby: 410 µA
      b. Alarm: 410 µA

G. Environmental criteria:

   1. Indoor/Dry location use only
   2. Operating Temperature range: 32 ºF to 120 ºF
   3. Humidity: 93 percent maximum RH at 90 ºF ± 3 ºF

H. Terminal Connections: The remote release module shall support wires from #18 AWG to #12 AWG.
I. Construction: The remote release module shall be made of high impact polymer faceplate with 16 gauge aluminum bracket.

ADDITIONAL EQUPMENT

A. One 4" square x 2-1/8" deep Steel outlet box (double gang)
B. One in-line releasing-circuit device

INSTALLATION AND CONNECTION

A. The Contractor shall install the remote release module in the 4" square x 2-1/8" deep steel outlet box and connection as shown on the plans and as required for proper operation.
B. The Contractor shall install the in-line releasing-circuit device and connect as required for proper operation.

DOOR ALARM

The magnetic contacts shall be hermetically sealed for long trouble-free life and have the following specifications:

A. Life tested 10,000,000 cycles
B. Corrosion-resistant
C. Rhodium-plated contacts
D. Surface-mount with screw terminal
E. Surface-mount with wire leads
F. Contact rated for 0.3 A @ 30 VDC
G. Leads shall be 22 AWG, 12”

10-3.36 CARBON MONOXIDE MONITORING

CARBON MONOXIDE CALIBRATION SERVER

The Carbon Monoxide (CO) Calibration Server shall be a Crystal RS112 Rugged 1U Server, Augmentix A+200 1U Rugged Server, or Themis RES-12XR3 Rugged Enterprise Server or equal, and a 1U form factor rack-mounted 15-inch TFT monitor/Keyboard drawer that shall meet the following specifications below:

HARDWARE

1st Processor:	Quad-Core3.00 GHz or faster/ Two 6 MB Level 2 Cache, 1333 MHz Front Side Bus (FSB) processor.
2nd Processor:	Quad-Core3.00 GHz or faster/ Two 6 MB Level 2 Cache, 1333 MHz Front Side Bus (FSB) processor.
Memory:	Minimum 8 GB, 667 MHz DDR2 ECC SDRAM Dual Ranked DIMMs.
1st and 2nd Hard Drives:	Two 300 GB, Serial Attached SCSI (SAS) Hot Plug Hard Drives.
Network Adapter:	Dual Port copper Gigabit Network Adapter.
CD-ROM Drive:	Combo DVD-ROM/CD-RW Drive
HD Configuration: RAID 1 with 2 drives	RAID 1 with 2 drives.
Bezel:	Included
Power Supplies:	Hot-Plug or Swap AC Power supply.
Input Voltage:	110/220 V(ac)
Power Cords:	Power Cord 4 ft minimum.
Environmental Specifications:	The SCADA Submaster Server shall be independently-test to and shall meet MIL-STD-810F for Humidity, Vibration and Shock.

SOFTWARE AND CONFIGURATION

Operating System	Microsoft Windows Server 2008 Standard x64 Edition or equal.
Additional Software:	1) Symantec Client Security or McAfee Total Protection for Small Business or equal. 2) CO Calibration software per CO Monitor manufacturer's recommendation. 3) Any additional software not specified, but shall be required to perform the functions specified in the "Network communication system" specification for the SCADA Submaster server.

SCADA SUBMASTER SERVER SUPPORT SERVICES

A 3 years for parts and labor, and 3 years 4 hour response on-site 7 days a week, 24-hour service.

15-INCH TFT MONITOR/KEYBOARD DRAWER SPECIFICATIONS

Mounting:	Rack mount, 19-inch
Display Type:	LCD, TFT panel display with built-in power saving and back light protection functions.
Display Size:	15-inch diagonal
Viewing Area (W x H) not to exceed:	(12" x 9")
Dimensions (W x H x D) not to exceed:	(17.5" x 2" x 20")
Contrast Ratio:	300:1 (typical)
Viewing Angle	
Horizontal:	70/70 degrees from center
Vertical:	55/60 degrees from center
Display Colors:	16 million
Maximum Resolution:	XGA (1024 x 768) @ 85 Hz
Brightness:	200 nits

Response Time	
Tr:	10 ms
Tf:	35 ms
Interface:	Analog RGB
Scanning Frequencies	
Vsync:	60 to 75 Hz
Hsync:	48.36 to 60 kHz
Main:	65 to 80 MHz
Pixel Pitch (H x V) not to exceed:	(0.012" x 0.012")
LCD panel protection:	Tempered glass to protect LCD Panel not to exceed (0.08" x 10" x 13.5").
Cable Connector:	15-pin mini DSUB
Monitor Control Type:	Digital microprocessor OSD control
VESA Plug-n-Play Level:	DDC1 and DCC2B
Screen Adjustment Controls:	1) Menu 2) Auto adjustment 3) Brightness 4) Contrast 5) Phase 6) H/V position 7) Pitch 8) Zoom 9) Color 10) Language 11) OSD position
Power Management:	1) VESA DPMS 2) EPA/Energy Star compliant
Keyboard:	PS/2, 83-key
Keyboard Dimensions (W x H x D) not to exceed:	(5.5" x 0.8" x 15")
Integrated Trackball:	PS/2, high-quality 16 mm trackball
Construction:	SPCC with Ni-coating
Housing:	Meets EIA RS-310C 1U 19-inch rack mount standard
Color:	Black
Mean Time Between Failures (MTBF):	25,000 hours or longer
Power Adapter	
Input:	115 to 230 V(ac), 1.8 A, 50/60 Hz, 2/1 A
Output:	12 V(dc) @ 3 A, 2.5 W per channel
Type:	AC PSU auto-switching
Input Impedance:	10 kΩ
Power Consumption:	26.25 W (Typical), 36 W (Maximum)
Operating Environment	
Temperature:	0 to 45 °C
Humidity:	20 to 90% @ 40 °C, non-condensing
Attitude:	10,000 ft
Shock:	10 g, 11 ms duration, half sine/six axis
Vibration:	10 to 58 Hz, + 0.075 mm; 58 Hz to 500 Hz, 1 g

Non-Operating Environment	
Temperature:	-40 to 70 °C
Humidity:	5 to 95% @ 40 °C, non-condensing
Attitude:	50,000 ft
Shock:	15 g, 11 ms duration, half sine/six axis
Vibration:	10 to 58 Hz, + 0.015 mm; 58 Hz to 500 Hz, 2 g
Agency Approvals	
FCC Conformity with:	Part 15, Subpart B
UL recognized to:	UL 1950, 3rd Edition.
CE conformity with:	UL equally standards
Support:	1) Pre- and Post sales technical support 2) Two year limited warranty
Ship Kit:	1) 1U 15-inch TFT monitor/keyboard drawer. 2) Two (2) set of L-brackets for rear mount (screws included). 3) Keys for key lock. 4) AC power cord. 5) User's guide.
Accessories:	Adapts PS/2 keyboard to AT connector

CARBON MONOXIDE MONITOR

The CO monitor shall be a fixed point gas monitor that shall employ an intelligent electronics platform to provide one or two points of detection from a single head for maximum flexibility and shall be able to monitor CO. The CO monitor shall be enclosed within an explosion proof stainless steel housing. The CO monitor shall have the added ability of stand alone operation, activating alarms, horns, or fans and can also shut down a system without the need to wire back to the CO monitor controller specified in the special provisions. The CO monitor shall meet the following requirements:

ENCLOSURES

The CO monitor enclosure shall be 316 stainless steel, explosion proof, NEMA 4X, and IP66 rated.

SENSORS

Type of Sensor: Electrochemical diffusion.

MEASURING RANGES

Carbon Monoxide: 0-999 parts per million (ppm) in 1 ppm increments.

INPUT CURRENT

150 mA @ 24 V(dc)

INPUT VOLTAGE:

12-28 V(dc) operating range (24 V(dc) typical).

DISPLAY

Dual-channel split-screen LED display (4 digit, 7-segment arrangement per channel) provides simultaneous display of one or two gases.

SIGNAL OUTPUT

A. 4-20 mA, linear (analog)
B. ModBus RTU (digital) RS485 digital communication with ModBus RTU software protocol system at 9600 baud.
C. Three or four wire system capable of accommodating over 200 devices in bus configuration.
D. Address selection through on board 8-position dipswitch.

ALARM RELAYS

Three alarm relays shall be provided as follows:

A. Two user programmable relays, SPST, N.O.:

1. High Alarm set to activate or close @ 120 ppm is indicated.
2. Low Alarm set to activate or close @ 35 ppm is indicated.

B. One fault relay, SPST, N.C.

CONTACT CAPACITY

5 A @ 30 V(dc).

TEMPERATURE RANGE

-4 °F to +122 °F (Typical)

HUMIDITY RANGE

15-90% RH (non-condensing)

APPROVALS

CSA: Class 1,Div. 1,2, Groups B,C, D Aexd d IIB

ADDITIONAL EQUIPMENT

A. The Contractor shall provide with the CO monitor, a Gas Delivery System, one bottle (Cylinder, Calibration Gas, 100 ppm CO, 5 AL), 1.0 LPM.

B. The Contractor shall install the Gas Delivery System, one bottle (Cylinder, Calibration Gas, 100 ppm CO, 5 AL), 1.0 LPM and as require for proper installation and operation.

CO MONITOR CALIBRATOR

The CO monitor calibrator shall perform automatically calibrate, keep records, perform instrument testing and diagnostics on the CO monitors.

ENCLOSURE:

Cast aluminum, explosion proof.

INPUT VOLTAGE:

24 V(dc).

OPERATING TEMPERATURE:

-40 °F - 167 °F

COMMUNICATION TO CO CALIBRATION SERVER:

A. A 10 Base T Ethernet support, RJ-45 Category 5 connection or wireless Ethernet.

B. The CO monitor calibrator shall be configured to interface with the CO calibration server to store the calibration, instrument testing and diagnostic data of the CO monitors.

COMMUNICATION TO CO MONITOR:

A. Modbus RTU, 3 Conductors, 18 AWG Shielded cable or wireless Modbus.

B. The CO monitor calibrator shall be configured to interface with the CO monitors to calibrate, perform instrument testing and diagnostics on the CO monitors.

DISPLAY:

128x64 Dot Matrix LCD, 3 status LEDs

APPROVALS:

NRTL/c and CSA- Class 1, 2, Groups B, C, D

CO MONITOR CONTROLLER

A The CO monitor controller shall be capable of having the following:

1. Eight-48 Analog Input; using up to Six -8 Analog Input Cards.
2. Onboard relays; using 4 fully programmable relay outputs per card (Relay Card) that shall be able to control alarms, fans, horns, etc., when alarm conditions are reached. The CO monitor controller Relay Cards shall be fully programmable with relays setting to activate from multiple channels, or multiple relay for a single channel. Time delays shall be programmable for each relay of the CO monitor controller Relay Card. This shall allow the relays of the CO monitor controller Relay Card to activate or de-activate after a specified time prior to an alarm.
3. Digital (Dry Contact) inputs using 4 Channel or 8 Channel digital input cards.
4. The CO monitor controller shall be able to monitor up to 72 digital Modbus RTU inputs as a Modbus RTU Master.
5. The CO monitor controller shall be able to be a Modbus RTU Remote device that shall be able to communicate to SCADA, HMI, PLC and PAC control systems.
6. The CO monitor controller shall be capable of CO monitor controller to CO monitor controller communications.
7. The CO monitor controller shall be compatible with the CO monitors.
8. The CO monitor controller shall be able to interface with a telephone line for remote call out capabilities.
9. The CO monitor controller shall be capable of tracking, logging and store up to1000 events.
10. The CO monitor controller shall be a NEMA 4X wall-mounted enclosure with display and with 24 hour battery back up.

SPECIFICATIONS

A. Enclosure: NEMA 4X ABS plastic

B. Analog inputs: Eight-48 analog inputs (8 per card); 4-20 mA, 0-20 mA, 0-1 V, 0-5 V, 0-10 V, ±1 V, ±5 V, ±10 V

C. Digital inputs: 0-72 digital Modbus RTU inputs

D. Outputs: Fully programmable relay outputs (4 per card)

E. Display: LCD display for programming and viewing channel information. Tri-color LED for each analog input and relay output to show status of channel.

F. Alarm notification: LCD alarm notification, LED alarm notification, audible alarm notification via local speaker, telephone dial out notification.

G. Programming interface: Local keypad or remotely via telephone.

H. Event log: Stores 1000 entries. Entries include entering and leaving alarm states, peak readings and calibrations.

I. Temperature range: -40 °F to +185 °F

J. Operating power range: 100-240 V(ac), 15-18 V(dc), on board battery backup

ADDITIONAL EQUIPMENT

A. One Relay Card.

B. One Analog Input Card for 4-20 mA analog data signal.

C. CO monitoring cables (number and length of cables required to connected all the CO monitors to the CO monitor controller). The CO monitoring cable shall meet the following specifications:

1. The CO monitoring cable jacket, insulation or any part of the cable shall not be made of PVC in accordance to NFPA 502.
2. The CO monitoring cable shall be able to provide the CO monitor controller with the require signal strength to operate properly at a minimum distance of 650 ft from the CO monitors using a 4 to 20 mA analog data signal.
3. The CO monitoring cable shall be compatible with the CO monitor controller and the CO monitors.
4. The CO monitoring cable shall be a Two (2) conductor cable.

CONFIGURATION

A. The CO monitor controller shall read the analog data signals of all the CO monitors.

B. The CO monitor controller shall be configured as a Modbus RTU Remote device that shall be able to communicate to SCADA, HMI, PLC and PAC control systems. The CO monitor controller shall send the analog data to the PAC that is connected to the CO monitor controller. The CO monitor controller shall also send the tracked, logged and store up events to the PAC that is connected to the CO monitor controller.

C. The CO monitor controller shall operate each relay of the CO monitor controller Relay Card to operate the Jet Fans in sequence based of the following CO levels from any of the CO monitors:

1. JF3 for the 3rd Jet Fan: 9 ppm or higher for 8-hours exposure time or 20 ppm or higher for one hour exposure time.
2. JF2 for the 2nd Jet Fan: 45 ppm or higher for 45-minute exposure time.
3. JF4 for the 4th Jet Fan: 65 ppm or higher for 30-minute exposure time.
4. JF1 for the 1st Jet Fan: 100 ppm or higher for zero exposure time.
5. Each relay of the CO monitor controller Relay Card shall remain activated for a period of 1/2 hour pass the reduced CO level in which that relay activated on.

D. The CO monitor controller shall track, log and store all the events of all the CO monitors.
E. The Configuration shall also be per California Air Resources Board requirements.

10-3.37 SECONDARY UNIT SUBSTATION

GENERAL

Scope

The Contractor shall install the secondary unit substation complete from the incoming line terminals to the outgoing line terminals as specified in these special provisions and as shown on the plans.

The secondary unit substation shall consist of primary equipment (medium voltage metal-clad switchgear), transformer (Vacuum Pressure Encapsulated (VPE) Dry-Type Transformer), and secondary equipment (deadfront type, low voltage metal-enclosed switchgear) as specified below. The manufacturer of the unit substation shall furnish and coordinate all major components of the substation, including incoming primary equipment section, transformer and secondary equipment section (low-voltage section) as well as low voltage drawout power circuit breakers (Power Circuit Breakers), and metering components (Power Meters, and Breaker Interface Modules). Provide a single warranty covering all substation assemblies, transformers and components.

Connections between the primary device and transformer shall be bus, and between the transformer and secondary shall be flexible bus braid.

References

The secondary unit substation shall be designed, assembled, manufactured, tested, and installed in accordance with latest applicable standards of NEMA, IEEE and ANSI, applicable to its three major sections:

A. MV Switchgear – NEMA SG4, SG5; and but not limited to ANSI/IEEE 37.20.2.
B. Secondary Substation Transformers – NEMA 210, NEMA 201, IEEE 100, ANSI C57.
C. LV Distribution Switchboards – NEMA PB-2, UL 891.ANSI-C37.20 – Switchgear assemblies and the following:

   1. ANSI-C37.13 – Low voltage power circuit breakers.
   2. ANSI-C37.17 – Trip devices.
   3. NEMA SG-5 – Switchgear assemblies.
   4. NEMASG-3 – Low voltage power circuit breakers.
   5. UL 1558.

Submittals: For Review/Approval

A. The following information shall be submitted to the Engineer:

   1. Master drawing index.
   2. Front view elevation.
   3. Floor plan.
   4. Single line.
   5. Schematic diagram.
   6. Nameplate schedule.
   7. Component list.
   8. Conduit entry/exit locations.
   9. Assembly ratings including:

      a. Short-circuit rating.
      b. Voltage.
      c. Continuous current.
      d. Basic Impulse level for equipment over 600 volts.
      e. kVA.

10. Major component ratings including:

    a. Voltage.
    b. Continuous current.
    c. Interrupting ratings.

11. Cable terminal sizes.
12. Connection details between close-coupled assemblies.
13. Composite front view and floor plan of close-coupled assemblies.
14. Impedance for transformers.
15. Product data sheets.

B. Where applicable, the following additional information shall be submitted to the Engineer:

1. Busway connection.
2. Connection details between close-coupled assemblies.
3. Key interlock scheme drawing and sequence of operation.
4. Electrical Schematic diagram.
5. Descriptive bulletins.

Submittals: For Construction

A. The following information shall be submitted for record purposes:

1. Final (as-built) plans and information for items listed paragraph as specified in this part of the special provisions and as shown on the plans.
2. Wiring diagrams.
3. Certified production test reports.
4. Installation information including equipment anchorage provisions.
5. Seismic certification.

B. The final (as-built) drawings shall include the same drawings as the construction plans and shall incorporate all changes made during the manufacturing process.

Qualifications

A. The manufacturer of the assembly shall be the manufacturer of the major primary and secondary components within the assembly.
B. For all equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified.
C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
D. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) through zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5 percent minimum-damping factor, CBC: a peak of 2.15 g's, and a ZPA of 0.86 g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.
E. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards:

1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
3. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

Regulatory Requirements

A. Certified copies of production test reports shall be supplied demonstrating compliance with these standards to the Engineer.
B. UL labels required (For the transformers and the secondary equipment).

Delivery, Storage and Handling

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment for the complete assembly and each major component.
B. Each switchgear assembly of the secondary unit substation shall be split into shipping groups for handling per the manufacturer's recommendations. Shipping groups shall be designed to be shipped by truck, rail or ship. Shipping groups shall be bolted to skids. Accessories shall be packaged and shipped separately. Each switchgear-shipping group shall be equipped with lifting eyes for handling solely by crane.

Operation and Maintenance Manuals

Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins, and renewal parts lists where applicable for the complete assembly and each major component.

Training

A. The Contractor shall provide a two day training session for up to ten State employees for an eight hour workday at a jobsite location determined by the State for both secondary unit substations.
B. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on operation of the assembly, circuit breakers, and major components within the assembly of each secondary unit substation.

PRIMARY EQUIPMENT

The primary equipment of the secondary unit substation shall be a medium voltage metal-clad switchgear as specified in this part of the special provisions and as shown on the plans. The primary equipment and all its components shall be designed, manufactured and tested in accordance with the latest applicable standards as specified in the "REFERENCES" for the MV Switchgear as specified in this part of the special provisions. The primary equipment shall consist of the following switchgear assemblies and shall meet the following specifications:

Primary Equipment of the Secondary Unit Substation for Battery Substation:

A. One Utility Metering Vertical Section: Size not to exceed 100.0" (H) x 50.0" (W) x 100.0" (D).
B. Three Medium Voltage Circuit Breaker Compartments (Incoming, Tie, and Feeder): Size not to exceed 50.0" (H) x 40.0" (W) x 100.0" (D) for each compartment.
C. Two Auxiliary Compartments (For Voltage Transformers and Control Power Transformer): Size not to exceed 50.0" (H) x 40.0" (W) x 100.0" (D).
D. One Control Vertical Compartment (For Controls): Size not to exceed 50.0" (H) x 40.0" (W) x 100.0" (D).

Ratings

Rating: Primary Equipment Switchgear, and Circuit Breaker.
The Primary Equipment 15 kV switchgear assembly ratings shall be as follows:

Maximum Design Voltage:	15 kV
Basic Impulse Level:	95 kV
Available System 3-phase Short Circuit Current:	18 kA Symmetrical
Nominal System Voltage:	12.47 kV three-phase three-wire
System Grounding:	ungrounded
Main Cross Bus Continuous Current Rating:	1200 Amperes

The 15 kV breaker ratings shall be as follows:

Circuit Breaker Nominal 3-Phase MVA Class:	500 MVA
Rated Continuous Current at 60 Hz:	1200 A
Circuit Breaker Rated Short-Circuit Current at Rated Maximum kV:	63 kA Symmetrical
Short-Time (3-Second) Current:	63 kA Asymmetrical
Circuit Breaker Closing and Latching Capability and assembly momentary:	100 kA Asymmetrical
Spring charge motor run Amperes:	2.0 A or less
Close or Trip Amperes for 240 V(ac) coils:	3.0 A or less
Trip Amperes for 125 VDC coil:	7.0 A or less
Close or Trip Voltage range for 240 V(ac) coils:	208 V(ac) or less to 254 V(ac) max
Trip Voltage range for 125 VDC coil:	70 V(dc) or less to 140 V(dc) max
Rated Interrupting Time:	3 cycles or less

Construction

A. The primary equipment switchgear assembly shall consist of individual vertical sections housing various combinations of circuit breakers and auxiliaries, bolted to form a rigid metal-clad switchgear assembly. Metal side sheets shall provide grounded barriers between adjacent structures and solid removable metal barriers shall isolate the major primary sections of each circuit. Hinged rear doors, complete with provisions for padlocking, shall be provided.

B. The stationary primary contacts shall be silver-plated and recessed within insulating tubes. A steel shutter shall automatically cover the stationary primary disconnecting contacts when the breaker is in the disconnected position or out of the cell. Provide rails to allow withdrawal of each 15 kV circuit breaker for inspection and maintenance without the use of a separate lifting device.

Bus

A. The main bus shall be copper with fluidized bed epoxy flame-retardant and track-resistant insulation. The bus supports between units shall be flame-retardant, track-resistant, glass polyester. The primary equipment shall be constructed so that all buses, bus supports and connections shall withstand stresses that would be produced by currents equal to the momentary ratings of the circuit breakers. Main bus for 15 kV shall be rated 1200 amperes. Insulated copper main bus shall be provided and have provisions for future extension. All bus joints shall be plated, bolted and insulated with easily installed boots. The bus shall be braced to withstand fault currents equal to the close and latch rating of the breakers. The temperature rise of the bus and connections shall be in accordance with ANSI standards and documented by design tests.

B. A copper ground bus shall extend the entire length of the secondary unit substation.

Wiring/Terminations

A. The secondary unit substation manufacturer shall provide suitable terminal blocks for secondary wire terminations and a minimum of 10 percent spare terminals shall be provided. One control circuit cutout device shall be provided in each circuit breaker housing. Primary equipment secondary wire shall be No. 14 AWG, type SIS rated 600 volt, 90 °C, furnished with wire markers at each termination. Wires shall terminate on terminal blocks with marker strips numbered in agreement with detailed connection diagrams.

B. Cable lugs for the medium voltage power cables terminating inside the primary equipment shall be of the type and size as required for the safe and proper installation of the medium voltage power cables specified in these special provisions and shown on the plans shall be furnished.

Circuit Breakers, Compartments, and Vertical Section Housings

A. The circuit breakers shall be horizontal drawout type, capable of being withdrawn on rails. The breakers shall be operated by a motor-charged stored energy spring mechanism, charged normally by a universal electric motor and in an emergency by a manual handle. The primary disconnecting contacts shall be silver-plated copper.

B. Each circuit breaker shall contain three vacuum interrupters separately mounted in a self-contained, self-aligning pole unit, which can be removed easily. The vacuum interrupter pole unit shall be mounted on glass polyester. A contact wear gap indicator for each vacuum interrupter, which requires no tools to indicate available contact life, shall be easily visible when the breaker is removed from its compartment. The current transfer from the vacuum interrupter moving stem to the breaker main conductor shall be a non-sliding design. The breaker front panel shall be removable when the breaker is withdrawn for ease of inspection and maintenance.

C. The secondary contacts shall be silver-plated and shall automatically engage in the breaker operating position, which can be manually engaged in the breaker test position.

D. Interlocks shall be provided to prevent closing of a breaker between operating and test positions, to trip breakers upon insertion or removal from housing and to discharge stored energy mechanisms upon insertion or removal from the housing. The breaker shall be secured positively in the housing between and including the operating and test positions.

E. The breakers shall be electrically operated by the following control voltages:

1. 230 V(ac) CLOSE and AC Capacitor Trip.
2. An additional 125 V(dc) Shunt Trip Coil to Trip the Circuit Breaker for each breaker.

F. Each circuit breaker shall be complete with switches, push buttons, and indicating lights to indicate and control varies functions of the circuit breaker and the primary equipment of the secondary unit substation as specified below:

1. The circuit breakers for the primary equipment of the secondary unit substation except for the incoming medium voltage circuit breaker in the primary equipment of the secondary unit substation shall have the following switches, push buttons, and indication lights to be installed on the medium voltage circuit breaker compartments as shown on the plans and shall be connected as shown on the plans:

   a. One Red Indication Light with the word "CLOSED" next to the light to indicate when the circuit breaker is closed.
   b. One Green Indication Light with the word "OPEN" next to the light to indicate when the circuit breaker is open.
   c. One Amber or Yellow Indication Light with the word "CHARGING" next to the light to indicate when the circuit breaker motor is charging.
   d. One White Indication Light with the word "LOCAL" next to the light to indicate when the circuit breaker is set to the local condition.
   e. One Control Switch (ANSI Device –Function #01) with the words "TRIP" and "CLOSE" on the control switch use to trip and close the circuit breaker.
   f. One Control Switch (ANSI Device-Function #43) with the words "LOCAL" and "REMOTE" on the control switch use to set the circuit breaker into the local or remote condition.
   g. One Push button (Normally Open) with the words "RESET CB" next to the push button use to reset the circuit breaker use to reset the circuit breaker.

2. The incoming medium voltage circuit breaker in the primary equipment of the secondary unit substation shall have the following switches, push buttons, and indication lights to be installed on the incoming medium voltage circuit breaker compartments as shown on the plans, and shall be connected as shown on the plans:

   a. All the switches, pushbuttons, and indication lights as specified in section 1.
   b. One Push button (Normally Open) with the words "RESET SYSTEM" next to the push button to reset the power source back to the normal.
   c. One Red Indication Light with the words "Incoming Power Available (BATTERY) next to the light to determine when the power is available on the Battery side of the Doyle Drive Tunnel.
   d. One Red Indication Light with the words "Incoming Power Available (MAIN POST)" next to the light to determine when the power is available on the Main Post side of the Doyle Drive Tunnel.
   e. One Push button (Normally Closed) with the words "Control Power Test" next to the push button to test the control power system on the Main Post side of the Doyle Drive Tunnel.
   f. One Red Push button (Normally Open) with the words "INTERLOCK BY-PASS (EMERGENCY USE ONLY)" next to the push button use to by-pass the circuit breaker interlock system.

3. The tie medium voltage circuit breaker in the primary equipment of the secondary unit substation shall have the following push button to be installed on the line medium voltage circuit breaker compartment as shown on the plans, and shall be connected as shown on the plans:

   a. All the switches, push buttons, and indication lights as specified in Section 1.
   b. One Red Push button (Normally Open) with the words "INTERLOCK BY-PASS (EMERGENCY USE ONLY)" next to the push button use to by-pass the circuit breaker interlock system.

G. The primary equipment of the secondary unit substation shall have a 15 kVA 12.47 kV/240 V/120 V Control Power Transformer that shall be installed in the auxiliary compartment (auxiliary compartment #1) to be use to power the equipment in the secondary unit substation.

H. The primary equipment of the secondary unit substation shall have a Control Vertical Compartment as shown on plans and shall meet the following specifications:

1. The control vertical compartment shall include a 3' x 3' x 1' enclosed space with a steel backpanel (not less than 32" x 32") use to install and mount varies items inside the space as shown on the plans with wire compartments for installing wires to the other parts of the secondary unit substation and conduit openings for the costumer uses as shown on the plans.
2. The control vertical compartment shall include a door with lock and keys to enclose the control vertical compartment.
3. The control vertical compartment shall also conform to the general electrical and construction design of the primary equipment as specified in this part of special provisions.
4. The steel backpanel of the control vertical compartment shall be in accordance's to the "new backpanel and new backplate" specifications as specified elsewhere in these special provisions.
5. The steel backpanel of the control vertical compartment shall include a Wall-Mounted 24-Connector Fiber Optic Patch Box as specified elsewhere in these special provisions installed on the steel backpanel.

I. An 18 kV distribution class surge arresters shall be provided and connected at the incoming terminations of the incoming medium voltage circuit breaker in the primary equipment of the secondary unit substation and securely grounded to the metal structure per manufacturers recommendation for the proper and safe installation and operation and as specified by the Engineer.

The compartments (the medium voltage circuit breaker compartments, the control vertical compartment and the auxiliary compartments) shall include but not be limited to fuses, wires, terminal blocks, and any additional accessories shown on the plans and as required for the proper and safe installation and operation of the Protective Relays, Backup Protective Relays, Line Current Differential Protective Relays, Power Circuit Breakers, Breaker Interface Module, Power Meters, Current Transformers, and Voltage Transformers shown on the plans and not specified in this specification of these special provisions.

Utility Metering

Where shown on the plans the utility metering vertical section and bus work shall contain provisions for voltage transformers and current transformers as required by the utility. The construction shall conform to the utility company's metering standards. The utility metering vertical section shall conform to the general electrical and construction design of the primary equipment of the secondary unit substation as specified in this specification of these special provisions. The utility metering vertical section shall provide separate barriered-off utility metering compartment or structure complete with hinged sealable door.

AUXILIARY DEVICES

Current Transformers

A. The medium voltage circuit breaker compartments shall included three multiratio ring type current transformers (Adjustable from 1200/5 to 50/5 ratios) inside each compartment. The thermal and mechanical ratings of the current transformers shall be coordinated with the medium voltage circuit breaker. Their accuracy rating shall be equal to or higher than ANSI standard requirements. Shorting terminal blocks shall be furnished on the secondary of all the current transformers. The current transformers shall be wired to shorting-type terminal blocks. The standard location for the current transformers on the bus side and line side of the medium voltage circuit breaker shall be front accessible to permit adding or changing current transformers without removing high-voltage insulation connections.

B. The primary equipment of the secondary unit substation shall included four conductors and those conductors shall be connected to the Protective Relays, Backup Protective Relay, Line Current Differential Protective Relay, and Power Meter from the secondary side of the current transformers as shown on the plans, and as required for the proper and safe installation and operation of those relays and meter.

C. The primary equipment of the secondary unit substation shall included four conductors and those conductors shall be connected to the Backup Protective Relay Y relay component of the incoming medium voltage circuit breaker compartment from the secondary side of the current transformers through the Protective Relay of the feeder medium voltage circuit breaker as shown on the plans, and as required for the proper and safe installation and operation of the relay.

Voltage Transformers

A. The primary equipment of the secondary unit substation shall included two sets of three voltage transformers (12.47 kV/120 V voltage ratio) including primary and secondary protective devices inside each enclosed auxiliary compartment (auxiliary compartment) of the primary equipment of the secondary unit substation as specified in this specification of these special provisions. The voltage transformers shall be mounted in drawout drawers contained in an enclosed auxiliary compartment (auxiliary compartment). Rails shall be provided as applicable for each drawer to permit easy inspection, testing and fuse replacement. Shutters shall isolate primary bus stabs when drawers are withdrawn. The three voltage transformers shall be connected in a wye configuration on both the primary and secondary side of the voltage transformers.
B. The primary equipment of the secondary unit substation shall include one set of three voltage transformers in the enclosed auxiliary compartment (auxiliary compartment #1) with one set connected to the line side of the incoming medium voltage circuit breaker for the primary equipment of the secondary unit substation.
C. The primary equipment of the secondary unit substation shall include one set of three voltage transformers in the enclosed auxiliary compartment (auxiliary compartment #2) connected to the bus side of the primary equipment of the secondary unit substation.
D. The primary equipment of the secondary unit substation shall include four conductors and those conductors shall be connected to the Protective Relays, and Power Meter from the secondary side of the sets of the three voltage transformers as shown on the plans, and as required for the proper and safe installation and operation of those relays and meter.
E. The primary equipment of the secondary unit substation shall include two conductors with the phases shown on the plans and those conductors shall be connected to the auxiliary voltage input of the Protective Relays from the secondary side of the sets of the three voltage transformers phase connections shown on the plans, and as required for the proper and safe installation and operation of those Protective Relays.

Control Relays

Power Control Relays, Transfer Control Relays, and SCADA Control and Indication Relays as specified in the “Power Control Relays” specifications, in the "Transfer Control Relays" specifications and in the “SCADA Control and Indication Relays” specifications respectfully of these Special Provisions and as shown on the plans within the compartments of the primary equipment of the secondary unit substation shall be furnished and installed in the compartments as shown on the plans, as specified in this specification, and as required for proper and safe operation of the Power Control Relays, and SCADA Control and Indication Relays in the compartments of the primary equipment of the secondary unit substation. Each control relay (Power Control Relay, and SCADA Control and Indication Relay) shall be labeled with its function name next to the relay.

Trip Units

A. The Contractor shall furnish the quantity of Protective Relays as shown on the plans (Three Protective Relays), and the type of protection relays as specified in the “Protective Relay” specification as specified in these special provisions. The Secondary Unit Substation manufacturer shall install in the primary equipment of the secondary unit substation the Protective Relays shown on the plans, and specified in this specifications required for the proper and safe installation and operation of those Protective Relays.
B. The Contractor shall furnish the quantity of Backup Protective Relays as shown on the plans (One Backup Protective Relay for the incoming medium voltage circuit breaker and located on auxiliary compartment #1), and the type of backup protection relay as specified in the “Backup Protective Relay” specification as specified in these special provisions. The Secondary Unit Substation manufacturer shall install in the primary equipment of the secondary unit substation the Backup Protective Relay shown on the plans, and specified in this specifications required for the proper and safe installation and operation of the Backup Protective Relay.
C. The Contractor shall furnish the quantity of Line Current Differential Protective Relays as shown on the plans (One Line Current Differential Protective Relay for the tie medium voltage circuit breaker) and the type of Line Current Differential Protection Relay as specified in the “Line Current Differential Protective Relay” specification as specified in these special provisions. The Secondary Unit Substation manufacturer shall install in the primary equipment of the secondary unit substation the Line Current Differential Protective Relays shown on the plans, and specified in this specification as required for the proper and safe installation and operation of the Line Current Differential Protective Relay.

Power Meters

The Contractor shall furnish the quantity of Power Meters as shown on the plans (One Power Meter for the incoming medium voltage circuit breaker and located on auxiliary compartment #1), and the type of power meter as specified in the "Power Meter" specification as specified in these special provisions. The Secondary Unit Substation manufacturer shall install in the primary equipment of the secondary unit substation the Power Meter shown on the plans, and specified in this specification as required for the proper and safe installation and operation of those Power Meters.

ACCESSORIES

A. Maintenance tool for manually charging the breaker closing spring and manually opening the shutter.
B. One – Levering crank for moving the breaker between test and connected positions.
C. One – Test jumper for electrically operating the breaker while out of its Compartment.
D. One – Breaker lifting yoke used for attachment to breaker for lifting breaker on or off compartment rails.
E. One – Set of rail extensions and rail clamps, when applicable.
F. One – Portable lifting device for lifting the breaker on or off the rails.
G. One – Ramp for rolling breaker mounted in lower compartment directly onto the floor.
H. One – Test cabinet for testing electrically operated breakers outside housing.
I. One – "Dockable" transport dolly for moving breaker about outside its Compartment.
J. One – Electrical levering device.
K. Rubber Mats (For indoor use) extending the full-length of the operating aisles of the Secondary Unit Substation installed. The mats shall be in accordance with latest edition of the ASTM Specifications for Rubber Matting with a dielectric strength of 50,000 volts minimum with 3,000 volts to ground minimum, 1/3-inch thick, and 3 ft wide with a corrugated surface. Install mats at the time of the field-testing of the Secondary Unit Substation.
L. Two-Manual Ground and Test Devices for the substation.

Enclosure for the Primary Equipment of the Secondary Unit Substation

The primary equipment of the secondary unit substation described in these specifications shall be of indoor construction, with devices arranged as shown on the plans.

Corona Free Design

The primary equipment shall be corona free by design and shall be tested for partial discharges in accordance with EEMAC standard G11-1. The corona discharges measured during the tests shall be less than 100 picocoulombs.

NAMEPLATES

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all incoming, tie, and feeder circuits as shown on the plans, and in these special provisions. Nameplates shall be laminated plastic, black characters on white background, and secured with screws. Characters shall be 3/16-inch high, minimum. Furnish master nameplate for each primary equipment giving information in accordance with IEEE Std. C37.20.2-1999, Section 7.4.1. Circuit nameplates shall be provided with circuit designations as shown on the State's single-line diagrams on the power distribution system shown on the plans.
B. Control components mounted within the assembly, such as fuse blocks, relays, push buttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

FINISH

The finish shall consist of a coat of gray (ANSI-61), thermosetting, polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have corrosion resistance of 600 hours to 5 percent salt spray.

TRANSFORMER

The transformer of the secondary unit substation shall be a Vacuum Pressure Encapsulated (VPE) Dry-Type Transformer as specified in this part of the special provisions and as shown on the plans. The transformer and all its components shall be designed manufactured and tested in accordance with the latest applicable standards as specified in the "REFERENCES" for the Secondary Substation Transformers as specified in this part of the special provisions. The transformer shall consist of the following transformer assemblies and shall meet the following specifications:

Transformer of the Secondary Unit Substation for the Battery Substation (As Shown on the Plans):

One indoor dry-type transformer rated at 2500 kVA 12 kV/ 480 V with a Delta on the primary at 12.47 kV and a Wye grounded on the secondary at 480 V/277 V.

Ratings

The ratings of the transformer shall be as specified below for the transformer specified in this part of the special provisions:

kVA Rating:	2500 kVA
Cooling:	Natural Air Convection (AA)
Impedance:	ANSI Standard Tolerance
HV:	12.47 kV Delta
HV BIL:	95 kV
HV De-energized Taps:	± 2 - 2-1/2 percent full capacity
LV:	480 Volts Wye-grounded
LV BIL:	10 kV

Construction

A. Transformer shall be cooled by natural air convection (AA).
B. The electrical insulation system shall utilize class H material in a fully rated 220 °C system. Transformer design temperature rise shall be based on a 30 °C average ambient over a 24-hour period with a maximum of 40 °C. Solid insulation in the transformer shall consist of inorganic materials such as porcelain, glass fiber, electrical grade glass polyester, or Nomex. All insulating materials must be rated for continuous 220 °C duty. The insulation between the high- and low-voltage coils shall be more than sufficient for the voltage stress without the need of a varnish.
C. The transformer shall be designed for a temperature rise of 150 °C and shall be capable of operating at 0 percent above base nameplate kVA capacity continuously without any loss of life.
D. The transformer shall be designed to meet the sound level standards for dry-type transformers as defined in NEMA TR1. The measurement procedure shall be as specified in ANSI C57.12.90.
E. The transformer shall be UL labeled (Also specified under the "Regulatory Requirements" as specified in this part of the special provisions).
F. The transformer shall be of explosion-resistant, fire-resistant, air-insulated, ventilated dry-type construction, and cooled by the natural circulation of air through the windings.
G. High-voltage and low-voltage windings shall be copper. Insulation between layers of the windings shall be by Insuldur paper or equal.
H. The entire core and coil assembly shall be Vacuum Pressure Encapsulated (VPE) with a silicone resin per MIL-1-24092. The total VPE process shall apply a four-cycle shield of silicone resin to the coils and a two cycle protective shield to the bus, core and support structure. The VPE process shall effectively encapsulate the entire core and coil assembly, which results in a transformer, which is virtually impermeable to moisture, dust, dirt, salt, air, and other industrial contaminants.
I. The high- and low-voltage coil assembly shall be preheated to evaporate any moisture, and then placed into a vacuum pressure tank. The air in the tank shall be evacuated; and at extremely low absolute pressure, all air bubbles are to be drawn out of the insulating materials. The resin shall be introduced to a level that submerges all parts while the vacuum is maintained for approximately one hour. Then the vacuum shall be released and pressure applied for approximately 1/2 hour, after which the coil shall be removed and placed in an oven for several hours in order for the resin to catalyze into a composite mass, completely sealing and binding the winding.
J. The transformer shall be supplied in a knockdown case design, for ease in fitting through limited openings, and shall be of heavy gauge sheet steel construction, equipped with removable panels for access to the core and coils. Front and rear panels shall incorporate lowered ventilating grills.

Accessories

Transformer shall include:

A. Diagram instruction plate.
B. Provisions for lifting and jacking.
C. Removable center panel for access to high-voltage strap-type connector taps for de-energized tap changing.
D. Two ground pads with continuous ground bus.

Finish

The paint shall be applied using an electrostatically deposited dry powder system to a minimum of three mils average thickness. Units shall be painted ANSI 61 for indoor service and shall match the primary and secondary equipment.

Terminal Compartments/Flange Connections

The transformer unit supplied shall include a HV close-coupled flange and a busway flange. Connections between the primary device and transformer shall be bus, and between the transformer and secondary shall be flexible bus braid.

Bushing Power Factor Sensing Equipment

The transformer shall be equipped with a continuous monitoring system to allow for pre-and post-shipment measurement of bushing power factor and internal partial discharges. In addition, vibro-acoustics testing shall be completed both prior to shipment and after final installation. Vibro-acoustics testing will indicate any initial winding looseness prior to shipment, and confirm that no additional internal stress has occurred during shipment and installation.

SECONDARY EQUIPMENT

The secondary equipment of the secondary unit substation shall be a deadfront type, low voltage metal-enclosed switchgear assembly utilizing drawout power circuit breakers (Size as shown on the plans) as specified in this part of the special provisions and as shown on the plans. The secondary equipment and all its components shall be designed manufactured and tested in accordance with the latest applicable standards as specified under "REFERENCES" for the LV Distribution Switchboards as specified in this part of the special provisions. The Secondary Equipment shall consist of the following components and shall meet the following specifications:

Secondary Equipment of the Secondary Unit Substation (As Shown on the Plans)

One deadfront type, low voltage metal-enclosed switchgear (480 V Metal Enclosed Drawout Switchgear as shown on the plans) with one Main Power Circuit Breaker, and three Feeder Power Circuit Breakers.

Ratings

A. Voltage rating shall be as indicated on the drawings. The entire assembly shall be suitable for 600 volts maximum AC service.
B. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current 200,000 amperes symmetrical at rated voltage (480 V(ac)).
C. The bus system shall have a minimum ANSI 4-cycle short-circuit withstand rating of 200,000 amperes symmetrical.
D. All circuit breakers shall have a minimum symmetrical interrupting capacity of 100,000 amperes. To ensure a fully selective system, all circuit breakers shall have 30 cycle short-time withstand ratings equal to their symmetrical interrupting ratings through 85,000 amperes, regardless of whether equipped with instantaneous trip protection or not.
E. All ratings shall be tested to the requirements of ANSI C37.20.1, C37.50 and C37.51 and UL witnessed and approved.

CONSTRUCTION

A. The switchgear shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide ventilators located on the top of the switchgear over the breaker and bus compartments to ensure adequate ventilation within the enclosure. Hinged rear doors, complete with provisions for padlocking, shall be provided.
B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to Contractor supplied floor sills to be set level in concrete per manufacturer's recommendations. Provisions shall be made for jacking of shipping groups, for removal of skids or insertion of equipment rollers. Base of assembly shall be suitable for rolling directly on pipes without skids. The base shall be equipped with slots in the base frame members to accommodate the use of pry bars for moving the equipment to its final position.
C. Each vertical steel unit forming part of the switchgear line-up shall be a self-contained housing having one or more individual breaker or instrument compartments, a centralized bus compartment and a rear cable compartment. Each individual circuit breaker compartment, or cell, shall be segregated from adjacent compartments and sections by means of steel barriers to the maximum extent possible. It shall be equipped with drawout rails and primary and secondary disconnecting contacts. Removable hinge pins shall be provided on the breaker compartment door hinges. Current transformers for feeder instrumentation, where shown on the plans, shall be located within the appropriate breaker cells and be front accessible and removable.

D. The stationary part of the primary disconnecting devices for each power circuit breaker shall be breaker mounted and consist of a set of contacts extending to the rear through a glass polyester insulating support barrier; corresponding moving finger contacts, suitably spaced, shall be furnished on the power circuit breaker studs which engage in only the connected position. The assembly shall provide multiple silver-to-silver full floating high pressure point contacts with uniform pressure on each finger maintained by springs. Each circuit shall include the necessary three-phase bus connections between the section bus and the breaker line side studs. Load studs shall be equipped with insulated copper load extension buses terminating in solderless type terminals in the rear cable compartment of each structure. Bus extensions shall be silver-plated where outgoing terminals are attached.
E. The circuit breaker door design shall be such that the following functions may be performed without the need to open the circuit breaker door: lever circuit breaker between positions, operate manual charging system, close and open circuit breaker, examine and adjust trip unit, and read circuit breaker rating nameplate.
F. The secondary disconnecting devices shall consist of floating terminals mounted on the stationary unit and engaging mating contacts at the front of the breaker. The secondary disconnecting devices shall be gold-plated and engagement shall be maintained in the "connected" and "test" positions.
G. The removable power circuit breaker element shall be equipped with disconnecting contacts and interlocks for drawout application. It shall have four positions, "connected," "test," "disconnected" and "removed." The breaker drawout element shall contain a worm gear levering "in" and "out" mechanism with removable lever crank. Levering shall be accomplished via the use of conventional tools. Mechanical interlocking shall be provided so that the breaker is in the tripped position before levering "in" or "out" of the cell. The breaker shall include an optional provision for key locking open to prevent manual or electric closing. Padlocking shall provide for securing the breaker in the connected, test, or disconnected position by preventing levering.
H. An insulating flash shield shall be mounted above each circuit breaker to prevent flashover from the arc chutes to ground.
I. Provide a rear compartment barrier between the cable compartment and the main bus to protect against inadvertent contact with main or vertical bus bars.
J. Provide in the cell when the circuit breaker is withdrawn, a safety shutter which automatically covers the line and load stabs and protects against incidental contact.
K. Provide a metal barrier full height and depth between adjacent vertical structures in the cable compartment.
L. Provide a glass polyester full height and depth barrier between adjacent vertical structures in the bus compartment with appropriate slots for main bus.

Bus

A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on ANSI standard temperature rise criteria of 65 °C over a 40 °C ambient (outside the enclosure).
In addition to full UL air clearances, the phase bus shall be insulated with a minimum of 5 mil thickness of epoxy resin coating. Removable boots shall be provided to give access to the cross bus joints for inspection and maintenance.
B. The secondary unit substation manufacturer shall provide a full capacity neutral bus.
C. A copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the secondary unit substation. The ground bus short-time withstand rating shall meet that of the largest circuit breaker within the assembly.
D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with Belleville-type washers.

Wiring/Terminations

A. Small wiring, necessary fuse blocks and terminal blocks within the switchgear shall be furnished as required. Control components mounted within the assembly shall be suitably marked for identification corresponding to the appropriate designations on manufacturer's wiring diagrams.
B. Provide a front accessible, isolated vertical wireway for routing of factory and field wiring. Factory provisions shall be made for securing field wiring without the need for adhesive wire anchors.
C. Front access to all circuit breaker secondary connection points shall be provided for ease of troubleshooting and connection to external field connections without the need of removing the circuit breaker for access.

D. All control wire shall be type SIS. Control wiring shall be 14 AWG for control circuits and 12 AWG for shunt trip and current transformer circuits. Wire bundles shall be secured with nylon ties and anchored to the assembly with the use of pre-punched wire lances or nylon non-adhesive anchors. All current transformer secondary leads shall first be connected to conveniently accessible shorting terminal blocks before connecting to any other device. Shorting screws with provisions for storage shall be provided. All groups of control wires leaving the switchgear shall be provided with terminal blocks with suitable numbering strips and provisions for No. 10 AWG field connections. Each control wire shall be marked to the origin zone/wire name/destination zone over the entire length of the wire using a UV cured ink process. Provide wire markers at each end of all control wiring. Plug-in terminal blocks shall be provided for all shipping split wires. Terminal connections to remote devices or sources shall be front accessible via doors above each circuit breaker.
E. NEMA 2-hole crimp-type lugs shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 °C of the size as shown on the plans.
F. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as required.
G. Reusable insulating boots shall be provided to cover all power cable terminations.

Circuit Breakers

A. All protective devices for the secondary equipment of the secondary unit substation shall be low voltage power circuit breakers. All breakers shall be UL listed for application in their intended enclosures for 100 percent of their continuous ampere rating.
B. All power circuit breakers shall be constructed and tested in accordance with ANSI C37.13, C37.16, C37.17, C37.50, UL 1066 and NEMA SG-3 standard. The breaker shall carry a UL label.
C. Breakers shall be provided in drawout configuration. The 800, 1600, 2000 and 3200 ampere frame power circuit breakers shall be provided in the same physical frame size, while 4000 and 5000 ampere frame power circuit breakers shall be provided in a second physical frame size. Both physical frame sizes shall have a common height and depth.
D. Power circuit breakers shall utilize a two-step stored-energy mechanism to charge the closing springs. The closing of the breaker contacts shall automatically charge the opening springs to ensure quick-break operation.
E. All breakers shall be electrically operated (EO).
F. Electrically operated breakers shall be complete with 125 V DC motor operators. The charging time of the motor shall not exceed 6 seconds.
G. To facilitate lifting, the power circuit breaker shall have integral handles on the side of the breaker.
H. The power circuit breaker shall have a closing time of not more than 3 cycles.
I. The primary contacts shall have an easily accessible wear indicator to indicate contact erosion.
J. The power circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage.
K. The power circuit breaker shall have a closing time of not more than 3 cycles.
L. The primary contacts shall have an easily accessible wear indicator to indicate contact erosion.
M. The power circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage.

Trip Units

A. Each low voltage power circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker.
B. The trip unit shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip.
C. The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.
D. The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.
E. Trip unit shall have selectable thermal memory for enhanced circuit protection.

F. Complete system selective coordination shall be provided by the addition of the following individually adjustable time/current curve shaping solid-state elements:

1. All circuit breakers shall have adjustments for long delay pickup and time.
2. All circuit breakers shall have individual adjustments for short delay pickup and time, and include I^2t settings.
3. All circuit breakers shall have an adjustable instantaneous pickup.
4. All circuit breakers shall have individually adjustable ground fault current pickup and time, and include I^2t settings .

G. The trip unit shall have provisions for a single test kit to test each of the trip functions.
H. The trip unit shall provide zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream breaker and allow the breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the present time delay. Factory shall wire for zone interlocking for the power circuit breakers within the switchgear.
I. The trip unit shall have an information system that utilizes battery backup LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A test push button shall energize a LED to indicate the battery status.
J. All circuit breakers shall have individually adjustable ground fault alarm only.
K. The trip unit shall have a 4-character LCD display showing phase, neutral, and ground current. The accuracy of these readings shall be ±2 percent of full scale.
L. The trip unit shall be equipped to permit communication via a network twisted pair for remote monitoring and control.

Accessories

The breaker interface unit shall be specified under "Breaker Interface Unit" specifications as specified elsewhere in these special provisions. The secondary unit substation manufacturer shall install in the secondary equipment the Breaker Interface Unit as shown on the plans and as required for the proper and safe installation and operation of the Breaker Interface Unit.

Transient Voltage Surge Suppression

A. Provide transient voltage surge suppression as specified under "transient voltage surge suppression" specifications as specified elsewhere in these special provisions. The secondary unit substation manufacturer shall install in the secondary equipment the transient voltage surge suppression as required for the proper and safe installation and operation of the transient voltage surge suppression.

ENCLOSURES

NEMA 1 Enclosure

Nameplates:

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as shown on the plans. Nameplates shall be laminated plastic, black characters on white background, and secured with screws. Characters shall be 3/16-inch high, minimum.
B. Furnish master nameplate giving switchgear designation, voltage ampere rating, short-circuit rating, and manufacturer's name.
C. Control components mounted within the assembly, such as fuse blocks, relays, push buttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's drawings.

Finish: All exterior and interior steel surfaces of the switchgear shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchgear shall be ANSI 61.

Accessories: Provide a traveling type circuit breaker lifter, rail-mounted on top of switchgear.

SECONDARY UNIT SUBSTATION EXECUTION

Factory Testing (For the primary equipment only)

A. The following standard factory tests shall be performed on the circuit breaker element provided under this section. All tests shall be in accordance with the latest version of ANSI standards:

1. Alignment test with master cell to verify all interfaces and interchangeability.
2. Circuit breakers operated over the range of minimum to maximum control voltage.
3. Factory setting of contact gap.
4. One-minute dielectric test per ANSI standards.
5. Final inspections and quality checks.

B. The following production test shall be performed on each breaker housing:

1. Alignment test with master breaker to verify interfaces.
2. One-minute dielectric test per ANSI standards on primary and secondary circuits.
3. Operation of wiring, relays and other devices verified by an operational sequence test.
4. Final inspection and quality check.

C. The manufacturer shall provide three certified copies of factory test reports.

Factory Testing (For the transformer only)

A The following standard factory tests shall be performed on all equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards:

1. Resistance measurements of all windings on the rated voltage connection of each unit and at the tap extremes of each unit of a given rating.
2. Ratio tests on the rated voltage connection and on all tap connections.
3. Polarity and phase-relation tests on the rated voltage connections.
4. No-load loss at rated voltage on the rated voltage connection.
5. Exciting current at rated voltage on the rated voltage connection.
6. Impedance and load loss at rated current on the rated voltage connection of each unit and on the tap extremes of each unit of a given rating.
7. Applied potential test.
8. Induced potential tests.
9. The manufacturer shall perform additional 100 percent quality control impulse test on each unit.

B. The following special factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest revision of ANSI and NEMA standards:

1. Temperature tests shall be made on all units. Tests shall not be required when there is available a record of a temperature test on an essentially duplicate unit.
2. ANSI impulse test on all windings.

C. The manufacturer shall provide three (3) certified copies of factory test reports.

Factory Testing (For the Secondary equipment only)

A. The switchgear shall be completely assembled, wired, adjusted and tested at the factory. After assembly, the complete switchgear shall be tested to ensure the accuracy of the wiring and the functioning of all equipment. The main bus system shall be given a dielectric test of 2200 volts for one minute between live parts and ground and between opposite polarities.
B. The wiring and control circuits shall be given a dielectric test of 1500 volts for one minute, or 1800 volts for one second, between live parts and ground, in accordance with ANSI C37.20.1.
C. A certified test report of all standard production tests shall be shipped with each assembly.

Field Testing (for the transformers only)

A. Measure primary and secondary voltages for proper tap settings.
B. Megger primary and secondary windings.

Field Adjustments (For the Primary equipment and Secondary equipment)

A. The Contractors shall perform field adjustments of the protective devices (Protective Relays, Backup Protective Relay, Power Circuit Breakers, and Line Current Differential Protective Relay) and of the Current Transformers as required to place the primary equipment and secondary equipment in final operating condition. The settings shall be in accordance with the approved report on the protective devices settings and current transformers settings from the "Short circuit, Protection, and Coordination study" specification as specified in these special provisions.

B. The Contractor at no additional cost to the state shall perform all necessary field settings of devices and adjustments and minor modifications to the primary equipment and secondary equipment to accomplish conformance with an approved report on the short circuit fault duty and other information associated with the protective devices from the "Short circuit, Protection, and Coordination study" specification as specified in these special provisions.

Field Adjustments (for the Transformers Only)

Adjust taps to deliver appropriate secondary voltage as specified in this part of the special provisions.

Field Quality Control

A. Provide the services for each secondary unit substation a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the secondary unit substation for a period of 20 working days per secondary unit substation. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the secondary unit substation and components contained herein.

B. The Contractor shall provide three copies of the manufacturer's field start-up report for each secondary unit substation.

Manufacturer's Certification

A. The Contractor shall provide a qualified factory-trained manufacturer's representative to certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall provide three copies of the manufacturer's representative's certification.

Installation (for the Secondary Unit Substation)

A. The Contractors shall install all equipment per the manufacturer's instructions and recommendations, these special provisions, the plans, the National Electrical Code, the National Electrical Safety Code, and as directed by the Engineer.

B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

Installation (for the Secondary Equipment Only)

A. The Contractors shall install all equipment per the manufacturer's recommendations, these special provisions, the plans, and as directed by the Engineer.

B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

C. The equipment shall be installed and checked in accordance with the manufacturer's recommendations. This shall include but not limited to:

1. Checking to ensure that the pad location is level to within 0.125 inches per three foot of distance in any direction.
2. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations.
3. Assembling all shipping sections, removing all shipping braces and connecting all shipping split mechanical and electrical connections.
4. Securing assemblies to foundation or floor channels.
5. Measuring and recording Megger readings phase-to-phase, phase-to-ground, and neutral-to-ground.
6. Inspecting and installing all circuit breakers in their proper compartments.

BREAKER INTERFACE MODULE (BIM)

The Breaker Interface Module (BIM) shall be a microprocessor-based, self-contained device suitable for door mounting and shall perform the following listed of functions specified below:

A. The BIM assembly shall have provisions for a communications module to provide for remote computer monitoring up to 10,000 feet.

B. Monitor and display parameters of up to 50 feeder circuit breakers as specified under the “Feeder Circuit Breaker” specifications as specified in these special provisions. Communications over the local area network shall be 9,600 baud. There shall be separate step up and step down buttons to select specific breakers by means of a breaker address in a display window. Parameters locally displayed at the BIM for each device shall also be capable of being communicated via twisted pair to a remote personal computer and shall include:

1. Phase Current
2. Energy
3. Present Demand Watts
4. Peak Demand Watts
5. Average Demand Current
6. Cause and Magnitude of trip
7. Trip history
8. Percent Total Harmonic Distortion (THD) for each phase
9. Percent Harmonic Content for each phase (1st through 27th harmonic)
10. Custom Circuit Description.

C. The BIM shall be capable of transmitting the following parameters:

1. Waveform Analysis
2. Power Factor
3. Breaker Curves

D. LEDs shall indicate circuit breaker status -- TRIPPED, OPEN, CLOSED, and NO RESPONSE.

E. Indicate cause of trip -- "Long Delay," "Short Delay," "Instantaneous," "Ground," "Override/Discriminator," or "Communications Network".

F. LED shall also indicate circuit breaker high-load alarm when current exceeds 85 percent of LUPUS setting for at least 40 seconds.

G. The program directing the functions and trip buffer data shall be permanently stored in the BIM so there is no need to reload data after an AC power loss. In addition, the addresses of breakers, type of devices and descriptions shall be stored in memory during an initial learn mode and shall be retained during an AC power loss.

H. The BIM shall have a built-in alarm relay with Form C contacts rated 10 amperes resistive at 277 V(ac) for remote alarm, as well as an alarm LED. An ASK/Reset pushbutton shall be provided to acknowledge the alarm as well as de-energize the alarm relay, change the alarm LED from flashing to steady on, and stop cycling the alarmed breakers. The alarm data shall be stored in BIM memory and displayed whenever the alarm breaker address is selected. The alarm data shall be purged from memory only after the RESET/Reset pushbutton has been depressed again after the breaker trip unit is reset.

I. The BIM shall be operated from a 240-volt AC, single-phase input power source which shall be provided as indicated on the plans and as specified under the “secondary unit substation” specifications as specified in these special provisions.

J. The BIM shall have a "Help" button function, which shall scroll English explanations in the alphanumeric window for any condition or abbreviations.

K. Make provisions for an addressable communication card capable of transmitting all data, including trip data over a compatible two-wire local area network to a central personal computer for storage and printout. Provide date and time stamping for all breaker operations. Reprogramming of the BIM shall not be required when adding a communication module. The network shall also be capable of transmitting data in RS232c format via a translator module.

L. A user defined password for changing setting.

M. 0ºC to 70ºC for the Operating Temperature.

N. 5 percent to 95 percent R.H. (noncondensing).

POWER METER

The power meter shall be a digital line Meter Analyzer and Protection device and shall have the following specifications, features and functions specified below:

A. The power meter shall provide direct reading metered or calculated values of the items listed below and shall auto range between Units, Kilo-units and Mega-units for all metered values. The power meter shall be capable of displaying the frequency distribution in graphic form and shall be capable of displaying the Wave Form in graphic form. The power meter shall be capable of displaying multiple parameters at once, including two user-configurable custom screens displaying any seven of the parameters listed. Indicator LED shall always remain active to display device status for safety and trouble-shooting purposes. Time, date, software version, and network address shall be displayed. Accuracy indicated below to be of read or calculated values based on full scale.

1. AC Current (Amperes) in A, B, and C phase, 3-Phase Average, Neutral (N) and Ground (G). Accuracy +/- 0.2 percent (provide neutral and ground current transformer)
2. AC Voltage (Volts) for A-B-, B-C, and C-A, Phase average, A-N, B-N, and C-N, average phase to N, and N-G accuracy. Real Power (Watts), Reactive Power (vars), Apparent Power (VA), for each phase and system. Accuracy +/- 0.4 percent. Forward/Reverse indication shall be provided.
3. Real Power (WATTS), Reactive Power (VARS), Apparent Power (VA), for each phase and system. Accuracy +/- 0.4 percent. Forward/Reverse indication shall be provided.
4. Real Energy (WH), Reactive Energy (VARH), Apparent Energy (VAH) for each phase and system. Accuracy +/- 0.4 percent. Forward/Reverse indication shall be provided.
5. Frequency (Hz) Accuracy +/- 0.4 percent.
6. Demand values for System Current (Amperes), System Real Power (WATTS), System Reactive Power (VARS), and System Apparent Power (VA).
7. Power Factor for both Displacement only 60-cycle fundamental WATTS to VA and Apparent total WATTS to total VARS including harmonics for A, B and C phase and system. Accuracy +/- 0.8 percent.
8. Current percent Total Harmonic Distortion (THD) in A, B and C phase and N.
9. Voltage percent THD in A-B, B-C and C-A phase, A-N, B-N and-N.
10. K-Factor (sum of the squares of harmonic currents times the square of their harmonic numbers).
11. Transformer Derating Factor (1.414 divided by the Crest Factor).
12. Crest Factor (ratio of peak current to RMS current).

B. The Power meter shall provide the following advanced analysis features:

1. Trend Analysis Screens displaying the minimum and maximum values for each metered value, with all parameters time stamped to 1-second resolution.
2. Demand Analysis Screens displaying present demand and peak demands for current (phase A, B, C, N and G) and power (system real (kW), reactive (kvar), and apparent (kVA). Peak demands shall display time and date stamp to within 1-second resolution. Demand Window Selection for metered demand values shall be selectable either as:

   a. A user-selectable fixed window (programmable from 1- to 60-minutes)
   b. Sliding window method with programmable 1- to 60-minute subintervals, for power (kW, kvar, kVA) demand only
   c. Initiated from a synch pulse for power (kW, kvar, kVA) demand only.
   d. Communication signal initiated from secondary unit substation network master computer. (If available).

3. Harmonic Analysis Screens shall be capable of being function key triggered to capture a high-speed waveform of two cycles of data sampled at 128 samples per cycle, simultaneously recording current in A, B and C phases, N and G as well as all voltages A-B, B-C and C-A phases, A-N, B-N, C-N and N-G. Data captured shall include the magnitude (percent of the fundamental) and the direction of harmonic source (phase angle) for all odd and even multiples of fundamentals from 1st through the 50th.

4. Event/Alarm Analysis Screens shall display data recorded for up to ten event/alarm conditions. The initiation level of the declaration of an event/alarm condition shall be field programmable for all measured parameters. For each event/alarm a description of the event/alarm, date, and time of event/alarm shall be recorded (10 ms resolution). In addition, a capture shall be made of all metered values available and all current and voltage distortion information available on the Harmonic Analysis Screens.
5. The power meter shall be capable of transmitting all data at time of the event via communications to a personal computer for creating and displaying wave forms. In addition, the Event/Alarm analysis screens shall be capable of being initiated from an energized discrete input circuit, or through the communications port.
6. Event/Alarm Condition Levels shall be capable of being triggered by up to 7 of any of 61 conditions when the programmed threshold is exceeded. All shall have programmable time delays from 0.1 to 60 seconds except voltage disturbance, which shall be programmable from 0 to 3600 cycles.

C. Voltage Disturbances

1. Undervoltage/sag – A-B, B-C, A-C (selectable from 50 to 100 percent)
2. Undervoltage/sag – A-N, B-N, C-N (selectable from 50 to 100 percent)
3. Overvoltage/swell – A-B, B-C, A-C (selectable from 100 to 150 percent)
4. Overvoltage/swell – A-N, B-N, C-N (selectable from 100 to 150 percent) If time delay is programmed, any disturbance lasting two (2) cycles (less if magnitude is sufficient to affect rms readings) shall trigger voltage disturbance event/alarm.

D. Maximum Threshold Exceeded

5-24 Percent THD (2-1000) or Magnitude of THD for:
Current Phases A,B,C
Voltage A-B, B-C, C-A
Voltage A-N, B-N, C-N

25-31 Demand
Current Phases A, B, C, Average
System Power – watts, vars, VA

32 Voltage – Neutral to Ground

33-34 Current – Neutral or Ground

E. Minimum or Maximum Threshold Exceeded
33-40 Current Phases A, B, C
41-46 System Power – watts, vars, VA
47-49 Frequency High, Low, High or Low
50-53 System Power Factor
Displacement Minimum and Maximum
Apparent Minimum and Maximum

F. Voltage Phase Unbalance
54-55 Voltage Line-to-Line or Line-to-Neutral
54-56

G. Current Phase Unbalance
56 Current comparison between Phases A, B, C

H. Discrete Input Energized
57-59 Input 1, 2, 3

I. PowerNet Communication
60 Remote command through communications port

J.. Manual Capture
61 Manual capture from pushbutton at device

L. The power meter shall receive and be capable of the following inputs:

1. Instrument Transformers: Input ranges of power meter shall accommodate external current transformers with ranges from 10,000/5 through 5/5 amperes. Provide external current transformers for each phase, neutral and ground circuit with rating as specified on the report from the "Short-Circuit", Protection, and Coordination study "specifications and as indicated on the plans to the primary equipment of the secondary unit substation as specified in these special provisions. Power meter shall be capable of overranging up to eight times nominal current rating. Provide external potential transformer connections suitable for 3- phase 120–volt AC to the primary equipment of the secondary unit substation as specified in these special provisions.
2. Control Power: The power meter shall be supplied from a separate control power source (240 V(ac)) as indicated on the plans and as specified under the "secondary unit substation" specifications as specified in these special provisions (Input range of 96 to 264 volts AC)
3. Dry Contacts: Three dry discrete input contacts shall be capable of being monitored, which may be programmed by the user to perform any of the following functions. The status of the input contacts shall be locally displayable and accessible through the communications port.

    a. Trigger an Event/Alarm Analysis including Harmonic Analysis information for display on the device and information for Wave Form Analysis and display at a personal computer.
    b. Act as a synchronizing pulse input to synchronize demand windows with a utility provided synchronizing pulse.
    c. Actuate a relay output
    d. Reset a relay output, peak demand Minimum/Maximum, or Event Analysis records.

M. Furnish Relay Output Contacts with four (4) Form C (NO/NC) relay output contacts, which shall be capable of being independently programmed for the following functions:

1. Act as a kWh, kVARH, or kVAH pulse initiator output.
2. Actuate on 1 or more Event/Alarm conditions, including discrete inputs and communication Command signal. Each relay contact shall be capable of being set for Auto or Manual Reset with 0- to 30-minute release delay in one–second increments. Relay contacts programmed to actuate on undervoltage shall have a programmable 0- to 30-minute delay on power-up for transfer applications.

N. Furnish 1 0 to 20 mA analog input and four 0 to 20 mA outputs. The input values shall be capable of being displayed on the device as a percentage and shall be accessible throughout the communications port. Each analog output shall be programmable to reflect a phase current, voltage, power, demand, percent THD, power factor, or system frequency.

O. The device shall be fully programmable from the faceplate, including alarm relay and power quality (e.g., harmonic distortion) settings. Programming shall be password protected.

P. Make provisions for an addressable communication card capable of transmitting all data, remotely controlling and programming the power meter over a compatible two-wire local area network to a central personal computer for storage, analysis, display, and printout. The network shall be capable of transmitting data in RS232c format via a translator module. The following minimum functions shall be available through communications at the personal computer with appropriate Windows-based software:

1. Monitoring and trending of all locally displayed values and device status.
2. Initiating an Event/Alarm.
3. Initiating an Event/Alarm information.
4. Retrieving Harmonic Analysis/Wave Form Analysis information including construction of the Harmonic Profile to graphically display simultaneously the relative magnitudes of the multiples of the fundamental frequency for both current and voltage of a given phase.
5. Retrieving Harmonic waveform analysis information for display of eight-cycle wave shapes of all simultaneously recorded current (phase A, B, C, N, and G) and voltages L-L and N-G.
6. Activating relay output contacts.
7. Programming device configuration and setpoints.
8. Synchronizing device clocks to within 30 milliseconds (for demand windows and time stamping).

Q. The power meter shall be UL listed, CSA certified and shall meet ANSI Standard C37.90.1 for surge protection.

R. Environmental Conditions

1. Operating Temperature: -20ºC to 70ºC
2. Storage Temperature: -30ºC to 85ºC
3. Operating Relative Humidity: -5 percent to 95 percent

S. Metering Standards

1. ANSI C12.20 Class 0.5 percent
2. ANSI C12.16 CLASS 05 percent
3. IEC687 CLASS 0.5 percent

10-3.38 RELAYS

PROTECTIVE RELAY

The Protective Relay shall be a multifunctional numerical intertie protection system (Communicating microprocessor-based protective relay) that meets the protection and control requirements outlined in IEEE Intertie Protection Standard 1547-2003. The protective relay shall provide protection, monitoring, local and remote control, fault locating, relay self-checking functions, and standard automation protocols. Also, the protective relay shall included but not be limited to the following requirements and specifications below:

RELAY INPUTS

5 Amp Currents Inputs

Continuous Rating:	20 A
One Sec. Rating:	400A
Saturation Limit:	150A
Burden:	<10 milliohms

Phase AC Voltage Inputs

Continuous:	300V, Line to Line
One Sec. Rating:	600 V, Line Neutral
Burden:	less than 1 VA @ 150 V(ac)

Auxiliary AC Voltage Input

Continuous:	150V
One Sec. Rating:	600V
Burden:	less than 1 VA @ 150 V(ac)

Selectable Wye or Delta Voltage Inputs

The relay shall be field selectable after Purchase to operate with either wye-connected (four wire) or open-delta-connected (three wire) potential transformers.

RELAY INPUTS (Control Inputs)

Number of Control Inputs:	4 Control Inputs
Wetting Voltage Range:	A) 35 to 150 V(dc) B) 55 to 135 V(ac)
Turn-on Voltage Range:	A) Low Range 26-38 V B) High Range 69-100V

Burden:	A) Low Range 13K ohms B) High Range 24 K ohms

The four control inputs shall be optically isolated inputs and programmable by the Protective relay logic. The control inputs shall recognize both DC and AC voltages. Each Control input Turn-on Voltage Range specified above shall be adjustable to the Low Range or the High Range.

RELAY OUTPUTS (CONTROL OUTPUTS AND ALARM OUTPUTS)

Control and alarm outputs (5 general-purpose control output contacts, and one fail-safe normally closed alarm output contact)

Number of Control Output Contacts:	5 Contacts
Number of Alarm Output Contacts:	1 Contacts
Type of Control Outputs Contacts:	Normally Open (NO)
Type of Alarm output Contact:	Normally Closed (NC)
Make and Carry:	30 A (0.2 sec)
Continuous:	7 A
Break:	0.3 A DC (L/R=0.04)

The five (5) control output contacts shall be isolated and programmable by the protective relay logic.

PROTECTIVE RELAY LOGIC

The protective relay shall include programmable logic for each control output, for all control inputs, and at least ten additional virtual outputs for user programming. Each control output and each virtual output shall be able to be program to perform Boolean algebra or logic operations to operate (based on the results of the equations) each control output and each virtual control output using the results (An "ON or "OFF") condition representing whether or not that relay element has been pickup) from the functions specified in the "RELAY PROTECTION AND CONTROL FUNCTIONS" section as specified in this section of the special provisions, the results from the virtual control outputs, and the results (An "ON or "OFF") condition representing whether or not that control input has been energized) from the control inputs of the protective relay as inputs to the Boolean algebra or logic equations.

RELAY PROTECTION AND CONTROL FUNCTIONS OVERCURRENT PROTECTION

Faults (50/51P-67P, 50/51Q-67Q)

The relay shall include two phase and two negative sequence instantaneous overcurrent elements, and two phase and one negative sequence time overcurrent elements, for detecting phase faults. Each instantaneous element shall have an adjustable definite time delay. Each over current element (with the exception of the 151P) shall be independently selectable for Forward, Reverse, or Non-Directional Operation. Positive and negative sequence voltage and current shall polarize the 67P directional elements. The 51P phase time overcurrent element shall also have voltage control or voltage restraint mode of operation (51V). The 51P element must be set for directional control to activate the 151P element. When the 51P element is set for directional control, the 151P will detect faults in the opposite direction of the 51P. If the 51P element is set for directional control and the polarizing quantities are not available, the 151P element will be active as non-directional overcurrent element.

Ground faults (50/51N-67N)

The relay shall include two neutral instantaneous overcurrent elements and two (2) neutral time overcurrent elements that operate on calculated residual (3I0) for detection of ground faults. Each instantaneous element shall have an adjustable definite time delay. Each element shall be independently selectable for forward, Reverse, or Non-Directional Operation. Negative and Zero sequence voltage and zero sequence current shall polarize the 67N directional elements.

Breaker Failure (50 BF)

Time set:	50 to 999msec
Drop out	0.5A
Time Accuracy:	+ 0.590 or 1½ cycle- ½ cycle

Breaker Monitoring

Duty mode:	I or I^2
Duty Alarm Range:	0 to 100 percent
Op counter Alarm Range:	0 to 99999
Trip Time Alarm Range:	20 to 1000msec

Protective relay curves

The time overcurrent elements of the protective relay shall be able to be programmable for All US type relay protection curves, All IEC type relay protection curves, and custom relay protection curves.

VOLTAGE PROTECTION

Volts per Hertz (Overexcitation) (24)

The relay shall include a volts/hertz protection element to protect against transformer and generator over excitation conditions.

Phase Under/Over voltage (27P/59P)

The relay shall include two phase undervoltage and two phase overvoltage elements for detecting single or multiphase voltage events. Each voltage element shall be independently configurable for "1 of 3", "2 of 3", or "3 of 3"phase operation and settable to monitor either ph-ph or ph-n voltages.

Auxiliary Under/Over Voltage (27X/59X)

The relay shall include one under and two overvoltage elements that monitor phase residual voltage (3V0) for detecting grounds on a delta system, or monitors an external broken delta voltage transformer (VT) source or a neutral voltage source (capacitor bank or generator) for detecting ground faults. Elements shall monitor either fundamental or third harmonic values.

Negative Sequence Overvoltage (47)

The relay shall include a negative sequence voltage element for detecting phase unbalance and reverse phase rotation.

Fuse Loss Detection (60)

The relay shall include a fuse loss detection element (sensing voltage input) that protects against false tripping for a blown sensing fuse.

FREQUENCY PROTECTION

Under/Over/Rate of Change of Frequency (810/U/R)

The relay shall include six frequency elements (individually settable for over, under, rate of change frequency detection) for detection of power system frequency disturbances. The frequency elements shall each have independently set timers. The frequency elements shall have a common undervoltage inhibit setting. The ROC elements shall also include a negative sequence voltage inhibit to prevent unwanted ROC operation during unbalance faults and other system disturbances, and a high/low frequency limit that establishes a window of ROC operation.

DIRECTIONAL POWER PROTECTION

Directional Power (32/132)

The relay shall include two sensitive power elements that can be independently set forward or reverse. Each directional power element shall be independently configurable for "1 of 3", "2 of 3", or "3 of 3" phase operation as well as total three-phase power.

SENSING AND CONTROL

Automatic Reclosing Control (79)

The relay shall include a four-shot recloser with zone sequence coordination and sequence controlled protective element blocking functions. The element shall include four independent reclose timers, a timer for reset after a successful reclose, a maximum cycle timer, and a reclose fail timer.

Synchronism Check (25)

The relay shall include a standard auxiliary voltage input that can be connected for synch check protection. This protection shall check for phase angle difference, voltage magnitude difference, frequency difference (slip) and if the 3-phase voltage transformer (VT) source voltage frequency is greater than the auxiliary voltage transformer (VT) frequency. A voltage monitor output shall provide independent dead/live voltage closing logic.

Settings Groups.

The relay shall have two user-programmable settings groups.

A. Virtual Control Switches (43/101)
The relay shall include two virtual selector switches (x43) and one virtual breaker control switch (101), controllable from both the HMI and communication ports.

B. Logic Timers (62/162)
The relay shall include two logic timers (62/162) to aid in the development of custom logic. The modes of operation for the timers (62/162) shall be Pickup/Dropout Timer (PU/DO), One-Shot Nonretriggerable Timer, One-Shot Retriggerable Timer, Oscillator, Integrating Timer, and Latch. The timers (62/162) delay time shall be adjustable from 0.000 to 9999 seconds. The time accuracy of the timers (62/162) shall be less than or equal to +/- 0.5 percent or +/- ¾ cycles.

MONITORING, COMMUNICATION, AND SOFTWARE REPORTING, DISPLAYS, AND ALARMS

Oscillography and Sequential Events Recorder (SER)

The relay shall be capable of automatically recording disturbance events of 15 to 40 cycles (user adjustable) with 4 cycles of prefault duration and user-defined triggering. The relay shall include a Sequence of Events Recording function (SER) that stores the latest 255 events.

Nonvolatile Status and Trip Target LEDs

The relay shall hold all programmed target and alarm information in nonvolatile memory and provide that information locally through the HMI/LEDs and remotely via communications ports.

Real Time Metering

The relay shall include real time metering that provides Watt, Watt-hour, VAR, VAR-hour, voltage, amp, and unbalance loading telemetry for the protected circuit.

Demand Metering

The relay shall include user-settable current demand for phase, neutral, and negative sequence currents, and forward and reverse watts and VARs with magnitudes and time stamps recorded for today's peak, yesterday's peak, and peak since reset.

Circuit Breaker Monitor

The relay shall include breaker status and operations counter reporting, fault current interruption duty monitoring, and trip-speed monitoring. A trip coil monitor circuit shall be internally connected across the trip output to provide trip circuit continuity monitoring. No additional external wiring shall be required to implement the trip circuit monitor function.

Distance to Fault

The relay shall include a distance-to-fault algorithm to provide an accurate estimate of fault location.

HMI/Display

A backlit 2 line x 16-character LCD display shall be provided integral to the relay, along with a 4 key cursor/navigation keypad. Separate target/alarm reset and settings edit pushbuttons shall be included. Keypad/pushbuttons shall include a continuous, flexible, water-resistant membrane overlay over all keys.

COMMUNICATIONS

Relay Interface

The relay shall include three independent general-purpose communication ports including a front and rear RS-232 port and a rear RS-485 port. All communications ports shall support ASCII protocol, and the RS-485 port shall support Modbus™.

Modbus RTU Slave Communications

The relay shall incorporate Modbus RTU slave protocol internally. External converters or adapters are not acceptable.

IRIG Input

The relay shall include an interface port for a demodulated IRIG-B time synchronization input signal. IRIG-B connection shall be to a barrier terminal strip capable of accepting ring lug terminated wiring.

PC Interface

The relay shall be capable of being set by Windows®-base graphical user interface and ASCII terminal interfaces.

ELECTRICAL ENVIRONMENT

A. IEEE C37.90-1989 Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
B. IEC 255-5 Insulation Test for Electrical Relays Impulse and Dielectric Strength (2000 V(ac) at 50/60 Hz).
C. IEEE C37.90.1-1989 Standard Surge Withstand Capability Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
D. IEC 255-22-1 1 MHz Burst Disturbance Tests for Electrical Disturbance Tests for Measuring Relays and Protection Equipment.
E. EN 61000-4-4 Electrical Fast Transient /Bust Immunity Test.
F. EN 61000-4-3 Radiated, Radio-frequency, Electro-magnetic Field Immunity Test
G. Type tested using a 5-watt, hand-held transceiver in the ranges of 144 and 440 MHz with the antenna placed within 152.4 mm of the relay.
H. IEEE C37.90.3 (Jan.01) Draft Standard Electrostatic Discharge Tests for Protective Relays.
I. EN 61000-4-2 Electrostatic Discharge Immunity Test.

A/D Converter

Sampling Rate: ½ cycle, adjusted to input frequency 10-75Hz

Communication Ports

Response Time:	<100 milliseconds for metering and control functions.
Baud Rate:	300 to 19200 Baud

Clock

Real Time Clock with 8-hour capacitor ride-through for clock backup power.

Power Supply

DC Range:	35 to 150 V(dc)
AC Range:	55 to 135 V(ac)
Burden:	A) 6 watts continuous B) 8 watts maximum with all Outputs energized

MECHANICAL ENVIRONMENT

Operating Temperature Range:	-40 to 70ºC
Operating Temperature Range for LCD only:	-20 to 70ºC
Storage Temperature Range:	-40 to 70ºC
Humidity:	Qualified to IEC 68 –2-38, 1ST Edition 1974, Basic Environmental Test Procedures, Part 2: Test Z/AD: Composite Temperature Humidity Cyclic Test. Qualified to IEC 255-21-1 (Class 1) Vibration Tests for Electrical Relays. Qualified to IEC 255-21-2 (Class 1) Shock and Bump Tests for Electrical Relays.

MECHANICAL CONNECTIONS

Terminal Blocks and Wiring:

Other than RS-232 wiring, all connections, including RS-485 wiring and IRIG-B wiring, shall be to barrier terminal strips capable of accepting ring lug connection. RS-232 wiring shall be to DB9S female connectors on the front and rear. RS-232 wiring shall be configured to allow 1-to-1 wiring to the DTE port on a PC, without need for null-modem adaptors or proprietary cabling or connectors.

Case size

The relay shall be packaged in a case no larger than 7 inches wide, 8 inches deep, and 8 inches high. The electronics module, including all active circuitry, must be extractable as a single unit, without need to disconnect or disturb any wiring. Hot-plug gable test paddles shall be included for in-case testing of overcurrent elements by secondary injection, without wiring changes. Shorting links for current circuits shall be internal to the relay case and shall remain in the case when the electronics module is extracted. A cover including provisions for attachment of a seal and allowing a clear view of the LCD display shall be included. The cover shall incorporate a means of allowing targets and alarms to be reset with the cover attached and sealed.

CERTIFICATIONS

UL Recognized

WARRANTY AND UTILITY APPROVAL

Warranty

7 Years.

Utility Approval

The Contractor shall provide documentation that the protective relay is on the utility company approved relay list to the Engineer as part of the approval of the protective relay.

BACKUP PROTECTIVE RELAY

The Backup Protective Relay shall be a dual overcurrent microprocessor-based protective relay that shall provide two (2) complete and independent groups of protection functions (designated as Relay X and Relay Y) or relay components in one compact unit. The Backup Protective Relay shall have separate optoisolated inputs, output contacts, and three-phase current inputs for each complete and independent group of protection functions (designated as Relay X or Relay Y) or relay components. The Backup Protective Relay shall also meet the following specifications:

2 **RELAY INPUTS (PER COMPLETE AND INDEPENDENT GROUPS OF PROTECTION FUNCTIONS (DESIGNATED AS RELAY X AND RELAY Y)**

5 Amp Current Inputs	
Continuous Rating:	15 A
One Sec. Rating:	250 A and linear to 100 A (symmetrical).
Limiting Dynamic Value:	625 A for 1 cycle (sinusoidal waveform)
Burden:	0.16 VA @ 5A, and 1.15 VA @ 15 A

RELAY INPUTS (Control Inputs)

Control Inputs (One per complete and independent groups of protection functions (designated as Relay X and Relay Y))

The control inputs shall be jumper-selectable optoisolated inputs. Both inputs shall be individually user-configured to operate on any of the following nominal voltages:

Voltage V(dc)	On for Voltage Range, V(dc)
24	15-30
48	30-60
125	80-150
250	150-300

Power Supply (For the Backup Protective Relay)

Rated:	48/125 V(dc) or 125 V(ac)
Range:	36-200 V(dc) or 85-140 V(ac)
Interruption*:	100 ms @ 125 V(dc)
Ripple*:	5 percent
Burden:	< 5.5 W

* - Note: Interruption and Ripple shall be per IEC 60225-11: 1979

Serial Communications

One (1) Rear-panel 9-pin sub-D connector.

RELAY OUTPUTS (PER COMPLETE AND INDEPENDENT GROUPS OF PROTECTION FUNCTIONS (DESIGNATED AS RELAY X AND RELAY Y)

Control Outputs (Two per complete and independent groups of protection functions (designated as Relay X and Relay Y) and One Alarm contact)

The output ratings for the control outputs (output contacts) shall be determined with IEC 60255-0-20 – 1974, using the simplified method of assessment. The output contacts shall meet the following specifications below:

A. Two (2) Normally Open (N.O.) Contacts per complete and independent groups of protection functions (designated as Relay X and Relay Y).
B. One (1) Normally Closed (N.C.) Alarm Contact for the Backup Protective Relay.
C. 6 A continuous carry
D. 30 A make per IEEE C37.90 – 1989
E. 100 A for one second
F. 270 V(ac)/360 V(dc) MOV for differential surge protection
G. Pickup/dropout time: < 5 ms

Breaking Capacity (L/R = 40 ms)

Voltage (V)	Current (A)	Operations
24	0.75	10,000
48	0.50	10,000
125	0.30	10,000
250	0.20	10,000

Cyclic Capacity (L/R = 40 ms)

Voltage (V)	Current (A)	Cycles/second
24	0.75	2.5
48	0.50	2.5
125	0.30	2.5
250	0.20	2.5

PROTECTIVE RELAY FUNCTIONS AND OPERATIONS

Backup Relay Configuration

The Backup Protective Relay shall have two independent sets of three-phase current inputs (X and Y) for relay components (Relay X and Relay Y respectfully) sharing a common data acquisition system, microprocessor, power supply, and alarm. Each set of current inputs and digital I/O shall independently protect, monitor and control its respective power system application.

Overcurrent Protection

The Backup Protective Relay shall have two overcurrent application settings for relay components Relay X and Relay Y, respectively. Selection of overcurrent applications from the operator interface shall determine utilization of input and output contacts. The relay components Relay X and Relay Y shall have eight overcurrent elements consisting of phase, negative-sequence, and ground protection elements. The time-overcurrent elements shall be comprised of four US and four IEC-type curves.

Adaptive Phase Overcurrent Elements

The Backup Protective Relay shall incorporate adaptive phase overcurrent elements that perform reliably in the presence of current transformer saturation, DC offset, and off-frequency harmonics for each relay component (Relay X and Relay Y).

Motor Protection

Each relay component (Relay X or Relay Y) shall protect motors using a thermal model capable of accounting for the thermal effects of both positive-and negative-sequence current. The motor protection application shall trip to prevent overheating for abnormal conditions of overload, locked rotor starting, frequent or prolonged starts, and unbalanced current.

Application Settings and Security

The Backup Protective Relay shall have a user interface with application settings that include feeder protection (FDR), overcurrent protection (OC1), motor protection (MOT), breaker failure protection (BFR), and a general-purpose timer (TMR). The Backup Protective Relay shall have two levels of user-controlled password protection.

Metering Functions and Event Reporting

The Backup Protective Relay shall store five of the latest 15-cycle events, and event summaries for the latest twenty events. The event information shall present measured quantities for the relay components Relay X and Relay Y, respectively. The latest event shall be stored in nonvolatile memory. The Backup Protective Relay shall have both an instantaneous and demand ammetering functions with a measurement accuracy of + two (2) percent.

Communication and Protocol

The Backup Protective Relay shall be equipped with a serial interface capable of hosting Modbus RTU protocol. The data rates shall range from 300 to 38,400 baud.

TYPE TESTS AND STANDARDS

Routine

Current Inputs: 2500 V(ac) for 10 seconds.

Dielectric Test

Power Supply, Optoisolated inputs, and Output Contacts: 3000 V(dc) for 10 seconds.

Standards

IEEE C37.90 – 1989 IEEE Standards for Relay Systems Associated with Electrical owner Apparatus, Section 8: Dielectric Tests.
Severity Level: 2500 V(ac) on analog inputs; 3100 V(dc) on Power Supply, Optoisolated inputs, and Output Contacts.

IEEE C37.90.1 – 1989 IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.
Severity Level: 3.0 kV oscillatory, 5.0 kV fast transient.

IEEE C37.90.2 – 1987 IEEE Trial-Use Standard, Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
Severity Level: 10 V/m

Exceptions

Performed with 200 frequency step per octave.
Digital Equipment Modulation Test not performed.
Test signal turned off between frequency steps to simulate keying.

UL 508 and CSA C22.2 No. 14-95 Industrial Control Equipment Standard for Safety.

IEC 60529 – 1989 Degrees of protection provided by enclosures. Severity Level: IP3X.

IEC 60801-2 – 1991 Electromagnetic Compatibility for industrial-process measurement and control equipment, Part 2: Electrostatic discharge requirements. Severity Level: 4

IEC 60801-3 – 1991 Electromagnetic Compatibility for industrial-process measurement and control equipment, Part 3: Electrostatic discharge requirements. Severity Level: 10 V/m

Exceptions:

Performed with 200 frequency step per octave.

IEC 60801-2 – 1991 Electromagnetic Compatibility for industrial-process measurement and control equipment, Part 4: Electrostatic discharge requirements.
Severity Level: 4 (4 kV on power supply, 2 kV on inputs and outputs).

Tests

IEC 60068-2-1 – 1990 Environmental testing, Part 2: Tests – Test Ad: Cold. Severity Level: 16 hours at –40ºC.

IEC 60068-2-2 – 1974 Environmental testing, Part 2: Tests – Test Bd: Dry Heat. Severity Level: 16 hours at +85ºC.

IEC 60068-2-3 – 1969 Basic Environmental testing procedures, Part 2: Tests – Test Ca: Damp heat, steady state. Severity Level: 96 hours at +40ºC, and 93 percent RH.

IEC 60068-2-4 – 1980 Basic Environmental testing procedures, Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle).Severity Level: 55 degree C, 6 cycles; Variant 1.

Exceptions

Humidity not less than 94 percent.
IEC 60255-5 – 1977 Electrical Relays, Part 5: Insulation tests for electrical Relays.

Dielectric Tests.

Severity Level: Series C (2500 V(ac) on analog inputs; 3000 V(dc) on power supply, contact inputs, and contact outputs).

Impulse voltage test.

Severity Level: 0.5 Joule, 5000 volt.

IEC 60255-21-1 – 1988 Electrical relays – Part 21: Vibration, shock, bump, and seismic tests on measuring relays and protection equipment, Section 1: Vibration test (sinusoidal). Severity Level: Class 2.

IEC 60255-21-2 – 1988 Electrical relays – Part 21: Vibration, shock, bump, and seismic tests on measuring relays and protection equipment, Section 2: shock and bump tests. Severity Level: Class 2.

IEC 60255-21-2 – 1993 Electrical relays – Part 21: Vibration, shock, bump, and seismic tests on measuring relays and protection equipment, Section 2: seismic tests. Severity Level: Class 2.

MECHANICAL

Temperature Rating

The Backup Protective Relay shall be capable of withstanding operating temperatures ranging from -40°C to +85°C.

Packaging

The Backup Protective Relay shall have physical dimensions not exceed 9 inches wide, 8.5 inches deep, and 4 inches high.

WARRANTY AND UTILITY APPROVAL

WARRANTY

The Backup Protective Relay shall be covered by a ten-year product warranty.

UTILITY APPROVAL

The Contractor shall provide documentation that the Backup protective relay is on the utility company approved relay list to the Engineer as part of the approval of the Backup protective relay.

CONFIGURATION

The Backup Protective Relay shall be configure for both phase and ground time-overcurrent protection, and phase and ground instantaneous overcurrent protection, on both the incoming medium voltage circuit breaker using the control outputs (output contacts) from the Relay X's relay component of the Backup protective relay, and on the feeder medium voltage circuit breaker using the control outputs (output contacts) from the Relay Y relay component of the Backup protective relay. The Backup Protective Relay shall be set in accordance with the "SHORT CIRCUIT, PROTECTION, AND COORDINATION STUDY" specifications as specified in these special provisions.

LINE CURRENT DIFFERENTIAL PROTECTIVE RELAY

The Line Current Differential Protective Relay shall be a microprocessor-based relay that shall provide a combination of functions including protection, monitoring, control, and automation. Line Protective Relay self-checking functions shall be included. The Line Current Differential Protective Relay shall also included but not be limited to the following requirements and specifications below:

RELAY INPUTS

5 Ampere Currents Inputs

Nominal:	5 A
Continuous Rating:	15 A, Linear to 100 A Symmetrical
Thermal Rating:	500 A for 1 second, 1250 A for 1 cycle
Burden:	0.27 VA at 5 A, 2.51 VA at 15A

Power Supply

Rated:	125/250 V(dc) or V(ac)
Range:	85–350 V(dc) or 85–264 V(ac)
Power Consumption	< 25W

Frequency and Rotation

System Frequency:	50 or 60 Hz
Phase Rotation:	ABC or ACB
Frequency Tracking:	40.1–65 Hz

RELAY INPUTS (Control Inputs)

Number of Control Inputs:	6 Control Inputs
Pickup:	105–150 V(dc)
Dropout:	75V(dc)
Current Input for the Control Inputs draw approximately:	8 mA

The six control inputs shall be optically isolated inputs and function as specified in these special provisions:

52A	Control Input that indicates position of circuit breaker.
Trip	Control Input that feeds the relay latching trip logic
Close	Control Input that feeds the relay latching close logic
87 DIS	Control Input that disables the Line Current Differential Protective Relays local and remote 87L protective function.
T1	Control Input that closes contacts R1 in the remote Line Current Differential Protective Relay, when T1 is energized: general-purpose transfer contact.
T2	Control Input that closes contacts R2 in the remote Line Current Differential Protective Relay, when T2 is energized: general-purpose transfer contact.

RELAY OUTPUTS (CONTROL OUTPUTS AND ALARM OUTPUTS)

Control and alarm outputs (6 standard control output contacts, 6 high-speed/high-current interrupting control output contacts, one 87L fail standard alarm output and one fail-safe standard alarm output contact).

Number of Standard Control Output Contacts:	6 Contacts
Number of Standard Alarm Output Contacts:	2 Contact
Type of Standard Control Outputs Contacts:	Normally Open (NO) or Normally, Closed (NC) (Jumper Configurable)
Type of Standard Alarm Output Contact:	Normally Open (NO) or Normally, Closed (NC) (Jumper Configurable)
Number of high-speed/high-current interrupting control output contacts:	6 Contacts
Type of high-speed/high-current interrupting control output contacts:	Normally open (NO)
Make:	30 A
Carry:	6A continuous carry at 70 °C, 4A continuous carry at 85 °C
1s Rating:	50 A

Standard Control Output Contacts only

Standard Contact MOV Protection (Max Voltage):	270 Vac, 360 Vdc, 40 J
Standard Contact Pickup/Dropout Time:	< 5ms
Standard Contact Break Capacity (10,000 operations):	0.30 A (L/R = 40 ms)
Standard Contact Cyclic Capacity (2.5 cycle/second):	0.30 A (L/R = 40 ms)

High-Speed/High-Current Interrupting Control Output Contacts only

High-Speed Contact MOV Protection (Max Voltage):	330 Vdc, 130 J
High-Speed Contact Pickup/Dropout Time:	< 10us; < 8ms, typical
High-Speed Contact Break Capacity (10,000 operations):	10.0 A(L/R = 40 ms)
High-Speed Contact Cyclic Capacity (4 interruptions/second):	10.0 A(L/R = 40 ms)
Make:	per IEEE C37.90–1989
Breaking and Cyclic Capacity:	per IEC 60255-23:1994

Programming and Control of control output contacts

All the control output contacts shall be isolated and function as specified in these special provisions:

OUTPUTS

Standard Outputs

The 1st Trip Contact
The 2nd Trip Contact
The 1st Close Contact
The 2nd Close Contact

R1 contact closes, when T1 control input is energized in the remote Line Current Differential Protective Relay: general-purpose transfer contact.
R2 contact closes, when T2 control input is energized in the remote Line Current Differential Protective Relay: general-purpose transfer contact.

87FAIL Contact indicates when a problem with the 87L protection.
ALARM Contact indicates when a problem with the hardware.

High-Speed Outputs

The 1st Trip Contact
The 2nd Trip Contact
The 1st Close Contact

The 2nd Close Contact

R1 contact closes, when T1 control input is energized in the remote Line Current Differential Protective Relay: general-purpose transfer contact.
R2 contact closes, when T2 control input is energized in the remote Line Current Differential Protective Relay: general-purpose transfer contact.

LINE CURRENT DIFFERENTIAL PROTECTIVE RELAY FUNCTIONS AND OPERATIONS

Current Differential Protection (87L).

The Line Current Differential Protective Relay shall compare local and remote phase and sequence currents to provide operation in less than one cycle. The Line Current Differential Protective Relay shall operate for unbalanced faults with currents below line charging current. Distortion caused by CT saturation of one or both ends shall not cause misoperation.

Zero Settings:

The Line Current Differential Protective Relay shall require no settings to provide current differential protection.

Transfer Trips :

The Line Current Differential Protective Relay shall accept transfer trip from the remote Line Current Differential Protective Relay with less the one-half cycle delay.

Transfer Contacts

The Line Current Differential Protective Relay shall include two transfer contacts. Delay from energizing the local input to closing the remote output of the Line Current Differential Protective Relay shall be less than 10ms. Both transfer contacts shall have direct tripping security per IEC 60834-1.

Output Contacts

The Line Current Differential Protective Relay shall include two type of preprogrammed outputs. Metallic contacts shall be rated per IEEE C37.90. High-speed high-current interrupting contacts shall make in less than 10 microseconds and shall interrupt up to 10 A of trip or Close current without damage to the contact.

Remote Terminal

The Line Current Differential Protective Relay shall be capable of acting as a remote data acquisition terminal for a traditional current differential relay with flexible settings. Protection parameters shall be determined exclusively by settings in the traditional current differential relay.

Line Current Differential Protective Relay Element Accuracies

Line Current Differential (87L) Elements
Phase, Negative-Sequence and Zero-Sequence Accuracy: +3% +0.01 of nominal current
Restraint Characteristic Accuracy: +5% of 6; +3C of 195C

COMMUNICATIONS

Channel Requirements.

The Line Current Differential Protective Relay shall have a direct single-mode fiber-optic interface. The Line Current Differential Protective Relay shall accommodate up to 5 ms of channel asymmetry. The direct single-mode fiber-optic interface shall simultaneously support relay-to-relay eight-bit direct logic communication.

Terminal Communications.

The Line Current Differential Protective Relay shall allow communications from any ASCII terminal without software.

Serial Communications.

The Line Current Differential Protective Relay shall include three independent EIA-232 and one EIA-485 serial ports for external communications. All ports shall allow simultaneously execution of integration and engineering access protocols.

IRIG-B.

The Line Current Differential Protective Relay shall include an interface port for a demodulated IRIG-B time synchronization input signal. The line current differential protection shall not rely on this or any other external time synchronization.

Serial Communications Ports

EIA-232:	1 Front, 2 Rear
EIA-485:	1 Rear, 2100 Vdc isolation
Baud Rate:	300–38400 all port except for the EIA-485 port, which is Baud Rate 300–19200

Differential Communications Ports (Two fiber-optics ports)

Type of fiber:	1300 nm single mode
Fiber connector for ports:	ST Connector
Tx Power:	–18 dBm
Rx Min. Sensitivity:	–58 dBm
Rx Max. Sensitivity:	0 dBm
System Gain:	40 dB
Distance Limitations:	80 km

Time-Code Input

The Line Current Differential Protective Relay shall accepts demodulated IRIG-B time-code input at Port 1 and Port 2. The Line Current Differential Protective Relay time shall be synchronized within ± 5 ms of the time source input. The Current differential protection shall not require an external time source.

MONITORING AND SOFTWARE REPORTING, DISPLAYS, AUTOMATION, CONTROLS, AND ALARMS

Event Reporting and Sequential Events Recorder.

The Line Current Differential Protective Relay shall be capable of automatically recording and storing up to 10 seconds of oscillographic records of 15 cycles containing local and remote currents, local voltages, system frequency, and dc system voltage. Events shall be stored in nonvolatile memory. The Line Current Differential Protective Relay shall also include a Sequential Events Recorder (SER) that stores the latest 512 entries.

Status and Trip Target LEDs.

The Line Current Differential Protective Relay shall include 16-status and trip target LEDs.

Circuit Breaker Monitor.

The Line Current Differential Protective Relay shall include a breaker wear monitor with user-definable wear curves, operation counter, and accumulated interrupted currents per phase.

Substation Battery Monitor.

The Line Current Differential Protective Relay shall measure and report the substation battery voltage presented to the Line Current Differential Protective Relay power supply terminals. Voltage level at the time of tripping shall be monitored and recorded.

Automation.

The Line Protective Relay shall include 16 local control elements, 16 remote control logic switches, 16 latching control switches, and 16 display messages in conjunction with a local display panel included in the relay. The Line Protective Relay shall have the capability to display custom messages.

TESTS

Environmental Tests

Cold:	IEC 60068-2-1:1990, Test Ad; Normal operating status at –40°C for 16 hours
Damp Heat, Cyclic:	IEC 60068-2-30:1980, Test Db; Normal operating status at 55°C, 6 cycles, 95% humidity.
Dry Heat:	IEC 60068-2-2:1974, Test Bd; Normal operating status at +85°C for 16 hours.
Object Penetration:	IEC 60529:1989, IP30

Dielectric Strength and Impulse Tests

Dielectric Strength:	IEC 60255-5:1977 IEEE C37.90-1989 2500 Vac for 10 seconds on analog inputs; 3100 V(dc) for 10 seconds on power supply, optoisolated inputs, and output contacts; 1500 V(ac) on isolated EIA-422 port.
Impulse:	IEC 60255-5:1997, 0.5 J, 5000 V
Laser Safety:	IEC 60825-1:1993 21 CFR 1040.10 ANSI Z136.1-1993 ANSI Z136.2-1988, eye-safe Class 1 laser product.

Electrostatic Discharge Test

ESD:	IEC 60255-22-2:1996, Severity Level 4 (8000 V contact, 15000 V air)

Electromagnetic Compatibility Immunity

Fast Transient Disturbance:	1) IEC 60255-22-4:1992 4 kV at 2.5 kHz 2) IEC 61000-4-4:1995 4 kV at 2.5 kHz (4000 V on power supply, 2000 V on inputs and outputs)
Radiated Radio Frequency:	IEC 60255-22-3:1989, 10 V/m IEEE C37.90.2-1995, 35 V/m
Surge Withstand:	1) IEEE C37.90.1-1989, 3000 V oscillatory, 5000 V transient 2) IEEE C37.90.1-2002 IEEE standard for surge withstand capability (SWC), tests for protective relays and relay systems associated with Electric Power Apparatus 3) Severity Level: 2.5 kV peak common mode, 2.5 kV peak differential mode oscillatory waveform, 4 kV at 2.5 kHz and 5 kHz fast transient waveform.
1 MHz Burst Disturbance:	IEC 60255-22-1:1988, Severity Level 3 (2500 V common and 1000 V differential mode)

Vibration and Shock Tests

Vibration:	IEC 60255-21-1:1988, Class 1; IEC 60255-21-2:1988, Class 1; IEC 60255-21-3:1993, Class 2.

GENERAL

Terminal Connections

Rear Screw-Terminal Tightening Torque:	1) 8-in-lb Minimum 2) 12-in-lb Maximum

Line Current Differential Protective Relay Mounting
The Line Current Differential Protective Relay shall be a Vertical Panel-Mounted Relay.

Environmental Capabilities.
The Line Current Differential Protective Relay shall be capable of continuous operation over a temperature range of –40° to +85°C.

CERTIFICATIONS AND WARRANTY

Certifications

ISO:	Line Current Differential Protective Relay designed and manufactured using ISO 9001:2000 certified quality program.
Other Certifications:	1) UL Listed 2) CSA Certified 3) CE Mark.

Warranty.
The Line Current Differential Protective Relay shall have a minimum 10-year worldwide warranty.

POWER CONTROL RELAYS

The power control relays shall be the following relays:

A. Square D Class 8501 Type XO60 - NEMA Type Relay for AC coil voltages and Square D Class 8501 Type XDO60 – NEMA Type Relay for DC coil voltages; or Cutler-Hammer AR Series Relay with six (6) convertible contacts for AC coil voltages and Cutler-Hammer ARD Series Relay with six (6) convertible contacts for DC coil voltages; or General Electric(GE) CR120B Series A Relay with eight (8) convertible contacts for AC coil voltages and General Electric(GE) CR120BD Series A Relay with eight (8) convertible contacts for DC coil voltages or equal.

B. The relays specified in section "A" shall be for the following power control relays shown on the plans:

   1. 27X – Auxiliary undervoltage power control relay.
   2. 127X - Second Auxiliary undervoltage power control relay.
   3. 95 - Reset power control relay.
   4. 96 - Incoming MV Circuit Breaker closed stopping power control relay.
   5. 97 - Source restore power control relay.
   6. 98 – CB Interface power control relay.

C. Square D Class 8501 Type XO40XTE1 – NEMA Type Relay attachment with the Square D Class 8501 Type XO60 - NEMA Type Relay for AC coil voltages and Square D Class 8501 Type XDO40XTE1 – NEMA Type Relay attachment with the Square D Class 8501 Type XDO60 – NEMA Type Relay for DC coil voltages; or Cutler-Hammer ART-ON Solid-State Timer attachment with the Cutler-Hammer AR Series Relay with six (6) convertible contacts for AC coil voltages and Cutler-Hammer ARTD-ON Solid-State Timer attachment with the Cutler-Hammer ARD Series Relay with six (6) convertible contacts for DC coil voltages; or General Electric(GE) CR122BT Series A Solid-State Timer attachment with General Electric(GE) CR120B Series A Relay with eight (8) convertible contacts for AC coil voltages and General Electric(GE) CR122BT Series A Solid-State Timer attachment with General Electric(GE) CR120BD Series A Relay with eight (8) convertible contacts for DC coil voltages or equal.

D. The relays specified in section "B" shall be for the following power control relays shown on the plans:

   1. 2R – Time delay closing power control relay.

E. Square D Class 8501 Type XO60XL – NEMA Type Relay attachment with the Square D Class 8501 Type XO60 - NEMA Type Relay; or Allen-Bradley 700-PL600; or General Electric(GE) CR120BL Series A Latch attachment with General Electric(GE) CR120B Series A Relay with eight (8) convertible contacts or equal for AC coil voltages and Square D Class 8501 Type XDO60XDL – NEMA Type Relay attachment with the Square D Class 8501 Type XDO60 – NEMA Type Relay, or Allen-Bradley 700DC-PL500, or General Electric(GE) CR122BC Series A Latch attachment with General Electric(GE) CR120BD Series A Relay with eight (8) convertible contacts or equal for DC coil voltages.

F. The relays specified in section "C" shall be for the following power control relays shown on the plans:

1. 86 – Lockout Power Control Relay (The 86 coil shown on the plans shall be for the set (or latching) coil and the 86R coil shown on the plans shall be for the reset (or unlatching) coil).

The type of contacts (Normally Open (N.O.) or Normally Closed (N.C.)) for the power control relays shall be as shown on the plans. The coil voltage for each power control relay shall be as shown on the plans.

SCADA CONTROL AND INDICATION RELAYS

The SCADA control and indication relays shall be Cutler-Hammer D7 Series control relays with wall/panel-mounted relay socket per relay; or Square D Class 8501 Type R control relays with wall/panel-mounted relay socket per relay; or General Electric(GE) CR420M; or equal. Each relay shall include a pilot light, and shall be a four (4)-pole double throw (4PDT) contact control relay. The coil voltage for each SCADA control and indication relay shall be shown on the plans. The SCADA control and indication relays shall be specified and shown on the plans as follows:

A. For The Secondary Unit Substation
   1. SCT – Trip Control SCADA control and indication relay.
   2. SCC – Close Control SCADA control and indication relay.
   3. SCR – Reset Control SCADA control and indication relay.
   4. SCRS – Reset System SCADA control and indication relay
   5. R1 – MV Circuit Breaker charging Indication SCADA control and indication relay.
   6. SCCPT – Control Power Test Control SCADA control and indication relay.

B. For The Motor Control Center (MCC)
   1. BMC- Backup Motor Control Relay
   2. 43L - Local Control Indicator Relay
   3. 43L# - The # Jet Fan Local Control Indication Relay
   4. BPA - AUX BY-PASS Contractor
   5. FR - Fault Relay
   6. LX1 - Lighting Control Circuit #1
   7. LX2 - Lighting Control Circuit #2
   8. ON - ON Indication Relay
   9. ON# - # Jet Fan On Indication Relay
   10. RCR - Run Control Relay
   11. SC - SCADA Lighting Control Relay
   12. STP - Back-Up Motor Control Indication Relay
   13. STP1 - First Back-Up Motor Control Indication Relay
   14. STP2 - Second Back-Up Motor Control Indication Relay
   15. STP4 - Fourth Back-Up Motor Control Indication Relay
   16. SCRC - SCADA Control ON/OFF of Motor Relay

TRANSFER RELAYS

The transfer relays shall be a two (2) pole Motor Starter with two (2) normally open (N.O.) and two (2) normally closed auxiliary contacts. The auxiliary contacts shall have a NEMA A600 or a NEMA P300 (when DC voltage is apply to the contact) rating @ 10 A minimum for the voltage shown on the plans. The transfer relays shall meet or exceed all NEMA, UL, and CSA standards. The transfer relays size shall be shown on the plans and based on the NEMA standard classifications. The coil voltage for each transfer relay shall be shown on the plans. The transfer relays shall have easy coil change and inspectable/replaceable contacts. The transfer relays shall have adjustable/interchangeable heater as required. Also, the relays shall be an open non-enclosed motor starter. Finally, the transfer relays shall be specified and shown on the plans as follows:

A. 83P – Primary Control Power Source Transfer Relay.

10-3.39 POWER DISTRIBUTION EQUIPMENT

3 PHASE POWER SUPPLY AND BATTERY CHARGER

The 3 Phase Power Supply and Battery Charger shall be a microprocessor-controlled float battery charger for Nickel-Cadmium (Ni-Cd) batteries; and shall be able to operate a DC load with or without batteries connected to it. The 3 Phase Power Supply and Battery Charger shall meet the following specifications:

GENERAL

Input Voltage:	480 V(ac) @ 60 Hz Three Phase.
Output Voltage:	130 V(dc)
Max Output Current:	125 A(dc)
Floating Charge Voltage:	134 V(dc) set by the Contractor.
Enclosure:	NEMA 1

The 3 Phase Power Supply and Battery Charger shall provide a continuous regulated DC output derived from an AC source. The output shall be suitable to maintain the battery in a fully charged state, while supporting any additional DC loads. The 3 Phase Power Supply and Battery Charger shall also have the ability to automatically or manually provide an equalizing charge as required for recharging the battery after discharge.

The 3 Phase Power Supply and Battery Charger shall have microprocessor technology to control and define all critical operational, calibration, regulation and alarm functions.

APPLICABLE CODES

The 3 Phase Power Supply and Battery Charger product line meets the requirements of the designated versions of the following industry and agency standards:

NEMA PE5-1996	Stationary type battery chargers
UL 1564	Standard for industrial battery chargers
UL 1012	Standard for stationary power supplies
CSA 22.2	Standard for battery chargers
ANSI C37.90-1989	Surge withstand capability definitions and tests
IEC 146	Semiconductor converters
FCC	Part 15 Subpart J Class A

FEATURES

The 3 Phase Power Supply and Battery Charger shall:

A. Have an output control that is constant-voltage, current-limited. Flat temperature coefficient of output voltage is standard. A battery temperature probe for temperature compensation of the output voltage shall be provided. The probe is compatible with Lead-Acid and Ni-Cd battery types.
B. Be capable of delivering 100 percent rated output current at the maximum stated equalize voltage and at the minimum rated ac input voltage, at 50 °C.
C. Have a current limit adjustable from 50 to 110 percent; factory set to 110 percent. The current limit specification does not mean that the charger will be able to deliver greater than 100 percent rated output current under all operating conditions.
D. Meet the SWC (oscillatory surge) requirements of ANSI C37.90, and the transient suppression levels for category B in IEEE Std. 28/ANSI C62.1.
E. Have a full wave six-pulse rectifier bridge with free-wheeling diode, single-winding transformer secondary, and dc inductor.
F. Have an AC input circuit breaker.
G. Have a DC output circuit breaker.
H. Start and operate with a crowbar short circuit on the output without tripping the DC circuit breaker.
I. Have no blocking diode provided. A blocking diode is not required, since a DC circuit breaker is standard. The DC load on the battery (without optional equipment) during an AC power failure is less than 0.5 A.
J. Survive a reverse polarity battery connection. The circuit breaker trips through the free-wheeling diode on unfiltered chargers; a polarity diode is included with filtered chargers to protect the output capacitors.
K. Have cooling: natural convection.
L. Have solderless CU-AL compression input and output terminals, including chassis ground.
M. Have a clear safety cover over all internal components. The safety cover is marked with an internal wiring diagram.
N. Have remote sense terminals.

O. Have a switchboard wiring that use Hypalon or XLPE (cross-linked polyethylene) insulation system, 600 V, 105 °C, except for PC board interconnections, which may use ribbon cable assemblies, or other standard industrial grade PC board interconnections. XLPE insulation is rated for the UL VW-1 vertical wire flame test.

Test points are provided for semi-automatic final test.

OPERATION

The 3 Phase Power Supply and Battery Charger shall:

A. Automatically determine the appropriate DC output, in terms of either voltage or current required for maintaining the battery and load either by preprogramming or in field reprogramming, via the touch panel controls.
B. Automatically know and respond to any alarm options or remote sensing options installed according to the manufacturer's instructions without further operator action.
C. Display, via a 1 percent digital display and associated LED indicators, all functions important to operation.
D. Display, during float operation, the digital display by alternating between DC voltage and DC current indications as designated by the appropriate LED being lit for the respective indication.
E. Display, during equalize operation, the digital display by alternating between DC voltage and DC current indications as designated by the appropriate LED being lit for the respective indication. If the unit is employing a timer, either automatic or manual the LED indicators shall indicate timer function while the digital display indicates the hours remaining for equalize charge.
F. Display error and message codes, indicating certain self-diagnostic anomalies and operating conditions indicated by the digital display, as required.

PROTECTIVE DEVICES

The 3 Phase Power Supply and Battery Charger shall:

A. Employ a circuit breaker for each AC input and DC output protection.
B. Have an AC input transient over voltage protection shall be accomplished via a MOV (metal-oxide varistor) on the AC input terminals.
C. Have a DC external transient over voltage protection shall be via a MOV (metal-oxide varistor) on the DC bus. This shall be located on the output terminals of the battery charger.
D. Be protected against damage in the event that the battery is connected in reverse.
E. Protection from oscillatory surges (SWC) as defined by ANSI C37.90-1978. 3 Phase Power Supply and Battery Charger shall operate correctly during and after application of oscillatory surges.
F. Output current limit shall be adjustable from 50 percent to 110 percent of rated output.
G. The 3 Phase Power Supply and Battery Charger shall protect itself from a short circuit in the output side electronically so as to limit the current output. When the short is corrected the 3 Phase Power Supply and Battery Charger will automatically return to normal charger operation. During a short circuit of the output an error code shall be provided as indication. The error code shall be removed when the output voltage rises above 2.0 V(dc).

CONTROLS

The following controls shall be located on the front panel, using touch sensitive switches to initiate all adjustments:

A. Charge mode key (selects float or equalize mode)
B. Equalization method key (selects timer method, manual, automatic, or manual timer)
C. Edit/Enter key (initiates changes in the 3 Phase Power Supply and Battery Charger parameters)
D. Meter mode key (selects volts, amperes, hours, or alternating display)
E. Up key (increases parameter value in Edit mode)
F. Down key (decreases parameter value in Edit mode)
G. AC circuit breaker
H. DC circuit breaker
I. Lamp test key
J. The following shall be the voltage adjustment ranges for the float voltage, the equalize voltage, the high DC voltage alarm, and the low DC voltage alarm:

Float Voltage Range:	110 to 141 V(dc)
Equalize Voltage Range:	117 to 143 V(dc)
High DC Voltage Alarm Range:	120 to 175 V(dc)
Low DC Voltage Alarm Range:	80 to 141 V(dc)

INDICATORS

Front panel indicators shall include the following:

A. Digital meter, 1 percent accuracy, 4-digit, 7-segment, that shall indicate the following:

   1. DC Volts
   2. DC Amperes
   3. Equalize hours remaining
   4. Error and message codes

B. DC Volts meter indicator (red LED)
C. DC Amperes meter indicator (red LED)
D. Equalize Hours Remaining indicator (red LED)
E. AC on indicator (green LED)
F. Float mode indicator (green LED)
G. Equalize mode indicator (yellow LED)
H. Manual equalize timer indicator (yellow LED)
I. Manual equalize indicator (yellow LED)
J. Automatic equalize indicator (yellow LED)

Front Panel Primary Alarm indicators shall include the following:

A. High voltage DC alarm indicator (red LED)
B. Low voltage DC alarm indicator (red LED)
C. DC output failure alarm indicator (red LED)
D. Positive ground fault indicator (red LED)
E. Negative ground fault indicator (red LED)
F. AC failure alarm indicator (red LED)

DIRECT CURRENT OUTPUT METER RANGES

The following shall be the DC output meter ranges for the DC voltage, and DC ampere ranges:

Voltage Range:	0 to 195 V(dc)
Ampere Range:	0 to 500 A(dc)

CURRENT LIMIT

Current limit shall be factory set at 110 percent of rating. This shall also be the limit available from the 3 Phase Power Supply and Battery Charger. Field adjustments may be made over a range from 50 percent to 110 percent of rating. The current limit shall be displayed directly in amperes.

PARALLEL OPERATION

Parallel operation of 2 or more chargers with the same DC voltage rating shall be a feature of the filtered charger with random load sharing.

OPERATING ENVIRONMENT

Operating environment shall be 0-50 °C, storage at -40 to 70 °C, RH 5 - 95 percent non-condensing, elevation to 3280 ft.

CONSTRUCTION

I/O power terminals with CU-AL compression lugs for #14 - 1/0 AWG.
Copper ground pad with one CU-AL compression lug for #14 - 1/0 AWG.
Alarm function terminals - compression terminal block for #22 - 14 AWG.
Enclosure shall be steel 14 GA for the outer skin, door and chassis, and shall employ adequate knock-outs for top, bottom, and right side conduit entry.

Finish will be ANSI-61 gray, baked powder epoxy.

SERVICEABILITY

The 3 Phase Power Supply and Battery Charger shall be serviceable by a technician using standard hand tools.

COATINGS

The 3 Phase Power Supply and Battery Charger shall have an anti-static coating for the circuit boards inside the 3 Phase Power Supply and Battery Charger in order to eliminate static discharge. The following shall be how the preparation and finish coating of the anti-static coating for the circuit boards inside the 3 Phase Power Supply and Battery Charger:

Preparation

Mask off customer electrical terminals, circuit board connectors and terminals, and all aluminum electrolytic capacitors. Clean all surfaces to be spayed.

Finish Coating

Use one or more 3 Phase Power Supply and Battery Charger manufactures approved anti-static coating hand held spray.

Application Method: Hand Held spray in well-ventilated area so as to coats all components other than those masked. Repeat as necessary to coat all components to achieve a minimum thickness of 0.001".

Curing Method: Air dried for one hour.

ALARMS, SELF-DIAGNOSTICS AND ERROR CODES

The 3 Phase Power Supply and Battery Charger shall be capable of automatic self-diagnostics, and indicate any anomaly by means of an error code on the digital display. Error and message code definitions shall be posted within the 3 Phase Power Supply and Battery Charger.

Primary Alarms shall provide an alarm sensing capability for all the following:

A. High voltage DC alarm indicator (red LED)
B. Low voltage DC alarm indicator (red LED)
C. DC output failure alarm indicator (red LED)
D. Positive ground fault indicator (red LED)
E. Negative ground fault indicator (red LED)
F. AC failure alarm indicator (red LED)
G. Summary alarm contact (one Form-C)

CONTROL PANEL

Control panel shall be a touch sensitive type, permanently laminated for protection, thereby eliminating the need for engraved functional nameplates.

DOCUMENTATION

A manual completely describing the installation, operation, and maintenance of the 3 Phase Power Supply and Battery Charger including all accessories and options shall be included. The 3 Phase Power Supply and Battery Charger shall have provision for storing the manual in a convenient permanent pocket.

The manufacturer of the 3 Phase Power Supply and Battery Charger shall provide certified test data on the 3 Phase Power Supply and Battery Charger to the Engineer.

A customized parts data package, including manufacturer's replacement part number and recommended spares shall be included with the 3 Phase Power Supply and Battery Charger.

Standard drawings consisting of an outline, internal layout, schematic and wiring diagram may be provided as needed.

FILTERS

The 3 Phase Power Supply and Battery Charger shall included the following filters installed in the 3 Phase Power Supply and Battery Charger:

A. A DC output filter consisting of one inductor and a one or two section capacitor capable of limiting the output ripple with battery connected to 100 mVrms when measured at the battery terminals in accordance with NEMA PE5.
B. Battery Eliminator Filter consisting of one or more capacitors in addition to the capacitors installed for the DC output filter to be installed within the 3 Phase Power Supply and Battery Charger enclosure. The filter shall reduce the output ripple voltage to 100 mVrms when measured at the 3 Phase Power Supply and Battery Charger terminals.

REMOTE SENSING

The Contractor or the manufacturer of the 3 Phase Power Supply and Battery Charger shall provide the following remote sensing:

A. Remote voltage sensing at the battery terminals using shield twisted pair conductor cable.
B. Temperature compensation for the charging of the batteries via a remote temperature compensation probe. The 3 Phase Power Supply and Battery Charger shall have an automatic probe failure detection and fail-safe control override for the probe.

ERROR CODES

Error codes as indicated on the front panel shall determine certain malfunctions as part of an integral microprocessor controlled self-diagnostic system. The error codes shall appear in the digital display as an alphanumeric indication beginning with the letter "E" followed by a number code, which reveals the problem being identified. Error code definitions shall be posted inside the access door to the charger and shall be listed in the manual. Certain codes, preceded by the letter "A" are provided to indicate special operating conditions.

FAIL SAFE OPERATION

Fail Safe Operation featuring a separate circuit from the microcontroller to detect a low DC voltage condition and enable the common alarm on the main board to change state. This uniquely protects the battery due a failure of the microprocessor.

VOLTAGE REGULATION AND TRANSIENT RESPONSE

The Power Supply and Battery Charger output voltage regulation shall be + 0.25 percent for the following conditions:

Input Voltage Regulation:	-12 percent to + 10 percent
Output Load Regulation:	0 to 100 percent of full load
Temperature:	0 ºC to 50 ºC
Frequency:	60 Hz + 3 Hz

The Power Supply and Battery Charger transient response for 20 percent to 100 percent load changes with the battery connected to the Power Supply and Battery Charger shall be the following:

Output Voltage Change:	+ 4 percent Maximum
Recovery to:	+ 2 percent in 200 ms
Recovery to:	+ 0.5 percent in 500 ms

MISCELLANEOUS

Mean Time Between Failure:	100,000 hours or longer
Security:	Padlock for Front Panel with two keys.

BATTERIES

The Contractor shall provide fifty-five 238 Ampere-hour (A·h) Gas-Recombination type Ni-Cd pocket plate constructed celled batteries rated at 2.4 V(dc) each that shall be compatible with the 3 Phase Power Supply and Battery Charger and use for inverters. The batteries shall be connected in series for a total voltage of 132 V(dc), and the 132 V(dc) series leads conductors of the batteries shall be connected to the equipment of the DC Power System for inverter. Finally, each battery shall meet the following specifications:

Ratings:	
Number of Cells per battery:	2 Cells
Nominal Voltage (dc) per cell:	1.2 V
Minimum Voltage during discharge per cell:	1.0 V
Maximum Voltage per cell:	1.425 V
Battery Rated Voltage:	2.4 V(dc)
Nominal ampere-hour capacity:	238

Construction:	
Plate Material:	Nickel-Cadmium
Cell Technology:	Gas-Recombination Pocket Plate Technology.
Battery and Cell Case:	High Impact Translucent Polypropylene.
Battery and Cell Lids:	Shall be heat welded to the Cases.
Cell Markings:	Maximum and minimum electrolyte level marks shall be permanently marked on two sides of each cell of the battery.
Terminal Markings:	The positive and negative terminals shall be clearly and permanently marked using appropriate colors.
Microporous Plate Separators:	Microporous plate separators shall be plastic grids, providing plate edge insulation.
Electrolyte Material:	Potassium hydroxide (KOH) with a small amount of lithium hydroxide (LiOH). The concentration shall permit operation from 140 °F to –40 °F.
Specific Gravity of Electrolyte:	1200 to 1250
Terminal Posts for the battery:	Terminal posts (Two terminal posts for each Cell) shall be fitted with durable O-ring seals under permanent pressure to prevent electrolyte leakage. Terminal posts shall be nickel plated and welded to the plate groups.
Cell connection bolt per pole:	2xM10
Vents for the battery:	The vents (One vent for each cell) shall be of spring loaded flip-top construction for easy opening and closing. Vents shall be fitted with low-pressure flame arresters.
Dimensions (Not to exceed):	18" H x 8" W x 10" L

Other Cell and Battery Parts:

A. Steel parts, plates etc., shall be welded and not bolted, to provide lowest internal resistance.
B. Intercell connections (or connectors) of the battery shall be pure copper with nickel plating. The intercell connectors shall be included and the cells of the battery shall be connected in series for a total voltage of 2.4 V(dc) using those intercell connectors.
C. Plastic covers over the connectors shall be provided and used.

Manufacturer Quality: The battery shall be manufactured under a strict ISO 9001 regime. The highest quality materials and rigorous quality checking procedures ensure all relevant international standards shall be met, such as but not be limited to IEC 60623 and IEC 62259.

Safety: Shall meet the safety requirements of EN 50272-2 with IP2 Level.

BATTERY RACK

The Contractor shall provide one battery rack for the fifty-five batteries, install the batteries on the rack and connect the batteries. The battery rack shall be made for the batteries and shall meet the following specifications and including the accessories and work specified below:

Type of Rack:

Tier:	Two
Number of Steps:	Two
Seismic Rating:	UBC and CBC Zone 4

Construction: Battery rack shall be constructed of phosphatized steel with a coat of powder epoxy acid resistant end frames and powder-coated polyethylene.

Dimensions (Not to exceed):

Height:	11'
Width:	3'
Length:	11'

Shipping: The battery rack shall be shipped in knocked down form.

Accessories: The following shall be the accessories included with the battery rack and work for the rack:

A. Thermometer.
B. One complete set of nickel-plated pure copper inter-battery hardware, interstep cable with connectors and nuts and bolts. The sizes of the complete set of items specified shall be as required for proper operation of the DC Power System for inverter. The nickel-plated pure copper inter-battery hardware, interstep cable shall be connected to the batteries.
C. One set of insulated wrenches shall be use to install and connect the batteries.
D. One set of cell numbers (110 Cells). The cell numbers shall be neatly label on each cell of the batteries from 1 to 110 starting from left to right facing the battery rack on the bottom 14 batteries of the battery rack and from right to left facing the battery rack on the top 13 batteries of the battery rack.
E. Anti-corrosion compound shall be use for the connection of the batteries.
E. "No smoking" sign shall be provided and installed near the batteries.
F. Portable Eyewash shall be provided and installed near the batteries.
G. One complete set of bolts for attaching the battery rack against the wall and on the concrete pad. The battery rack shall be install per manufacture recommendation against the wall and on the concrete pad with the complete set of bolts.
H. Overall protective covers for the batteries (One cover per Step) to cover all of the batteries in each step shall be provide with access to the terminal ports to connect the batteries to the DC power system for inverter and the interstep connections of the batteries.

12-20 kVA MODULAR UPS SYSTEM

The 12-20 kVA Modular UPS System shall be a modular uninterruptible power supply system for workstation, server, network, telecom and other sensitive electronic equipment applications. It defines the electrical and mechanical characteristics and requirements for a continuous-duty single-phase, solid-state, uninterruptible power supply system. The 12-20 kVA Modular UPS System shall meet the following specifications:

STANDARDS

The 12-20 kVA Modular UPS System shall be designed in accordance with the applicable sections of the current revision of the following documents:

UL Standard 1778
IEEE C62.41, Category A & B
CSA 22.2, No. 107.1
FCC Part 15, Sub Part B, Class A
National Electrical Code (NFPA 70)
IEC 62040-3 (formerly NEMA PE-l)

SYSTEM DESCRIPTION

General

The 12-20 kVA Modular UPS System consists of the following number of modules for capacity and redundancy of the UPS part of the 12-20 kVA Modular UPS System:

Two Control Modules
Four 4 kVA Power Modules
Six Battery Modules
Twelve Battery Modules for the Modular 12 Bay Extended Battery Cabinet.

All modules are to be operating simultaneously and sharing the load. If a power or control module malfunctions, the load will transfer automatically to the bypass line. If a battery module malfunctions, it will automatically isolate itself from the system. The 12-20 kVA Modular UPS System will have one or more modules than what is required to supply the full rated load. The malfunction of one of the modules will cause that module to be isolated from the system and the remaining module(s) will continue to carry the load. Replacement of a module is capable without disturbance to the connected load (Hot-swappable/User Replaceable).

MODES OF OPERATION

The 12-20 kVA Modular UPS System shall be designed to operate as a true on-line system:

A. Normal - The critical AC load is continuously supplied by the UPS inverter. The input converter derives power from a utility AC source and supplies DC power to the inverter. The battery charger maintains a float-charge on the battery.
B. Back-up - Upon failure of utility AC power the critical AC load is supplied by the inverter. In this mode the inverter is powered from the battery. There is no interruption in power to the critical load upon failure or restoration of the utility AC source.
C. Recharge - Upon restoration of utility AC power, the input converter will automatically restart and resume supplying power to the inverter. The battery charger will resume recharge of the battery.
D. Automatic Restart - After a utility AC power outage and complete battery discharge, the 12-20 kVA Modular UPS System will automatically restart and resume supplying power to the critical load. In addition, the battery charger will automatically recharge the battery. This feature is enabled (factory default) and will be capable of being disabled by the user. The user will also be able to program two auto restart delay settings:

    1. Battery capacity percent level
    2. Countdown timer

E. Bypass - The bypass will provide an alternate path for power to the critical load and is capable of operating in the following manner:

    1. Automatic - In the event of an internal failure or should the inverter overload capacity be exceeded, the 12-20 kVA Modular UPS System will perform an automatic transfer of the critical AC load from the inverter to the bypass source.
    2. Manual - Should the 12-20 kVA Modular UPS System need to be taken out of service for limited maintenance or repair, manual activation of the bypass will cause an immediate transfer of the critical AC load from the inverter to the bypass source. The input converter, inverter, and battery charging operations will continue to operate, provided the control enable switch is in the "On" position.

PERFORMANCE REQUIREMENTS

System

Configuration: The 12-20 kVA Modular UPS System shall be configured to the power rating of 12 kVA redundant system.

Isolation: Input to output isolation is provided via the output transformer, regardless of the operating mode (UPS or bypass).

Remote Stop: The 12-20 kVA Modular UPS System provides provisions for remote stop (Emergency Power Off) capability.

Alternate Current Input to 12-20 kVA Modular UPS System

Voltage Configuration: 208 or 240 V(ac) nominal (tap selectable), single-phase, 2-wire plus ground. The operating voltage range is variable based upon output loading percentages as follows:

Percentage UPS Load	Input Voltage
80 – 100	170 V(ac)
60 – 80	144 V(ac)
30 – 60	127 V(ac)
0 – 30	110 V(ac)

Frequency: 40 to 70 Hz.
Input Current Distortion: 5 percent THD maximum at full load.
Input Power Factor: 0.98 lagging at 100 percent rated load.
Inrush Current: 150 percent of full load input current maximum for 3 cycles.
Surge Protection: Sustains input surges without damage per criteria listed in IEEE C62.41, Category B.

Alternate Current Output

Voltage Configuration: 240/120 V(ac), single-phase, 3-wire plus ground or 208/120 V(ac) single-phase, 3-wire plus ground.
Voltage Regulation: ± 3percent steady state.
Frequency Regulation: 60 Hz, ± 0.5 percent.
Frequency Slew Rate: Field selectable from 0.5 to 5.0 Hz maximum per second.
Bypass Frequency Synchronization Range: Field selectable from 0.5 to 5.0 Hz maximum per second.
Voltage Distortion: 3 percent total harmonic distortion (THD) maximum into a 100 percent linear load, 7 percent THD maximum into a 100 percent non-linear load with crest factor ratio of 3:1.
Load Power Factor Range: 0.5 lagging to 1.
Output Power Rating: Rated kVA at: 0.7 lagging power factor.
Overload Capability:

A. >100 percent - 110 percent indefinitely
B. 111 percent -150 percent for 10 seconds
C. 151 percent - 200 percent for 0.25 seconds

The load will be transferred to bypass when any of the above conditions are exceeded. >201 percent for min. 2 cycles, then shut down of 12-20 kVA Modular UPS System. Immediate shutdown into a short circuit.
Voltage Transient Response: ±7 percent maximum for any load step up to and including 100 percent of the 12-20 kVA Modular UPS System rating.
Transient Recovery Time: To within 1 percent of steady state output voltage within 96 ms.

Batteries

Internal Battery: The battery consists of flame retardant, valve regulated, lead acid cells. The 12-20 kVA Modular UPS System shall be suitable for installation inside a computer room per requirements of UL Standard 1778.
Reserve Time: The 12-20 kVA Modular UPS System contains internal battery system to provide a reserve time of 7 minutes at 100 percent load with an equal number of power and battery modules fitted. The 12-20 kVA Modular UPS System includes provisions to fit additional battery modules internally if space permits. The 12-20 kVA Modular UPS System also interfaces with an external battery cabinet to extend reserve time capabilities.
Battery Recharge: To prolong battery life, the 12-20 kVA Modular UPS System includes temperature-compensated battery charging. When equal number of power modules and battery modules are fitted the battery charger is able to recharge the internal batteries to 90 percent charge in six hours at nominal input voltage and nominal ambient temperature.

ENVIRONMENTAL CONDITIONS

Ambient Temperature

Operating: 12-20 kVA Modular UPS System: 0 °C to +40 °C; battery 20 °C to 25 °C for optimum performance.
Storage: 12-20 kVA Modular UPS System:–20 °C to +60 °C; battery –20 °C to 25 °C for maximum 6 months.

Relative Humidity

Operating: 5 to 95 percent non -condensing.
Storage: 5 to 95 percent non -condensing.

Altitude

Operating: To 10,000 feet. De-rating/reduced operating temperature range required for higher altitudes.
Storage: To 30,000 feet.

Audible Noise

Noise generated by the 12-20 kVA Modular UPS System during normal operation does not exceed 62 dBA measured at three feet from the surface of the 12-20 kVA Modular UPS System.

Electrostatic Discharge

The 12-20 kVA Modular UPS System shall be able to withstand a minimum 15 kV without damage and will not affect the critical load.

USER DOCUMENTATION

The specified 12-20 kVA Modular UPS System shall be supplied with one user's manual. Manuals include installation drawings and instructions, a functional description of the equipment with block diagrams, safety precautions, illustrations, step by step operating procedures, and routine maintenance guidelines.

WARRANTY

The 12-20 kVA Modular UPS System manufacturer warrants the 12-20 kVA Modular UPS System against defects in materials and workmanship for two years. The warranty covers all parts for two years and onsite labor for 90 days. With start-up provided by manufacturers recommended service company, the warranty covers all parts and onsite labor for two years. Maintenance contract packages shall be available.

QUALITY ASSURANCE

Manufacturer Qualifications

A minimum of thirty year's experience in the design, manufacture, and testing of solid-state UPS systems is required.

Factory Testing

Before shipment, the manufacturer fully and completely tests the system to assure compliance with the specification. These tests include operational discharge and recharge tests on the internal battery to guarantee rated performance. The 12-20 kVA Modular UPS System ships completely assembled and all modules installed.

PRODUCT

Fabrication

All materials and components making up the 12-20 kVA Modular UPS System will be new, of current manufacture, and not in prior service except as required during factory testing. The 12-20 kVA Modular UPS System is constructed of replaceable subassemblies. All active electronic devices are solid-state.

Wiring

Wiring practices, materials, and coding will be in accordance with the requirements of the National Electrical Code (NFPA 70) and other applicable codes and standards.

Cabinet

The 12-20 kVA Modular UPS System unit shall comprised of: power module, battery module, control module, and user interface module housed in a single free-standing enclosure and meets the requirements of IP20. The 12-20 kVA Modular UPS System shall be designed such that the battery modules may be installed into any module bay in the cabinet and power modules into any module bay in the top half of the cabinet. The 12-20 kVA Modular UPS System cabinet shall be cleaned, primed, and painted with the manufacturer's standard color. Casters and leveling feet are provided. 12 bay cabinet dimension is 20 inches wide, 28 inches deep, and 53 inches high.

Cooling

The 12-20 kVA Modular UPS System shall be cooled by forced air via internally mounted fans.

COMPONENTS

Input Converter

General

Incoming AC power is converted to a regulated DC output by the input converter for supplying DC power to the inverter. The input converter provides input power factor and input current distortion correction.

Alternate Current Input Current Limit

The input converter is provided with AC input over current protection.

Input Protection

The 12-20 kVA Modular UPS System has built-in protection against undervoltage, overcurrent, and overvoltage conditions including low-energy surges introduced on the primary AC source and the bypass source. The 12-20 kVA Modular UPS System can sustain input surges without damage per criteria listed in IEEE C62.41, Category A & B. The 12-20 kVA Modular UPS System cabinet contains an input breaker sized to supply full 20 kVA rated load and to recharge the battery at the same time.

Battery Recharge

To prolong battery life, the 12-20 kVA Modular UPS System contains temperature-compensated battery charging. When an equal number of power modules and battery modules are installed the battery charger shall be able to recharge the internal batteries to 90 percent charge in six hours at nominal input voltage and nominal ambient temperature.

Charger Output Filter

The battery charger is a DC power supply to minimize ripple current into the battery.

Inverter

General

The inverter converts DC power from the input converter output, or the battery, into precise regulated sine wave AC power for supporting the critical AC load.

Overload

The inverter is capable of supplying current and voltage for overloads exceeding 100 percent and up to 200 percent of full load current. A visual indicator and audible alarm indicates overload operation. For greater currents or longer time duration, the inverter has electronic current-limiting protection to prevent damage to components. The inverter is self-protecting against any magnitude of connected output overload. Inverter control logic senses and disconnects the inverter from the critical AC load without the requirement to clear protective fuses. The load will be transferred to bypass when any of the above conditions are exceeded.

Maximum Load Alarm

The user can set the alarm point to a value less than 100 percent rating such that the 12-20 kVA Modular UPS System will alarm before an overload condition or loss of redundancy is reached.

Output Frequency

The output frequency of the inverter is controlled by an oscillator. The oscillator will hold the inverter output frequency to ±0.5 percent for steady state and transient conditions. The inverter tracks the bypass continuously, providing the bypass source maintains a frequency within the user-selected synchronization range. If the bypass source fails to remain within the selected range, the inverter will revert to the internal oscillator.

Output Protection

The 12-20 kVA Modular UPS System inverter employs electronic current limiting.

Battery over Discharge Protection

To prevent battery damage from over discharging, the 12-20 kVA Modular UPS System control logic controls the shutdown voltage set point. This point is dependent on the rate of discharge.

Display and Controls

General

The front panel will consist of multiple status LEDs, switches, and a four line by twenty character LCD display for additional alarm/configuration information. All mimic display LED's are green in color and indicate the following:

A. AC Input
B. On Battery
C. Load On/Off
D. On Inverter
E. On Bypass

The 12-20 kVA Modular UPS System fault indicator is used with additional indicators and audible alarms to notify the user that a 12-20 kVA Modular UPS System fault condition has occurred. The color of the fault indicator LED is amber.

A. Replace Battery Module
B. Replace Power Module
C. Replace Control Module
D. On Bypass
E. Low Battery
F. OverTemp Warning
E. UPS Shutdown

If there is a fault condition, the 12-20 kVA Modular UPS System will attempt to maintain conditioned power to the load, or at minimum transfer to bypass. There will also be a visual indication on each module should the module fail and need to be replaced.

In addition to an audible/visual fault signal the 12-20 kVA Modular UPS System also records fault occurrences in a rolling event log. The event log on the standard unit can record up to 255 occurrences, with the oldest events discarded first, etc. The user has access to the event log through the LCD display. Every alarm and event recorded in the event log will contain a time and date stamp.

Audible Alarms

The volume of all audible alarms is at least 65 dBA at a distance of three feet. An audible alarm is used in conjunction with the LED/LCD indication to indicate a change in 12-20 kVA Modular UPS System status.

The audible alarms enunciate for utility line loss, low battery (while on battery), and all other alarm conditions. For all alarm conditions, the user must look at the display to determine the cause of error/alarm. All alarm tones are a continual tone until the condition rectifies itself or the alarm is silenced. Once silenced, the audible alarm will not sound until a new alarm condition is present.

Alarm Silence Button

In addition to the load On/Off switch, the user interface includes an audible 'Alarm Silence' switch. If the alarm silence switch is pressed for one second, all current audible alarms will be disabled. If a new alarm occurs, or a cancelled alarm condition disappears and then re-appears, the audible alarm is re-enabled.

LCD Display

The LCD display is used to provide information to the user. The display is used to program all information (voltage, frequency, etc.) into the 12-20 kVA Modular UPS System. Any display values that require time/date will be 'year 2000' compliant.

Automatic Battery Test

The 12-20 kVA Modular UPS System will initiate an automatic battery testing sequence periodically, at a programmed day and time of day, selectable by the end user. The user will be able to select the interval of the battery test and will be able to select 1, 2, 3, 4, or 6 week intervals, or can select to disable the automatic battery test.

Should a battery failure occur, the battery module will disconnect itself from the critical DC bus and the 12-20 kVA Modular UPS System will immediately return to normal mode and fault signals (visual, audible, and remote via serial) will be communicated. No audible or remote (via serial/contact closures) indication of the battery test is communicated during the duration of the automatic battery test.

The automatic battery test factory default settings are enabled at a two week interval and to occur on Wednesdays at 0600 hours (based on the twenty-four hour clock).

Remote Emergency Power Off (REPO)

The remote emergency power off function (REPO) allows the user to disable all 12-20 kVA Modular UPS System outputs in an emergency situation. The REPO, in order to be flexible, will be able to interface with either normally open (NO) or normally closed (NC) systems. The REPO is activated when a pair of 'SELV' contacts, external to the 12-20 kVA Modular UPS System, are activated. The REPO connection is through a simple terminal block type connector.

The REPO function will not operate if no system control modules are present in the 12-20 kVA Modular UPS System or if the manual bypass switch is in the bypass position. The user must supply a means of interfacing with the REPO circuit to allow disconnecting the 12-20 kVA Modular UPS System input feeder breaker to remove all sources of power to the 12-20 kVA Modular UPS System and the connected equipment to comply with local wiring codes/regulations.

Regardless of the UPS mode of operation when the REPO is activated, the 12-20 kVA Modular UPS System output will not be re-enabled until the following occurs:

A. REPO contacts are reset (closed if NC contacts are used and open if NO contacts are used)
B. Input circuit breaker is closed
C. Control enable switch is turned on
D. User interface on/off switch is depressed

Bypass

General

A bypass circuit is provided as an integral part of the 12-20 kVA Modular UPS System. The bypass has an overload rating of 300 percent rated full load for 10 cycles and 1000 percent for sub-cycle fault clearing. The bypass control logic contains an automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit provides a transfer of the load to the bypass source, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the 12-20 kVA Modular UPS System.

Automatic Transfers

The transfer control logic automatically activates the bypass, transferring the critical AC load to the bypass source, after the transfer logic senses one of the following conditions:

A. Inverter overload capacity exceeded
B. Inverter over temperature
C. UPS fault condition

For inverter overload conditions, the transfer control logic inhibits an automatic transfer of the critical load to the bypass source if one of the following conditions exists:

A. Inverter/Bypass voltage difference exceeding preset limits (±15 percent of nominal)
B. Bypass frequency out of preset limits (±5 percent of nominal frequency)

Automatic Retransfer

Retransfer of the critical AC load from the bypass source to the inverter output is automatically initiated unless inhibited by the manual control. The transfer control logic inhibits an automatic retransfer of the critical load to the inverter if one of the following conditions exists:

A. Bypass out-of-synchronization range with inverter output
B. Overload condition exists in excess of the inverter full load rating
C. UPS fault condition present

Manual Transfer

In addition to the internal bypass function, the 12-20 kVA Modular UPS System has a manual bypass function. The manual bypass function is provided via of a switch mounted on the bottom-front of the 12-20 kVA Modular UPS System, removal of the lower front bezel is required. The actual AC break time between inverter and bypass is less than four milliseconds.

The manual bypass provides a partial 'wrap-around' bypass, and is configured to wrap around the rectifier, battery charger, inverter, and battery in the same manner as the automatic bypass. The manual bypass does not wrap around the EMI filtering, overcurrent protection or isolation transformer.

The 12-20 kVA Modular UPS System will initiate an audible alarm upon transfer to manual bypass. The audible alarm is capable of being silenced by the user. The alarm will continue to sound (unless silenced) while in bypass mode. This shall provide a reminder to the user that the load continues to be powered from utility supply alone.

Internal Battery

Flame retardant, valve regulated, gas recombination, lead acid batteries shall be used as a stored-energy source for the specified 12-20 kVA Modular UPS System. The battery is housed in separate replaceable modules that slide into any open bay of the 12-20 kVA Modular UPS System cabinet, and are sized to support the inverter at rated load and power factor, in an ambient temperature between 20 °C and 25 °C, for a 7 minutes reserve time. The expected life of the battery is 3 to 5 years or a minimum 250 complete discharge cycles. For extended battery reserve time, additional battery modules may be added if the frame size allows; external battery cabinets are available as an option.

COMMUNICATIONS

General

The 12-20 kVA Modular UPS System allows for flexibility in communications via two DB9 communication ports and four manufacturers built ports on the rear of the 12-20 kVA Modular UPS System. The 12-20 kVA Modular UPS System shall be able to communicate through two communications ports simultaneously; the media of either communications port may change without affecting the operation of the 12-20 kVA Modular UPS System. The use of the manufacturers communication card will not affect the operation of the two communications ports.

Relay Contacts

The relay contacts are available through one DB-9F communication connector, and are compatible with the manufacturers recommended software. The 12-20 kVA Modular UPS System can communicate via relay contact closure the following information:

A. Low Battery
B. On Battery

There shall be one connector that provides relay contacts fitted on the 12-20 kVA Modular UPS System (designated Comm port 1). Relay contacts are rated for 48 V(dc), 1 A. Additional signals (such as on bypass and summary alarm) are provided via the manufacturers communication card option.

The following pins for Comm port 1 are used:

Pin 1	Low Battery (normally open)
Pin 4	Shutdown in battery mode (5-12 VDC for 1.5 sec)
Pin 5	Common
Pin 7	Low Battery common
Pin 8	On Battery (normally open)
Pin 9	On Battery common

Serial Communications

The 12-20 kVA Modular UPS System shall be able to communicate via the manufacturers recommended protocol through the following communication port: Comm port 2.

The serial port on the UPS will only communicate with manufacturers recommended software.

The pin-out configuration for Comm port 2 is as follows:

Pin 2	Transmit Data
Pin 3	Receive Data
Pin 5	Common

Network Communications

The user shall have the option of installing an optional manufacturers communication card to provide HTTP supported SNMP communication over a local area network. This card supports 10/100 Mbit Ethernet over unshielded twisted pair connection.

ACCESSORIES

Modular 12 Bay Extended Battery Cabinet

The 12-20 kVA Modular UPS System shall include a Modular 12 Bay Extended Battery Cabinet. It shall include 12 Battery Modules installed in the cabinet. The Extended Battery Cabinet shall included two manufacturers recommended battery communication cards and two 10-foot communications cables. The Modular 12 Bay Extended Battery Cabinet requires one unused manufacturers recommended battery communication cards on the rear of the 12-20 kVA Modular UPS System and a maximum of four extended battery cabinets can be used with one 12-20 kVA Modular UPS System.

Dimensions shall not to exceed 25" W x 30" D x 55" H.

Maintenance Bypass Cabinet

The 12-20 kVA Modular UPS System shall include a Maintenance Bypass Cabinet to provide a complete "wrap-around" protection and allows the UPS part of the 12-20 kVA Modular UPS System to be pulled from service without interrupting power to the loads. The Maintenance Bypass Cabinet controls shall include a manual break-before-make bypass transfer switch, UPS input disconnect switch, and a branch rated output circuit breaker. The Maintenance Bypass Cabinet controls are located behind a lockable front panel to provide operation security.

The Maintenance Bypass Cabinet shall include an isolation transformer in the bypass path.

The Maintenance Bypass Cabinet dimensions shall not to exceed 30" W x 20" D x 15" H.

Sheet metal cover plates shall be installed over any remaining distribution slots not used. These slots may be upgraded in the future by a qualified electrician. Note that removing or installing additional output distribution options will require powering down of the connected load.

The 12-20 kVA Modular UPS System shall include a 100 A output circuit breaker which is rated for 100 percent continuous use.

FIELD SERVICES

Field Quality Control

The following inspections and test procedures will be performed by factory trained field service personnel during the 12-20 kVA Modular UPS System start-up.

Visual Inspection:

A. Inspect equipment for signs of shipping or installation damage.
B. Verify installation per drawings.
C. Inspect cabinets for foreign objects.
D. Verify neutral and ground conductors are properly sized and configured.

Mechanical Inspection:

A. Check all power modules are correctly fitted.
B. Check all battery modules are correctly fitted.
C. Check all terminal screws, nuts, and spade lugs for tightness.

Electrical Inspection:

A. Confirm input voltage and phase rotation is correct.
B. Verify bypass voltage jumper is correct for voltages being used.

Unit Start-Up and Site Testing

The manufacturer's field service personnel will provide site testing. Site testing consists of a complete test of the 12-20 kVA Modular UPS System and the associated accessories supplied by the manufacturer. A partial battery discharge test will be provided as part of the standard start-up procedure. The test results will be documented, signed, and dated for future reference.

MEDIUM VOLTAGE POWER CABLE

The medium voltage power cable shall be a 15 kV rated medium voltage power cable designed to operate at conductor temperatures of 90 °C normal, 130 °C emergency, and 250 °C short circuit conditions as defined by ANSI/ICEA S-93-639-2004 and Underwriters Laboratories (UL) Standard 1072. The medium voltage power cable shall be suitable for installations above or below grade, indoors or outdoors, and in wet or dry locations. The qualifying cable shall be Underwriters Laboratories (UL) labeled as MV-90, Sunlight Resistance and For Cable Tray use (UL) which shall be in accordance with UL standard 1072. The medium voltage power cable shall consist of the conductor, the conductor shield, the insulation, the insulation shield, and an overall jacket as specified below; and the manufacturer of the medium voltage power cable shall perform the tests (Insulation and Production Tests) on the cable as specified below.

CONDUCTOR

The conductor shall be a compressed, class B stranded copper, filled conductor in accordance with the requirements of Part 2 of the ANSI/ICEA S-93-639-2004, and the conductor shall consist of tin coated strands in the outer layer of the copper conductor that shall be in accordance with ASTM B-8.

CONDUCTOR SHIELD

The conductor shield (Stress Control Layer) shall be an extruded, black-colored, non-conducting thermoset material that shall be in accordance with Part 3 of the ANSI/ICEA S-93-639-2004. The minimum average thickness shall be 0.012-in.

INSULATION

The insulation shall be a discharge resistant, ethylene propylene (EP) based compound, which shall be in accordance with Part 4 of the ANSI/ICEA S-93-639-2004. The minimum point thickness of the insulation shall be 0.21-in. The discharge resistance of the insulation shall be demonstrated by withstanding 21 kV(ac) @ 25 °C and @ 20 percent RH for 250 hours without failure when tested in accordance with the method described in ASTM D2275-89 "Standard Test Method for Voltage Endurance of Solid Electrical Insulating Materials Subjected to Partial Discharge (Corona) on the Surface" and submit the result of the test to the Engineer for approval, before excepting of the cable.

INSULATION SHIELD

The insulation shield shall consist of a nonmetallic semi-conducting material extruded directly over the insulation and a helically applied 0.005-in thick copper tape. The nonmetallic layer shall be black-colored with properties and thickness conforming to the requirements of Part 5 of the ANSI/ICEA S-93-639-2004. The layer shall be free stripping from the ethylene propylene (EP) insulation. The metallic shield shall consist of a 0.005-in thick copper tape applied helically per Part 6 of the ANSI/ICEA S-93-639-2004.

OVERALL JACKET

The overall jacket shall be a Chlorinated Polyethylene (CPE) Jacket, and with a minimum point thickness in accordance to the following:

Calculated diameter over metallic shield (in)	Jacket minimum thickness (in)
0.70or less	0.055
0.71 to 1.50	0.070
1.51 to2.50	0.100
2.51 and larger	0.125

Surface printing shall be in according to UL Standard 1072.

PRODUCTION TESTING

Production testing shall consist of the following:

A. Continuous 2 kV(dc) spark testing of the non-conducting stress control layer prior to extrusion of the ethylene propylene (EP) insulation.
B. Mooney Viscosity, Scorch Viscosity, and Specific Gravity of each batch of the ethylene propylene (EP) insulation prior to extrusion.
C. AC Voltage Withstand test for a 5-minute duration, of each finished cable at 44 kV.
D. Volume resistivity of the nonmetallic shield.
E. DC Resistance of all insulated conductors and metallic shields.
F. Dimensional verification of all extruded layers.
G. Absence of water in conductors and interfaces conformed.
H. Insulation resistance measurements.

FEEDER CIRCUIT BREAKER

The feeder circuit breaker shall be a three pole/three phase molded case circuit breaker with a programmable trip unit that shall meet the following specifications below:

CIRCUIT BREAKER

A. The feeder circuit breaker shall be a molded case circuit breaker with inverse time and instantaneous tripping characteristics as programmed by the programmable trip unit.
B. The feeder circuit breaker shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of industrial standard de-ionizing arc chutes. A push-to-trip button on the front of the feeder circuit breaker shall provide a local manual means to exercise the trip mechanism.

C. The feeder circuit breaker shall have a minimum symmetrical interrupting capacity of 100,000 amperes at 480 V(ac).
D. Ground fault protection shall be provided for the feeder circuit breaker set to 1000 A or higher.
E. Where indicated on the plans, the feeder circuit breaker shall be UL listed for series application.
F. Where indicated on the plans, the feeder circuit breaker shall be current limiting.
G. The feeder circuit breaker shall be a UL listed circuit breaker for applications at 100 percent of their continuous ampere rating in the switchboard of the secondary equipment for the secondary unit substation.

PROGRAMMABLE TRIP UNIT

A. The feeder circuit breaker microprocessor-based tripping system shall consist of three current sensors, a trip unit and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.
B. Interchangeable rating plugs shall establish the continuous trip ratings of the feeder circuit breaker. Rating plugs shall be fixed-type as indicated. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.
C. System coordination shall be provided by the following microprocessor-based programmable time-current curve shaping adjustments:

    1. Programmable long-time setting
    2. Programmable long-time delay with selectable I2t or I4t curve shaping
    3. Programmable short-time setting (dependent on long-time setting)
    4. Programmable short-time delay with selectable flat or I2t curve shaping and zone selective interlocking
    5. Programmable instantaneous setting
    6. Programmable ground fault setting trip or alarm
    7. Programmable ground fault delay with selectable flat or I2t curve shaping and zone selective interlocking.

D. The microprocessor-based trip unit shall have a powered/unpowered selectable thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.
E. Provide and factory wire zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream circuit breaker, and allow the circuit breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the pre-set time delay.
F. When the instantaneous setting has been deselected, a selectable discriminator circuit shall be provided to prevent the breaker being closed and latched on to a faulted circuit.
G. Internal ground fault protection or alarm settings shall not exceed 1200 amperes. Provide neutral ground fault sensor for four-wire loads
H. The trip unit shall have an information system that utilizes battery backed-up LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A trip-reset button shall be provided to turn off the LED indication after an automatic trip. A test push-button shall energize an LED to indicate battery status.
I. Feeder circuit breaker shall include a minimum of one auxiliary switch and one bell alarm with form C contacts, one shunt trip, and one undervoltage release.
J. A red LED shall be provided on the face of the trip unit and pre-set to flash on and off when an adjustable high-load level is exceeded. A time-delay shall be provided to avoid nuisance alarms. The microprocessor-based trip units shall be capable of monitoring the following data:

    1. Instantaneous value of phase, neutral and ground current.
    2. Minimum and maximum current values.
    3. Average demand current.
    4. System diagnostic information such as alarms and cause of trip.
    5. Approximate level of fault current that initiated an automatic trip operation.

K. The monitored data shall be displayed by a hand-held programmer, a breaker interface module or a remote computer.
L. The trip unit shall be capable of two-way communication via a network twisted pair for remote monitoring and control. The trip unit shall be provided with an address register for identification on the network. All monitored values shall be transmittable over the network.

M. The trip unit shall contain test capability. Testing shall be carried out by using a hand-held programmer, a breaker interface module or a remote computer to select the values of test current within a range of available settings. The basic protection functions shall not be affected during test operations. The breaker may be tested in either the "Trip" or "No Trip" test mode.

N. For enhanced system analysis the following additional parameter values shall be monitored:

1. Peak demand (kW)
2. Present demand (kW)
3. Reverse energy (kWh)
4. Forward energy (kWh)
5. Total energy (kWh)
6. Power factor
7. Percentage harmonic content
8. Total Harmonic Distortion (THD)
9. Line-to-line voltage

O. A hand-held programming unit shall be provided to set/change the network communication breaker address for each device, set the system baud rate, distribution frequency, display breaker information, and display monitored values. In addition, provide password protection for programming time current set points and to perform functional testing of phase and ground trip characteristics. The programmer shall be self-powered by an internal battery. Provide as a minimum one hand-held programming unit per assembly.

MOTOR CONTROL CENTER

The motor control center shall be a full-voltage non-reversing motor control center that shall included but not be limited to: Combination starter units, Control and Indication Relays, Power Control Relays, Overload relays, Soft Start Controllers, Lighting Contactors and Circuit Breakers; and shall meet the following specifications:

GENERAL

Scope

The Contractor shall install the motor control center.

References

The Motor Control Center and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA, ANSI and UL 845.

Submittals – for Review/Approval

The following information shall be submitted to the Engineer:

A. Master drawing index
B. Front view elevation
C. Floor plan
D. Top view
E. Single line
F. Unit wiring diagrams depicting remote devices
G. Nameplate schedule
H. Starter and component schedule
I. Conduit entry/exit locations
J. Assembly ratings including:

1. Short-circuit rating
2. Voltage
3. Continuous current

K. Major component ratings including:

1. Voltage
2. Continuous current
3. Interrupting ratings

L. Cable terminal sizes
M. Product data sheets.

Where applicable the following information shall be submitted to the Engineer:

A. Busway connection
B. Connection details between close-coupled assemblies
C. Composite floor plan of close-coupled assemblies
D. Key interlock scheme drawing and sequence of operations.

Submittals – For Construction

The following information shall be submitted for record purposes:

A. Final drawings and information for items listed under "Submittals – for Review/Approval"
B. Unit wiring diagrams
C. Certified production test reports
D. Installation information
E. Seismic certification and equipment anchorage details.

The final drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

Qualifications

The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) through Zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5 percent minimum damping factor, CBC: a peak of 2.15 g's, and a ZPA of 0.86 g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.

The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards:

A. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the State. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
B. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in the above codes.
C. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

Regulatory Requirements

The motor control centers shall bear a UL label. Certified copies of production test reports shall be supplied demonstrating compliance with these standards when requested by the Engineer.

Delivery, Storage and handling

Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

Operation and Maintenance Manuals

Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PRODUCTS

Motor Control Center (MCC) No. 1 for Battery Substation:

One Jet Fans and Lighting Controls Interface Control Compartment.
One Terminal Block (TB) Interface Compartment.
Four 150 hp Jet Fan with a Soft Start Controller for each Jet Fan Control Sections (Jet Fan No.1 to No.4).
Two Lighting Control Circuit Compartments (Lighting Control Circuit No.1 and No.2).
One Main Circuit Breaker Compartment.

Motor Control Center (MCC) No. 2 for Battery Substation:

One Jet Fans and Lighting Controls Interface Control Compartment.
One Terminal Block (TB) Interface Compartment.
Two 100 hp Jet Fan with a Soft Start Controller for each Jet Fan Control Sections (Jet Fan No.1 and No.2).
Two Lighting Control Circuit Compartments (Lighting Control Circuit No.1 and No.2).
One Main Circuit Breaker Compartment.

Ratings

The Motor Control Center(s) shall be 600 V class suitable for operation on a three-phase, 60 Hz system. The system operating voltage shall be 480/277 V(ac) and the number of wires shall be four wires.

Construction

Structures shall be totally enclosed deadfront, free-standing assemblies. The structures shall be 90 inches high and 21 inches deep for front-mounted units. The structures shall contain a horizontal wireway at the top, isolated from the horizontal bus and shall be readily accessible through a hinged cover. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference.

Compartments for mounting control units shall be incrementally arranged such that not more than six Size 1 starters for front-mounted only can be mounted within each vertical structure. Guide rails shall be provided.

A vertical wireway with minimum of 35 square inches of cross-sectional area shall be adjacent to each vertical unit and shall be covered by a hinged door. Wireways shall contain steel rod cable supports.

All full voltage starter units through NEMA Size 5 shall be of the drawout type. Drawout provisions shall include a positive guide rail system and stab shrouds to absolutely ensure alignment of stabs with the vertical bus. Drawout units shall have a tin-plated stab assembly for connection to the vertical bus. No wiring to these stabs shall extend into the bus compartment. Interior of all units shall be painted white for increased visibility. Units shall be equipped with side-mounted, positive latch pull-apart type control terminal blocks rated 600 V. Knockouts shall be provided for the addition of future terminal blocks. In addition, a master terminal block shall be drawout and shall be located in the bottom wireway, readily accessible through a hinged cover. All control wire to be 14 gauge minimum.

All drawout units shall be secured by a spring-loaded quarter turn indicating type fastening device located at the top front of the unit. Each unit compartment shall be provided with an individual front door.

An operating mechanism shall be mounted on the primary disconnect of each starter unit. It shall be mechanically interlocked with the unit door to prevent access unless the disconnect is in the OFF position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. A second interlock shall be provided to prevent removal or reinsertion of the unit while in the ON position. Padlocking facilities shall be provided to positively lock the disconnect in the OFF position with from one to three padlocks with the door open or closed. In addition, means shall be provided to padlock the unit in a partially withdrawn position with the stabs free of the vertical bus.

Bus

Each structure shall contain a main horizontal copper silver-plated bus, with minimum ampacity of 2000 A. The horizontal bus shall be rated at 65 °C temperature rise over a 40 °C ambient in compliance with UL standards. Vertical bus feeding unit compartments shall be copper and shall be securely bolted to the horizontal main bus. All joints shall be front-accessible for ease of maintenance. The vertical bus shall have a minimum rating of 300 A for front-mounted units and 600 A for back-to-back mounted units.

The vertical bus shall be completely isolated and insulated by means of a labyrinth design barrier. It shall effectively isolate the vertical buses to prevent any fault-generated gases to pass from one phase to another. The vertical bus shall include a shutter mechanism to provide complete isolation of the vertical bus when a unit is removed.

Buses shall be braced for 100,000 A_{rms} symmetrical.

A copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the motor control center.

Each structure shall contain tin plated vertical ground bus rated 300 A. The vertical ground bus shall be directly connected to the horizontal ground bus via a tin-plated copper connector. Units shall connect to the vertical bus via a tin-plated copper stab.

The main horizontal copper silver-plated bus shall be connected to a TVSS.

Wiring/Termination

Wiring shall be NEMA Class II, Type C.

Motor and Lighting Controllers

Combination starter units shall be full-voltage non-reversing, and shall be HMCP Motor Circuit Protectors.

Each combination unit shall be rated 65,000 AIC symmetrical at 480 V(ac). The HMCP shall provide adjustable magnetic protection and be provided with pin insert to limit magnetic adjustment to a maximum of 1700 percent motor nameplate full load current to comply with NEC requirements. All HMCP combination starter units shall have a "tripped" position on the unit disconnect and a push-to-test button on the HMCP. Type HMCP motor circuit protectors shall include transient override feature for motor inrush current.

Motor Starters

Magnetic starters through NEMA Size 9 use for the jet fans paralleling full voltage bypass contactors and the jet fans isolation contactors shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring. Each starter use for the jet fans paralleling full voltage bypass contactors and the jet fans isolation contactors shall have three NO contacts and three NC contacts.

Coils shall be of molded construction through NEMA Size 9. All coils to be color-coded through Size 5 and permanently marked with voltage, frequency and part number.

Overload relays shall be an ambient compensated bimetallic-type with interchangeable heaters, calibrated for 1.0 and 1.15 service factor motors. Electrically isolated NO and NC contacts shall be provided on the relay. Visual trip indication shall be standard. A test trip feature shall be provided for ease of troubleshooting and shall be conveniently operable without removing components or the motor starter. Overload to have (+/-) 24 percent adjustability, single-phase sensitivity, and isolated alarm contact, and manual or automatic reset.

NEMA Size 00 through 2 starters shall be suitable for the addition of at least six external auxiliary contacts of any arrangement normally open or normally closed. Size 3 through 8 starters shall be suitable for the addition of up to eight external auxiliary contacts of any arrangement normally open or normally closed.

Each starter use for the Jet Fan Controls, the Lighting Control Circuits, and the Jet Fans and Lighting Controls Interface Controls shall be equipped with the following:

For the Jet Fan Controls:

A. A fused control power transformer (480 V(ac) to 120 V(ac)).
B. A Hand-Off-Auto (HOA) selector switch.
C. Two NO Pushbutton (For the Emergency Backup Motor Control, and Reset).
D. Five indicating lights (One green indication light for "Run", one yellow or amber indication light for "Backup Motor Control", one red indication light for "Power On", and two white indication lights for "Local" and "Fault").
E. A Soft Start Controller (150 hp for MCC No.1 and 100 hp for MCC No.2).
F. SCADA Control and Indication Relays (for all relays except for the AC Latching Relay (8 Poles), the Time Relay (TR), and the Disconnect Relay (DC) Relay).
G. Power Control Relays (for the AC Latching Relay (8 Poles), the Time Relay (TR), and the Disconnect Relay (DC) Relay).
H. One paralleling full voltage bypass contactor and one isolation contactor.
I. Load Side transient voltage surge suppression (TVSS).

For the Lighting Control Circuits:

A. A fused control power transformer (480 V(ac) to 120 V(ac)).
B. A Hand-Off-Auto (HOA) selector switch.
C. One lighting contactor with two NO auxiliary contacts and two NC auxiliary contacts for each lighting contactor.
D. Two indicating lights (One red indication light for "On", and one white indication light for "Local").
E. SCADA Control and Indication Relays (for all relays).

For the Jet Fans and Lighting Controls Interface Controls:

A. A fused 5 kVA 480/240/120 V control power transformer.
B. Two indicating lights (One red indication light for "Vent on High", and one green indication light for "Vent on Low").
C. Power Control Relays (for all relays except for the Low Relay, the High Relay, and Lighting Control Circuit Relays).
D. SCADA Control and Indication Relays (for the Low Relay, the High Relay, and Lighting Control Circuit Relays).

Device panel to have space to accommodate six oil tight pilot-control devices or indicating ammeters, voltmeters, or elapsed time meters.

Soft Start Controller as specified in the Soft Start Controller Specifications for each Jet Fan; shall be provided and installed in the Motor Control Center.

Lighting Contactor as specified in the Lighting Contactor Specifications for each Lighting Control Circuit; shall be provided and installed in the Motor Control Center.

Overcurrent Devices

Circuit Breakers

The Main Circuit breaker shall have a minimum interrupting capacity of 100 kAIC at 480/277 V(ac).

Individual feeder breakers shall have a minimum interrupting capacity of 65 kAIC at 480/277 V(ac).

Individual feeder breakers use for the Lighting Control Circuits shall have shunt trips.

Each circuit breaker shall have a auxiliary contact.

Miscellaneous Devices

Transient Voltage Surge Suppression

Provide transient voltage surge suppression as specified under "transient voltage surge suppression". The motor control center manufacturer shall install in the motor control center the transient voltage surge suppression as required for the proper and safe installation and operation of the transient voltage surge suppression.

Control Relays

Provide the Power Control Relays, and the SCADA Control and Indication Relays as specified in the "Power Control Relays" and "SCADA Control and Indication Relays" within the compartments and within the sections of the motor control center shall be furnished and installed in the compartments required for proper and safe operation of the Power Control Relays, and SCADA Control and Indication Relays in the compartments and in the sections of the motor control center.

Incoming Feeder Terminations and Device

Incoming cable shall terminate within the control center on a main breaker termination point. Main breakers shall be provided as shown on the plans, as specified under "Overcurrent Devices," and be molded case.

Enclosures

The type of enclosure shall be in accordance with NEMA standards for type 12 dust-tight and drip-proof. All enclosing sheet steel, wireways and unit doors shall be gasketed.

Nameplates

Each unit will have a 1.0 x 2.5-inch engraved nameplate. The lettering shall be black 3/16-in high, on a white background.

Finish

The control center shall be given a phosphatizing pretreatment. The paint coating shall be a polyester urethane, thermosetting powder paint. The manufacturer's standard color shall be used.

The control center finish shall pass 600 hours of corrosion-resistance testing per ASTM B 117.

EXECUTION

Factory Testing

The motor control centers shall have been tested in a high-power laboratory to prove adequate mechanical and electrical capabilities.

All factory tests required by the latest ANSI, NEMA and UL standards shall be performed.

A certified test report of all standard production tests shall be available to the Engineer upon request.

Field Quality Control

Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and startup of the equipment specified under this section for a period of 20 working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative:

A. Rig the MCC assembly into final location and install on level surface.
B. Check all removable cells and starter units for easy removal and insertion.
C. Perform insulation tests on each phase and verify low-resistance ground connection on ground bus.
D. Connect all power wiring and control wiring and verify basic operation of each starter from control power source.
E. Torque all bolted connections made in the field and verify all factory bolted connections.
F. Calibrate any control relays (Power Control Relays and SCADA Control and Indication Relays) for their intended purpose and make written notations of adjustments on record drawings. Perform startup of any solid-state starters.

The Contractor shall provide three copies of the manufacturer's field startup report.

Manufacturer's Certification

A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations. Equipment shall be inspected prior to the generation of any reports.

The Contractor shall provide three copies of the manufacturer's representative certification.

Training

The Contractor shall provide a training session for up to 20 State employees for 5 workdays at the jobsite or other office location chosen by the owner.

The training session shall be conducted by a manufacturer's qualified representative.

The training program shall consist of the following:

A. Review of the MCC one-line drawings and schedules
B. Review of the factory record shop drawings and placement of the various cells
C. Review of each type of starter cell, components within, control, and power wiring
D. Review contactor coil replacement and contact replacement procedures
E. Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program
F. Provide three-ring binders to participants complete with copies of drawings and other course material covered.

Examination

The Contractor shall fully inspect shipments for damage and report damage to manufacturer and the Engineer.

Overload relay heater ratings must be properly sized and coordinated for each motor starter unit.

The Contractor shall verify NEC clearances prior to installation of equipment. Verify UL labeling of the assembly prior to installation.

Installation

The Contractor shall follow the installation instructions supplied by the manufacturer.

The control wiring shall be as shown on the plans except as modified by the approval and submittal process. Interface all local and remote devices into the control wiring and operational systems for each load.

Field Adjustment

Follow the manufacturer's instructions and these special provisions concerning any short-circuit device settings as specified under the "Short circuit, Protection, and Coordination study", heater selection, timing relays, or startup of components.

Field Testing

Follow the minimum requirements as stipulated in the NETA testing procedure for this type of motor control center assembly.

Generate a field report on tests performed, test values experienced, etc., and make available to the Engineer upon request.

SOFT START CONTROLLER

The Soft Start Controller shall be solid state reduced voltage motor controller that shall meet the following specifications.

GENERAL

Scope of work

The Soft Start Controller are for use with NEMA Design B, AC motors to reduce the current in-rush as well as mechanical shocks that can result from starting or stopping a motor across the line.

Quality Assurance

The electronic "Soft Start Controller" shall be listed by an independent testing laboratory in accordance with UL 508 - Industrial Control Equipment.

The Soft Start Controller shall carry the CE mark for indication of compliance to low voltage and EMC directives in accordance with EN / IEC 60947-4-2.

The manufacturer shall be a certified ISO 9002 facility.

Warranty

An eighteen-month warranty shall be provided on materials and workmanship from date of invoice.

PRODUCT

General Description

The Soft Start Controller shall utilize an SCR bridge consisting of at least two SCRs per phase to control the starting and stopping of industry standard motors.

The Soft Start Controller shall provide torque control for linear acceleration independent of motor load or application type without external feedback. The gating of the SCRs will be controlled in such a manner to ensure stable and linear acceleration ramp.

The Soft Start Controller shall be controlled by a microprocessor that continuously monitors the current and controls the phasing of the SCRs. Analog control algorithms shall not be allowed.

All soft starter power ratings will utilize the same control board/module.

Motor Data

The Soft Start Controller for MCC No.1 shall be designed to operate a NEMA design B motor with a nameplate rating of 150 horsepower, rated for 210 A continuous at 460 V ±10 percent.

The Soft Start Controller for MCC No.2 shall be designed to operate a NEMA design B motor with a nameplate rating of 100 horsepower, rated for 140 A maximum continuous at 460 V ±10percent.

Ratings

The Soft Start Controller shall be designed to operate in an ambient temperature 14 °F to 104 °F. For ambient temperatures between 104 °F and 140 °F, de-rate the current by 2 percent per °F above 104 °F.

Storage temperature range shall be -13 °F to 158 °F.

Maximum relative humidity shall be 95 percent, non-condensing or dripping water, conforming to IEC 60947-4-2.

The Soft Start Controller shall be designed to operate in altitudes up to 3300 ft. For higher altitudes, de-rate by 2.2 percent for each additional 330 ft with a maximum of 6600 ft.

The Soft Start Controller shall be capable of operation between ±10 percent of nominal voltage rating.

The Soft Start Controller shall automatically adapt for operation at 50 or 60 Hz, with a frequency tolerance of ±5percent. By configuration, it will have to be capable of operation at a supply line frequency that can vary by ±20percent during steady state operation.

The Soft Start Controller shall be capable of supplying 400 percent of rated full load current for 23 seconds at maximum ambient temperature. The soft starter shall also be capable of 10 evenly spaced starts per hour at 400 percent of full rated current for 12 s per start.

The SCRs shall have a minimum PIV rating of 1800 V(ac). Lower rated SCRs with MOV protection are not acceptable.

Adjustments and Configurations

All programming/configuration devices, display units, and field control wiring terminals shall be accessible on the front of the control module. Exposure to control circuit boards or electrical power devices during routine adjustments is prohibited.

Digital indication shall provide, as a minimum, the following conditions:

A. Soft Start Controller status - ready, starting/stopping, run.
B. Motor status - current, torque, thermal state, power factor, operating time, power in kW.
C. Fault status - Motor thermal overload, soft starter thermal fault, loss of line or motor phase, line frequency fault, low line voltage fault, locked rotor fault, motor underload, maximum start time exceeded, external fault, serial communication fault, line phase reversal fault, motor overcurrent fault.

The Soft Start Controller must be preset to the following for adjustment-free operation in most applications:

A. Linear (torque-controlled) acceleration ramp of 15 s.
B. Current limitation to 400 percent of the motor full load current rating.
C. Class 10 overload protection.
D. Motor current preset per NEC / NFPA 70 table 430.150 for standard hp motors.

A digital keypad shall be utilized configure the following operating parameters as required:

A. Motor full load amperes adjustable from 40 to 130 percent of the Soft Start Controller's rating.
B. Current limitation on starting adjustable from 150 to 700 percent of the motor current rating, not to exceed 500percent of the Soft Start Controller rating.
C. Linear (torque-controlled) acceleration ramp adjustable from 1 to 60 s.
D. Initial torque adjustable from 10 to 100 percent of nominal motor torque.
E. Torque limit adjustable from 10 to 200 percent of nominal motor torque.
F. Maximum start time adjustable from 10 to 999 s.
G. Voltage boost adjustable from 50 to 100 percent of the nominal supply voltage.
H. Selection of freewheel, soft stop or braking.
I. Linear (torque-controlled) deceleration ramp time adjustable from 1 to 60 s.
J. Threshold to change to freewheel from a controlled deceleration ramp to freewheel stop: adjustable from 0 to 100 percent of the nominal motor torque.
K. Braking torque level adjustable from 0 to 100 percent effectiveness.
L. Selection of Class 2, 10, 10A, 15, 20, 25 or 30 motor thermal overload protection.

A digital keypad shall be utilized configure the following controller parameters as required:

A. Selectable automatic reset operation.
B. Cancellation of the torque control loop for multi-motor installations.
C. Adjustment of the stator loss estimation for specialty motors.
D. Assignment of Soft Start Controller inputs and output control terminals.
E. Activation of line phase reversal protection.
F. Reset of motor thermal state.
G. Return to factory settings.
H. Activation of test mode for use with low power motors.
I. Indication of elapsed time in hours of starting, running and stopping.

Output relays shall provide the following status indications:

A. One Form A normally open (NO) minimum for indication of fault.
B. One Form A NO for indication that acceleration ramp is complete and current is below 130 percent motor FLA (end of start).
C. One Form A NO assignable to one of the following functions: motor thermal alarm, motor current level alarm, and motor underload alarm.

Additional inputs and outputs shall be available to provide the following status indications:

A. Two assignable control inputs for the following functions: force to freewheel stop, external fault input, disable serial link control, external motor overload reset or general fault reset.
B. Two assignable logic-level signal outputs for the following functions: motor thermal overload alarm, "motor powered" signal, motor overcurrent alarm, or motor underload alarm.
C. One analog output shall be available for 4 to 20 or 4 to 20 mA indication of motor current, motor torque, motor power, motor thermal state, or power factor.

Relay and I/O functions listed above must be isolated with respect to common.

PROTECTION

A microprocessor-based thermal protection system shall be included which continuously calculates the temperature-rise of the motor and Soft Start Controller and provides:

A. A motor overload pre-alarm that indicates by relay contact or logic output that the motor windings have exceeded 130 percent of its rated temperature rise. This function shall be for alarm only.
B. A motor overload fault will stop the motor if the windings have exceeded 140 percent of temperature-rise.
C. An electronic circuit with a time-constant adjustable to the motor's thermal cooling time-constant ensuring the memorization of the thermal state even if power is removed from the Soft Start Controller.

The Soft Start Controller shall provide line and motor phase loss, phase reversal, underload, stall, and jam protection.

The integral protective features shall be active even when the shorting contactor is used to bypass the SCRs during steady state operation.

COMMUNICATIONS

The Soft Start Controller will have to include a multidrop serial link for its direct connection to Modbus.

The Soft Start Controller shall be able to be connected to Ethernet and other networks, with connection to communication bus as an option.

The communication shall be able to provide access to the control, to the adjustment and to the supervision of the Soft Start Controller.

EXECUTION

Installation

The Soft Start Controller shall be installed inside the Motor Control Center; per the manufacturer's specifications of the Soft Start Controller.

A standard wiring diagram shall be included for making the appropriate electrical connections.

Start Up

The services of a qualified manufacturer's service representative shall be available to install, test, and start up all Soft Start Controllers with the motor control centers furnished under this specification.

POWER SUPPLY AND BATTERY CHARGER

The power supply and battery charger shall be a microprocessor-controlled float battery charger for Nickel-Cadmium batteries; and shall be able to operate a DC load with or without batteries connected to it. The power supply and battery charger shall meet the following specifications:

GENERAL

Input Voltage:	1. Field-Adjustable to 120/208/240 V(ac) at 60 Hz single phase. 2. Shall be set to 240 V(ac)
Output Voltage:	130 V(dc)
Max Output Current:	20 A(dc)
Floating Charge Voltage:	134 V(dc) which shall be set by the Contractor.

The power supply and battery charger shall provide a continuous regulated DC output derived from an AC source. The output shall be suitable to maintain the battery in a fully charged state, while supporting any additional DC loads as defined in the plans. The power supply and battery charger shall have the ability to automatically or manually provide an equalizing charge as required for recharging the battery after discharge.

The power supply and battery charger shall have microprocessor technology to control and define all critical operational, calibration, regulation and functions.

OPERATION

The power supply and battery charger shall automatically determine the appropriate DC output, in terms of either voltage or current required for maintaining the battery and load either by pre-programming or in-field re-programming, via the touch panel controls.

The power supply and battery charger shall automatically know and respond to any alarm and remote sensing as specified in this section of the special provisions that are installed according to the manufacturer's instructions without further operator action.

The batter charger shall display, via an one percent digital display and associated LED indicators, all functions important to operation.

During float operation, the digital display shall alternate between DC voltage and DC current indications as designated by the appropriate LED being lit for the respective indication.

During equalize operation, the digital display shall alternate between DC voltage and DC current indications as designated by the appropriate LED being lit for the respective indication. If the power supply and battery charger is employing a timer, either automatic or manual the LED indicators shall indicate timer function while the Digital display indicates the hours remaining for equalize charge. Also, when in either the automatic or manual modes of the equalize cycle, the time limit shall be between zero and 255 hours, set by the controls.

Error and message codes, indicating certain self-diagnostic anomalies and operating conditions shall be indicated by the digital display, as required.

PROTECTIVE DEVICES

The power supply and battery charger shall employ a circuit breaker for the AC input and the DC output protection.

AC input transient over voltage protection shall be accomplished via a MOV (Metal-Oxide Varistor) on the AC input terminals.

DC external transient over voltage protection shall be via a MOV on the DC bus. This shall be located on the output terminals of the power supply and battery charger.

The power supply and battery charger shall be protected against damage in the event that the battery is connected in reverse. The maximum reverse current from the battery when the AC input power fails shall be 90 mA.

ANSI C37.90-1978 shall define the protection from oscillatory surges (SWC). The power supply and battery charger shall operate correctly during and after application of oscillatory surges.

Output current limit shall be adjustable from 50 percent to 110 percent of the rated output current.

The power supply and battery charger shall protect itself from a short circuit in the output side electronically so as to limit the current output. When the short is corrected the power supply and battery charger shall automatically return to normal charger operation. During a short circuit of the output an error code shall be provided as indication. The error code shall be removed when output voltage rises above 2.0 V(dc).

Upon application of AC mains, the power supply and battery charger output shall increases over a period of approximately four seconds to full power, or to a lesser amount as demanded by the load.

CONTROLS AND ADJUSTMENTS

The following controls shall be located on the front panel, using touch sensitive switches to initiate all adjustments:

A. Charge mode key (selects float or equalize mode).
B. Equalization method key (selects timer method, manual, automatic, or manual timer).
C. Edit/Enter key (initiates changes in the power supply and battery charger parameters).
D. Meter mode key (selects Volts, Amperes, Hours, or Alternating Display).

E. Up Key (increases parameter value in Edit mode).
F. Down key (decreases parameter value in Edit mode).
G. AC circuit breaker.
H. DC circuit breaker.
I. Lamp test key.

The following shall be the voltage adjustment ranges for the float voltage, the equalize voltage, the high DC voltage alarm, and the low DC voltage alarm:

Float Voltage Range:	From 110 V(dc) to 141 V(dc)
Equalize Voltage Range:	From 117 V(dc) to 143 V(dc)
High DC Voltage Alarm Range:	From 120 V(dc) to 175 V(dc)
Low DC Voltage Alarm Range:	From 80 V(dc) to 141 V(dc)

INDICATORS

Standard front panel indicators shall include the following:

A. Digital Meter: one percent accuracy, four digit, and seven segment.
B. The digital meter shall indicate the following:

1. DC Volts.
2. DC Amperes.
3. Equalize hours remaining.
4. Error and Message codes.

C. DC Volts Meter indicator (red LED).
D. DC Amperes Meter indicator (red LED).
E. Equalize Hours Remaining indicator (red LED).
F. AC On indicator (green LED).
G. Float Mode indicator (green LED).
H. Equalize Mode indicator (yellow LED).
I. Manual Equalize Timer indicator (yellow LED).
J. Manual Equalize indicator (yellow LED).
K. Automatic Equalize indicator (yellow LED).
L. Standard Front Panel Primary Alarm indicators shall include the following:

1. High Voltage DC Alarm indicator (red LED).
2. Low Voltage DC Alarm indicator (red LED).
3. DC Output Failure Alarm indicator (red LED).
4. Positive Ground Fault indicator (red LED).
5. Negative Ground Fault indicator (red LED).
6. AC Failure Alarm indicator (red LED).

DC OUTPUT METER RANGES

The following shall be the DC output meter ranges for the DC voltage, and DC ampere ranges:

Voltage Range:	From 0 V(dc) to 195 V(dc)
Ampere Range:	From 0 A(dc) to 30 A(dc)

CURRENT LIMIT

The current limit shall be factory set at 110 percent of rated DC ampere (20 ADC). This shall also be the limit available from the power supply and battery charger. Field adjustments may be made over a range from 50 percent to 110 percent of rated DC ampere (20 ADC). The current limit shall be displayed directly in amperes and is adjustable in 0.01 A increments.

PARALLEL OPERATION

The power supply and battery charger shall be able to operate in parallel with two or more power supply and battery chargers with the same DC voltage rating of 130 V(dc), and random load sharing.

ENVIRONMENT

Audible Noise (Ave for four sides, 1.5 M from the PS & BC):	Less than 62 dB (A)
Cooling:	Natural Convection
Operating/Storage Ambient Temperature:	From 0 ºC to 50 ºC/From -40 ºC to 70 ºC
Elevation:	1000 M without derating
Relative humidity:	From 0 to 95 percent non-condensing

CONSTRUCTION

Input and output shall employ 10-32 stud terminals with solderless compression terminals, accepting No. 12 to No. 6 AWG copper or aluminum wire.

Alarm function terminals shall be a compression terminal block, accepting No. 22 to No. 14 AWG copper or aluminum wire.

The alarm relay contact rating 0.5 A resistive at 120 V(ac)/125 V(dc).

The power supply and battery charger shall have a 1/8" (D) x 1" (H) x 8" (W) copper bus for a ground pad with one (1) solderless compression terminal, accepting No. 14 to No. 2 AWG copper or aluminum wire installed inside the charger.

The enclosure shall be18 gauge steel for the outer skin, 16 gauge steel for the door and 14 to 16 gauge steel for the chassis. The enclosure shall have a minimum of four 1.31" (in diameter) right side knockouts, two 1.31" (in diameter) top knockouts, and two 1.31" (in diameter) bottom knockouts for conduits.

The finish of the enclosure shall be ANSI-61 gray, baked powder epoxy.

COATINGS

The power supply and battery charger shall have an anti-static coating for the circuit boards inside the power supply and battery charger in order to eliminate static discharge. The following shall be how the preparation and finish coating of the anti-static coating for the circuit boards inside the power supply and battery charger:

Preparation

Mask off customer electrical terminals, circuit board connectors and terminals, and all aluminum electrolytic capacitors. Clean all surfaces to be spayed.

Finish Coating

A. Use one or more power supply and battery charger manufactures approved anti-static coating hand held spray.
B. Application Method: Hand held spray in well-ventilated area so as to coats all components other than those masked. Repeat as necessary to coat all components to achieve a minimum thickness of 0.001".
C. Curing Method: Air dried for 1 hour.

SERVICEABILITY

The power supply and battery charger shall be serviceable by a technician using standard hand tools.

ALARMS, SELF-DIAGNOSTICS AND ERROR CODES

The power supply and battery charger shall be capable of automatic self-diagnostics, and indicate any anomaly by means of an error code on the display. Error and message code definitions shall be posted within the power supply and battery charger.

Primary alarms for the power supply and battery charger shall provide an alarm sensing capability for all the following:

A. High Voltage DC alarm indicator (red LED).
B. Low Voltage DC alarm indicator (red LED).
C. DC output failure alarm indicator (red LED).
D. Positive ground fault indicator (red LED).
E. Negative ground fault indicator (red LED).
F. AC failure alarm indicator (red LED).

Summary alarm contact, one form-C shall be use for the DC power system alarm.

CONTROL PANEL

The control panel for the power supply and battery charger shall be a touch sensitive type, permanently laminated for protection, thereby eliminating the need for engraved functional nameplates.

DOCUMENTATION

Standard drawings, consisting of an outline, internal layout, and schematic and wiring diagrams shall be provided.

The manufacturer of the power supply and battery charger shall provide certified test data on the power supply and battery charger to the Engineer.

A manual, completely describing the installation, operation, and maintenance of the charger along with all accessories and options shall be included with power supply and battery charger. The power supply and battery charger shall have for storing the manual in a convenient permanent pocket.

FILTERS

The power supply and battery charger shall included the following filters installed in the power supply and battery charger:

A. DC Output Filter.--Consisting of one inductor and a one or two section capacitor capable of limiting the output ripple with battery connected to 100 mV(rms) when measured at the battery terminals in accordance with NEMA PE5.
B. Battery Eliminator Filter.--Consisting of one or more capacitors in addition to the capacitors installed for the DC output filter to be installed within the power supply and battery charger enclosure. The filter shall reduce the output ripple voltage to 100 mV(rms) when measured at the power supply and battery charger terminals.

VOLTAGE REGULATION AND TRANSIENT RESPONSE

The power supply and battery charger output voltage regulation shall be +0.25 percent for the following conditions:

Input Voltage Regulation:	From -12 percent to +10 percent
Output Load Regulation:	From 0 to 100 percent of full load
Temperature Range:	From 0 ºC to 50 ºC
Frequency:	60 Hz + 3 Hz

The power supply and battery charger transient response for 20 percent to 100 percent load changes with the battery connected to the power supply and battery charger shall be the following:

Output Voltage Change:	+4 percent Maximum
Recovery to:	+2 percent in 200 ms
Recovery to:	+0.5 percent in 500 ms

REMOTE SENSING

The power supply and battery charger shall provide the following remote sensing:

A. Remote voltage sensing shall be supplied at the battery terminals using shield twisted pair conductor cable as shown on the plans.
B. Temperature compensation for the charging of the batteries via a remote temperature compensation probe. The power supply and battery charger shall have an automatic probe failure detection and fail-safe control override for the probe.

ERROR CODES

Error codes as indicated on the front panel, shall determine certain malfunctions as section of an integral microprocessor controlled self-diagnostic system. The error codes shall appear in the digital display as an alphanumeric indication beginning with the letter “E” followed by a number code, which reveals the problem being identified. Error code definitions shall be posted inside the access door to the charger and shall be listed in the manual. Certain codes, preceded by the letter “A” are provided to indicate special operating conditions.

FAIL SAFE OPERATION

The power supply and battery charger shall include fail-safe features that are a separate circuit from the micro controller to detect a low dc voltage condition and enable the common alarm on the main board to change state. This uniquely protects the battery due to a failure of the microprocessor.

MISCELLANEOUS

The power supply and battery charger shall have physical dimensions not to exceed 20" wide, 15" deep, and 20" high.
Mean Time Between Failure: 100,000 hours or longer
Security: Padlock for front panel with two keys.

BATTERIES

The Contractor shall provide thirty-seven 119 Ampere-hour (Ah) Gas-Recombination type Nickel-cadmium (Ni-Cd) pocket plate constructed celled batteries rated at 3.6 V(dc) each that shall be compatible with the power supply and battery charger and use for substations. The batteries shall be connected in series for a total voltage of 133.2 V(dc), and the 133.2 V(dc) series leads conductors of the batteries shall be connected to the equipment of the DC power system for switchgear shown on the plans. Finally, each battery shall meet the following specifications:

Ratings:

Number of Cells per battery:	3 Cells
Nominal Voltage (dc) per cell:	1.2 Volts per Cell
Minimum Voltage during discharge per cell:	1.0 Volts per Cell
Maximum Voltage per cell:	1.425 Volts per Cell
Battery Rated Voltage:	3.6 V(dc)
Nominal ampere-hour (AH) capacity:	119 ampere-hours

Construction:

A. Plate Material: Nickel-Cadmium (Ni-Cd).
B. Cell Technology: Gas-Recombination Pocket Plate Technology.
C. Battery and Cell Case: High Impact Translucent Polypropylene.
D. Battery and Cell Lids shall be heat welded to the Cases.
E. Cell Markings: Maximum and minimum electrolyte level marks shall be permanently marked on two sides of each cell of the battery.
F. Terminal Markings: The positive and negative terminals shall be clearly and permanently marked using appropriate colors.
G. Microporous plate separators shall be plastic grids, providing plate edge insulation.
H. Electrolyte material shall be potassium hydroxide (KOH) with a small amount of lithium hydroxide (LiOH). The concentration shall permit operation from –40 ^{o}F to 140 ^{o}F.
I. Specific gravity of electrolyte shall be from1200 to 1250.
J. Terminal posts for each cell the battery shall be fitted with durable O-ring seals under permanent pressure to prevent electrolyte leakage. Terminal posts shall be nickel plated and welded to the plate groups.
K. Cell connection bolts per pole shall be M10 size.
L. Vents for the battery, one vent for each cell, shall be of spring loaded flip-top construction for easy opening and closing. Vents shall be fitted with low-pressure flame arresters.
M. Dimensions for the battery shall not to exceed: 18" (H) x 8" (W) x 8" (L).
N. Other Cell and Battery Parts:

1. Steel parts and plates shall be welded and not bolted, to provide lowest internal resistance.
2. Intercell connections or connectors of the battery shall be pure copper with nickel plating. The intercell connectors shall be included and the cells of the battery shall be connected in series for a total voltage of 3.6 V(dc).
3. Plastic covers shall be provided and used over the connectors.

O. Manufacturer Quality: The battery shall be manufactured under a strict ISO 9001 regime. The highest quality materials and rigorous quality checking procedures ensure all relevant international standards shall be met, such as but not be limited to IEC 60623 and IEC 62259.
P. Safety requirements shall meet EN 50272-2 with IP2 Level.

BATTERY RACK

The Contractor shall provide one battery rack for the 37 batteries. The Contractor shall install the batteries on the rack and connect the batteries as specified. Also, the battery rack shall be made for the batteries and meet the following specifications and including the accessories and work specified below:

Type of Rack

Tier:	Two Tier
Number of Steps:	Two
Seismic Rating:	UBC and CBC Zone 4

Construction

Rack shall be constructed of phosphatized steel with a coat of powder epoxy acid resistant end frames and powder-coated polyethylene.

Dimensions

Height (Not to exceed)	11'
Width (Not to exceed)	3'
Length (Not to exceed)	7'

Shipping

The rack shall be shipped in knocked down form.

Accessories

The following shall be the accessories included with the rack and work for the rack:

A. Thermometer.
B. One complete set of nickel-plated pure copper inter-battery hardware, interstep cable as specified in the special provisions with connectors and nuts and bolts.
C. One set of insulated wrenches shall be use to install and connect the batteries.
D. One set of 111 cell numbers. The cell numbers shall be neatly label on each cell of the batteries from 1 to 111 starting from left to right facing the rack on the bottom ten batteries of the rack and from right to left facing the rack on the top seven batteries of the rack.
E. Anti-corrosion compound shall be use for the connection of the batteries.
E. "No smoking" sign shall be provided and installed near the batteries.
F. Portable eyewash shall be provided and installed near the batteries.
G. One complete set of bolts for attaching the rack against the wall and on the concrete pad. The rack shall be install per manufacture recommendation against the wall and on the concrete pad shown on the plans with the complete set of bolts.
H. Overall protective covers for the batteries, one cover per step to cover all of the batteries in each step shall be provided with access to the terminal ports to connect the batteries to the DC power system for switchgear shown on the plans and the interstep connections of the batteries.

INVERTER

The inverter shall be a continuous duty, on-line 5 kVA 130 V(dc) in which DC power is converted to 120 V(ac) (clean, and conditioned) single-phase AC power inverter. The inverter shall meet the following specifications:

A. General:

kVA Rating:	5
Phase:	1
AC Output Voltage:	120
Load Power Factor:	0.8
DC Input Volts:	From 105 to 140

B. Applicable Standards, Codes and Regulations.--Unless noted otherwise, the design, fabrication, testing, and performance of the inverter shall be in accordance with the standards and codes, where applicable, of the following agencies:

National Electrical Manufacturers Association (NEMA)
American National Standards Institute (ANSI)
National Electric Code (ANSI/NFPA 70-1993)
Institute of Electrical and Electronic Engineers (IEEE)
International Electrotechnical Commission (IEC)

C. Environmental Conditions:

1. Operating Temperature.--The inverter shall operate at rated output without any adverse affects in an ambient temperature of from 32 °F to 104 °F, except batteries.
2. Relative Humidity.--The inverter shall operate at a relative humidity range from 5 percent to 95 percent non-condensing over the temperature range from 50 °F to 104 °F.
3. Operating Altitude.--The inverter shall operate at any altitude from sea level up to 8,200 foot above sea level without derating.

D. System description.--The inverter shall consist of the following major components:

Static Inverter (Single Phase Output)
Static Transfer Switch (Zero break)
Manual Bypass Switch (Zero break)
Manual Bypass Switch
Bypass transformer (Regulated)

E. System Operation:

1. Normal.--The critical load is continuously supplied by the inverter, with isolated, regulated AC voltage. The inverter output shall be in phase with the bypass source. If the bypass source deviates more than ±0.5 percent of (50 Hz or 60 Hz) the inverter output shall run on its own internal oscillator until the reference source returns to within acceptable limits.
2. Low DC Disconnect.--When the battery voltage reaches 105 V(dc) for 5 seconds, the inverter shall automatically transfer the load to bypass and disconnect the battery via a shunt trip in the breaker to prevent damage to the batteries.
3. Bypass.--During an overload or load fault, at the inverter output, the static switch shall automatically transfer the load to commercial power (transfer point factory set at 120 percent of rated load) without interruption.
4. On clearing an inverter malfunction, fault or overload condition, the static transfer switch shall automatically transfer the UPS load from the bypass to the inverter output. The transfer from both directions shall be without interruption (zero-break). A static switch transfer can only be accomplished when the inverter output is in sync with the bypass source (except during inverter failure).
5. Transfer to the bypass may also be accomplished manually by the Bypass to Load push button without interruption. This shall lock out the auto retransfer function.
6. Upon the deterioration or failure of the inverter bridge output load to bypass without any interruption.
7. Load Transfer.--Pressing the "Bypass to Load" push button while the inverter is supplying the load, the static switch shall transfer the load to the bypass source if the bypass source is available and it is in sync with the inverter. The operation of the "Inverter to Load" push button is the same as the "Bypass to Load" push button except it transfers the load to the inverter.
8. Manual Bypass.--During maintenance, the inverter may be bypassed without interruption to the load for ease of inspection. A regulated , non current limited, bypass transformer shall be furnished.

F. Static Inverter:

1. General.--The static inverter shall be a ferroresonant type, which generates single phase AC power. The inverter shall be capable of providing continuous and uninterruptible output power while operating from any DC source within the operating input range.
2. The inverter bridge shall use power transistors, and Insulated Gate Bipolar Transistors, (IGBT's) to generate the square wave input for the ferroresonant transformer.

3. Output Voltage.--The inverter's output circuit shall be magnetically isolated from the input circuit and be supplied with a convenient means of grounding or ungrounding the inverter's output.
4. The inverter's output voltage shall be maintained for at least 1/2 cycle during an input bridge failure to insure a zero-break static transfer to the bypass source.
5. The inverter's output voltages shall be supplied in standard (50 or 60) Hz values.
6. Input Voltage.--The DC input voltage shall range from 105 V(dc) to 140 V(dc) while maintaining the specified output voltage.
7. Voltage Regulation.--The inverter steady state output voltage regulation shall not change more than ±2 percent under any of the following conditions:

   a. From 0 to 100 percent load change and from 100 percent to 0 load change.
   b. Minimum to maximum DC bus voltage.

8. Frequency Regulation.--The free-running, steady state output frequency of the inverter shall not deviate more than 0.1 percent due to the following conditions:

   a. From 0 percent to 100 percent load.
   b. Minimum to maximum ambient temperature.
   c. Minimum to maximum DC bus voltage.

9. Frequency Control.--The output frequency of the inverter shall be controlled by a crystal controlled oscillator, which can be operated as a free-running unit or as a slave for synchronized operation with a separate AC source. The inverter shall track the AC reference source provided it is 50 ±0.5 percent Hz or 60 ±0.5 percent Hz. Upon failure or excessive frequency deviation of the reference the oscillator shall automatically revert to its free-running mode.
10. Load Power Factor.--The inverter shall be capable of handling linear loads from 0.8 pf to 1.0 pf while maintaining a ±2 percent regulation and non- linear loads (switch-mode power supplies) with a power factor range from 0.7 pf to 1.0 pf.
11. Harmonic Distortion.--The inverter shall limit the total harmonic distortion of the output voltage to less than 5 percent RMS total with a 100 percent linear load or less than 7.5 percent THD with a 100 percent switch-mode type load.
12. Crest Factor.--The inverter shall be capable of supplying non-linear loads exhibiting a crest factor of up to 3.0 at full load without additional filtering or increasing the size of the inverter.
13. Slew Rate.--The inverter frequency rate of change shall not exceed 1 Hz/s when synchronizing to the bypass reference.
14. AC Transient Response.--The inverter voltage transient response shall not exceed from +8 percent to -10 percent due to a 100 percent-50 percent or 50 percent-100 percent step load change. During a 100 percent step load the maximum deviation shall be 23 percent for the first half cycle.
15. AC Transient Recovery.--The output voltage, following the step load changes listed above, shall return to within ±2 percent of the steady state output voltage within 50 ms.
16. Overload Capability.--The inverter shall be capable of supplying loads up to 120 percent of the rated load for 10 seconds without transfer to the bypass. The inverter shall current limit at approximately 175 percent and supply up to 500 percent rated current for approximately one cycle.
17. Over Temperature.--Upon heat sink over temperature, the U.P.S. shall automatically transfer the load to the bypass source. If the over temperature occurs for more than 60 seconds, the DC/battery input breaker shall trip protecting the bridge from damage. Manual retransfer of the load o the inverter shall be permitted when the temperature returns to normal.
18. DC Input Transient.--The DC input shall include an input filter to suppress externally generated DC transients and to control inverter switching transients at the battery. Filtering shall be designed to suppress a transient of 4000 volts, with a 10 µs duration, occurring at the inverters DC input terminals.

G. Static Transfer Switch:

1. General.--The static transfer switch shall be a naturally commutated, high speed transfer device provided as an integral part of the U.P.S. The control of the unit shall provide an automatic or manual uninterrupted transfer of the load to the bypass.
2. The static transfer switch shall use inverse parallel connected 600 volt silicon controlled rectifiers with an ampacity suitable to carry ten times the inverter's capacity for one cycle.
3 Operation.--The static transfer switch shall automatically connect the bypass source to the critical load and have the following features:

a. Uninterrupted Transfer.--The static switch shall automatically transfer the critical load after the control logic senses one of the following conditions:

   i. Inverter Failure.
   ii. Inverter Overcurrent.
   iii. Inverter Output Over/Under Voltage (±10 percent) >16 ms.
   iv. Low DC Disconnect.
   v. Manual Transfer via front panel push button.

b. Uninterrupted Automatic Retransfer.--If the transfer control switch is set for automatic retransfer, the control circuit shall be capable of retransferring the critical load to the inverter output when the overload is removed and the inverter output is within specification.
c. Uninterrupted Manual Retransfer.--If the transfer control switch is set for manual retransfer, upon manual command the critical load shall be transferred to the inverter.
d. Transfer Lockout.--The transfer logic shall not allow a transfer to the bypass source if one of the following conditions exist:

   i. Bypass source out of sync with inverter output, except for upon inverter failure or low DC disconnect.
   ii. Bypass source not available.

4 Transfer Time.--The transfer time of the static transfer switch shall be zero, resulting in an uninterrupted flow of power to the inverter loads.
5 Transfer Point.--The static switch current sense transfer point shall be adjustable from 100 percent to 125 percent, factory set at 120 percent. The current sense shall be designed to prevent premature switching of the static switch with high crest factor loads.
6 Auto-retransfer Defeat.--An internal switch shall be provided to defeat the automatic retransfer of the static switch after a transfer to the bypass source. Shipment setting for the unit shall be OFF (i.e. auto-retransfer not activated).
7 Design.--The static switch shall be designed to fail over to the bypass source. An independent watchdog circuit shall be provided to insure static switch transfer to bypass upon microprocessor failure.

H. Manual Bypass Switch.--A manually operated mechanical bypass switch shall be provided to facilitate the inverter maintenance. In the bypass position, this switch and the static switch input breaker shall isolate the static switch from the bypass source and connect the output directly to the bypass power source.

The manual bypass switch shall be mounted in the inverter enclosure to reduce interconnect wiring.

The manual bypass switch shall be of a "Make-Before-Break" configuration to ensure absolute continuity of AC power to the critical UPS loads during switch over.

The manual bypass switch shall not require the assistance of the static switch to insure a zero break load transfer.

I. Accessories:

1. Controls.--All controls specified below shall be accessible on the front panel unless otherwise noted:

   a. Inverter to Load.--A lighted momentary push button shall be provided to transfer the load to the inverter source.
   b. Bypass to Load.--A lighted momentary push button shall be provided to transfer the load to the bypass source.

2. Indicator Lights and Alarms.--The inverter shall be equipped with the following equipment:

   a. Indicators shall be front replaceable long life LED's.
   b. A form "C" contact (SPDT) rated 3 A at 120 V(ac)/28 V(dc) shall be furnished for each specified alarm.
   c. Battery Supplying Load.--An indicator (Red) and alarm contact shall be provided to indicate when the battery is supplying load. The relay shall be normally energized.
   d. Bypass Source Failure.--An indicator (Red) and alarm contact shall be provided to indicate when the bypass source has failed. The relay shall be normally energized.
   e. Inverter Supplying Load.--An indicator (Amber) shall be provided to indicate when the inverter is powering the load.
   f. Fan Failure.--An indicator (Red) and alarm contact shall be provided when any fan has failed. The relay shall be normally deenergized.

g. In Sync.-- An indicator (Green) shall be provided when the internal oscillator of the inverter is synchronized to a bypass reference source that is within 50 Hz ±0.5 Hz or 60 Hz ±0.5 Hz.
h. Static Switch Transfer.--An alarm contact shall be provided to sense when the inverter is supplying power to the load. The relay shall be normally energized.
i. Indicators shall be supplied to indicate the position of the static switch.

3. Meters.--At a minimum the front panel shall be equipped with the following 3.5" scale analog meters (2 percent accuracy) for the following functions:

a. Inverter Output Voltmeter.
b. AC Output Ammeter.
c. Inverter Output Frequency Meter (expanded scale).

J. General Requirements:

1. The overall DC to AC efficiency shall be greater than 80 percent with the inverter at full rated load and nominal input voltage.
2. Overload Protection:

a. The overload devices shall not be activated when the inverter is started under any normal operating conditions.
b. Bypass Circuit Breaker.--A front access molded case breaker shall be provided for Bypass disconnection and overload protection. The AIC rating of the breaker shall be 10 kA minimum.
c. Inverter Input Circuit Breaker.--A molded case breaker shall be provided for DC input disconnection of both input lines and overload protection. The AIC rating of the breaker shall be 10 kA minimum.
d. Semiconductor Fuses.--The semiconductors shall be protected from cascaded failure with special fast acting fuses.

3. Audible Noise.--The audible noise generated by the unit under rated operating conditions shall not exceed 65 dBA at 5 feet away from any side of the enclosure and 3 feet above ground. The sound levels shall be measured with the unit operating at rated load, voltage and frequency.
4. Cooling.--Forced-air cooling shall be provided when necessary to ensure that all components are operating at below their specified operating temperature.
5. Wiring.--The PCB (printed circuit board) control wiring will be 22 AWG PVC ribbon cable. Control wires and power wires depending on their ampacity will be either SIS or cross-linked polyethylene. SCI shall utilize NEC, bulletin 70 and NEMA PE-1 and PE-5 wiring procedures. Power wire for all equipment: 10 AWG through 4/0 is Switchboard cable type SIS UL; CSA listed VW-1 90 °C, 600 V, and chemically cross-linked Polyethylene. Control wire 18 AWG through 14AWG for custom inverters is Switchboard cable type SIS UL, CSA listed VW-1 90 °C, 600 V, and chemically cross-linked Polyethylene. Power wire: 262 MCM through 777 MCM for larger sizes of chargers and inverters is DLO 90 °C, 600 V-2000 V Ethylene Propylene Rubber (EPR) inner jacket and a Hypalon outer jacket.
6. EMI Suppression.--Electromagnetic effects shall be minimized to ensure that computer systems, or other similar electronic systems, shall neither adversely affect nor be adversely affected by the inverter.
7. Control Power Supply.--The control logic power supply shall incorporate a parallel redundant concept with the inverter DC input and the bypass as a dual source of logic power, to insure control power at all times.
8. Transformers.--All power transformers or chokes shall be designed using copper windings for reliability and efficiency. The insulation type shall have a temperature rating of at least 200 °C (UL 1446, Class N).
An epoxy based insulating varnish shall be applied with a VPI (Vacuum Pressure Impregnation) system to insure a low temperature rise over the 30 year design life of the transformer.
9. Nameplate Markings.--The nameplate shall be located on the front inside display door and the following minimum information shall be provided on the nameplate:

a. Manufacturer's Name, Model Number and Serial Number
b. Bypass AC Input Voltage, Phase and Frequency
c. DC Input Voltage and Current
d. Rated Output Voltage, Amps, Frequency, Power Factor, kVA and kW.

K. Mechanical Specifications:

1. Enclosure.--The enclosure shall be a NEMA-1(IP-20), free standing, with minimum 12 GA framework. Door panels shall be a minimum of 14 GA steel and side panels shall be a minimum of 18 GA.
   The enclosure shall be mounted on channels with a 3 inch lifting base open at the front and back to facilitate moving with a fork lift and to provide an entrance area for air movement through the enclosure.
   The enclosure shall be designed with blank plates on the sides and rear for installation against a wall. The equipment shall be designed to allow replacement or maintenance of all components from the front.
   One or more hinged doors shall be provided in the front with door locks on each. Hinged panels, 36" and larger, shall be provided with a 2 point latching system for holding the panels securely. Removable covers shall be attached with machine screws.
   Vermin screens shall be provided to prevent the entry of small animals into the inverter cabinets.

2. Ventilation.--Air inlets and outlets shall be protected by screens or perforated metal guards to prevent the entrance of a rod having a diameter of 0.5 inches or longer.
3. Cable Entry.--Cable entry shall be through the top or bottom of the cabinet. On UL units, bottom cable entry is recommended.
4. Power Connections.--The connections to the AC output or DC input shall be of the stud type and shall be sized for full load service.
   Alarm connections shall be sized to allow connection of 12 AWG wire maximum. The alarm terminal boards shall be rated for 300 V(ac).
5. Parts Placement.--The inverter shall be designed to permit front access to modules, fuses, and assemblies. Parts, test points, and terminals shall be placed so they are accessible for circuit checking, adjustment, and maintenance without removal of any adjacent assembly or component or pose a shock hazard.
6. Wire Supports.--Permanent wire supports shall be used, no adhesive backed wire supports shall be used.
7. Wire Marking.--All point-to-point wires shall be marked with a permanent marking system on both ends of each wire.
8. Component Marking.--All PCB's, indicator lights, meters, controls, semiconductors, and fuses shall be clearly marked with the component designation for ease of serviceability.
9. Personnel Safety.--The cabinet shall be constructed so that all controls, except float/equalize, are operable with the doors closed, preventing exposure to high voltage terminals. High voltage warning labels shall be visible when any of the cabinet doors are opened.
10. Painted Surfaces.--All external painted surfaces shall be ANSI 61 Gray enamel with a minimum of 2.0 mil thickness and shall be smooth with no runs, sags, or graininess. All internal mounting plates shall be galvanized.
11. Shop Testing.--The inverter testing shall be in conformance with IEEE 944-1986 section 7.0, and IEC-146-4. Certified test data shall be supplied to verify test results.
    The manufacturer shall have type-test data available to demonstrate Inverter performance with switch-mode type power supplies.
12. Documentation.--Cabinet outline and interconnect drawings shall be dimensioned and scaled, and include the following information:

    a. Location of any removable plates for Owner's conduit entry.
    b. Location and size of all terminal blocks for Owner's connections.
    c. Location and size of ventilation openings.
    d. Location of cabinet grounds.
    e. Block diagram including currents for customer cable sizing, breaker locations and sizes, and meter locations.
    f. Size and weight of equipment.
    g. Front panel identification chart.
    h. Nominal heat loss for the specified equipment.
    i. Schematic type drawings shall include the following information:
    j. Inverter schematics shall include item designations for all electrical components.
    k. Relay contacts diagrams shall be shown in the deenergized position.
    l. Wire sizes and numbers shall have the same designations that appear in the equipment.

L. Preparation for Shipment.--Preparation for shipment shall be in accordance with the manufacturer's standard shipping procedure.

One complete set of instruction books and "as-built" drawings shall be included with the equipment when shipped.

To facilitate site access, shipment of individual cabinets, rather than complete lineups, may be necessary.

SWITCHBOARD

The switchboard shall be a free-standing, deadfront type low voltage distribution switchboard, utilizing group mounted circuit protective devices, feeder circuit breakers, that shall meet the following:

GENERAL

Scope

The Contractor shall install, where indicated, a free-standing, deadfront type low voltage distribution switchboard, utilizing group mounted circuit protective devices, feeder circuit breakers, as specified herein, and as shown on the plans.

References

The low voltage distribution switchboards and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards:

A. NEMA PB-2.
B. UL Standard 891.

Submittals – For Review/Approval

A. The following information shall be submitted to the Engineer:

1. Master drawing index.
2. Front view elevation.
3. Floor plan.
4. Top view.
5. Single line.
6. Schematic diagram.
7. Nameplate schedule.
8. Component list.
9. Conduit entry/exit locations.
10. Assembly ratings including:

    a. Short-circuit rating.
    b. Voltage.
    c. Continuous current.

11. Major component ratings including:

    a. Voltage.
    b. Continuous current.
    c. Interrupting ratings.

12. Cable terminal sizes.
13. Product data sheets.

B. Where applicable, the following additional information shall be submitted to the Engineer:

1. Busway connection.
2. Connection details between close-coupled assemblies.
3. Composite floor plan of close-coupled assemblies.
4. Key interlock scheme drawing and sequence of operations.

Submittals – For Construction

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information.
2. Wiring diagrams.
3. Certified production test reports.
4. Installation information.
5. Seismic certification and equipment anchorage details.

B. The final (as-built) drawings shall include the same drawings as the original construction drawings and shall incorporate all changes made during the manufacturing process.

Qualifications

A. The manufacturer of the assembly shall be the manufacturer of the circuit protective devices within the assembly.
B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement
D. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) through zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5 percent minimum damping factor, CBC: a peak of 2.15g's, and a ZPA of 0.86g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.
E. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards:

1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
3. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

Regulatory Requirements

The low-voltage switchboard shall be UL labeled.

Delivery, Storage and Handling

Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

Operation and Maintenance Manuals

Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PRODUCTS

Ratings

A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current 100,000 amperes symmetrical at 480 V(ac)/277 V(ac).
B. The voltage rating of the switchboard shall be 480 V(ac)/277 V(ac).

Construction

A. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.
B. All sections of the switchboard shall be rear aligned with depth not to exceed 40'. All protective devices shall be group mounted. Devices shall be front removable and load connections front accessible enabling switchboard to be mounted against a wall.
C. The assembly shall be provided with adequate lifting means.
D> The switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

Bus

A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).
B. A full capacity neutral bus shall be provided.
C. A copper ground bus (minimum 1/4 x 2 inch), shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.
D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.
E. The main horizontal copper silver-plated bus shall be connected to a TVSS.

Wiring/Terminations

A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
B. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 °C of the size as shown on the plans.
C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as required.
D. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

Main Protective Device

The main protective device shall be the feeder circuit breaker. The switchboard manufacturer shall install in the switchboard the feeder circuit breaker as shown on the plans and as required for the proper and safe installation and operation.

Feeder Protective Devices

The feeder protective devices shall be the feeder circuit breaker. The switchboard manufacturer shall install in the switchboard the feeder circuit breaker required for the proper and safe installation and operation.

Accessories

The breaker interface unit shall be specified under "Breaker Interface Unit," specified elsewhere in these special provisions. The switchboard manufacturer shall install in the switchboard the breaker interface unit for the proper and safe installation and operation.

Enclosures

NEMA 1 Enclosure.

Nameplates

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.
B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

Finish

All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

Transient Voltage Surge Suppression

The Contractor shall install in the switchboard the transient voltage surge suppression as required for the proper operation.

EXECUTION

Factory Testing

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
B. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one minute between live parts and ground.
C. The manufacturer shall provide three certified copies of factory test reports.

Manufacturer's Certification

A certified test report of all standard production tests shall be available to the Engineer upon request.

Installation

A. The Contractors shall install all equipment per the manufacturer’s instructions and recommendations, these special provisions, the plans, the National Electrical Code, the National Electrical Safety Code, and as directed by the Engineer.
B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to Contractor supplied floor sills to be set level in concrete per manufacturer’s recommendations All necessary hardware to secure the assembly in place shall be provided by the Contractor.

Field Adjustments

A. The Contractors shall perform field adjustments of the protective devices, feeder circuit breakers, as required to place the switchboard in final operating condition. The settings shall be in accordance with the approved report on the protective devices settings from the "System Studies and Field Testing".
B. The Contractor at no additional cost to the state shall perform all necessary field settings of devices and adjustments and minor modifications to the switchboard to accomplish conformance with an approved report on the short circuit fault duty and other information associated with the protective devices from the "System Studies and Field Testing".

SUBSTATION BUILDING TRANSFOMER

The substation building transformer shall meet the following specifications:

Size	100 kVA, Three phase
Input voltage	480 V(ac)
Output voltage	208 V/120 V
Input frequency	60 Hz ±3 Hz
Transformer type	Three phase, computer grade, dual-shielded isolation transformer
Taps	2 – FCAN at 2.5 percent each, 4 – FCBN at 2.5 percent each
Transformer impedance	From 3 Ω to 5 Ω
Efficiency	>96 percent
Harmonic distortion	<1 percent added
Noise attenuation:	
Common-mode Transverse-mode	-120 dB -20 dB/decade. Std.
Overload inrush rating	200 percent for 10 s and 1000 percent for 1 cycle
Operating environment Temperature Humidity Altitude	 From 32 °F to 104 °F From 10 percent to 90 percent RH non-condensing From 0' to 7000'
Storage environment Temperature Humidity	 From -15 °F to 122 °F From 0 percent to 95 percent RH non-condensing

The substation building transformer shall have a secondary surge suppression circuit.

10-3.40 NETWORK COMMUNICATION SYSTEM

The network communication system shall have the communications topology and perform the operations specified, and the Contractor shall perform the required work for, and on the following components of the network communication system specified below:

COMMUNICATIONS TOPOLOGY

A. Rack-mounted Ethernet switch, Ethernet switch and Ethernet router 5-Port switch.

1. The rack-mounted Ethernet switch, the Ethernet switch and Ethernet router 5-port switch shall be configured into 2 VLANs.
2. The first VLAN shall be for the SCADA system components and the tunnel fire alarm control panel.
3. The second VLAN shall be for the CO calibrator and the CO calibration server system use to remotely calibrate, perform instrument testing and diagnostics the CO monitors.

B. SCADA submaster server

1. The SCADA submaster server shall communicate with PAC#1, PAC#2, PAC#3, the tunnel fire alarm control panels, the servers at the Caldecott tunnel and the fire control display station via the Ethernet network first VLAN.

C. CO calibration server

1. CO calibration server shall communicate with the CO calibrator and the CO monitor manufacturer recommended server via the Ethernet network second VLAN.

D. PAC#1, PAC#2 and PAC#3

1. PAC#1, PAC#2 and PAC#3 shall communicate with the SCADA submaster server and the servers at the Caldecott via the Ethernet network first VLAN.
2. Attention is directed to the "Serial Communication System" in these special provisions.

E. Tunnel Fire Alarm Control Panel

1. tunnel fire alarm control panel shall communicate with the SCADA submaster server and the servers at the Caldecott via the Ethernet network first VLAN using Modbus TCP/IP Ethernet protocol.

F. Fire Control Display Station

1. Fire Control Display Station shall communicate with the SCADA submaster server and the servers at the Caldecott via the Ethernet network first VLAN.

G. CO Calibrator

1. CO Calibrator shall communicate with the CO calibration server and the CO Monitor manufacturer recommended Server via the Ethernet network second VLAN.

OPERATION

A. SCADA submaster server

1. The SCADA submaster server shall provide the fire control display station the functions specified under "Fire Control Display Station" of these special provisions.
2. The SCADA submaster server shall provided the ability for the operator for to view the status, alarms, the alarm history, the event history and provide control/reset commands of all operations except for the individual call box operations, shown on the plans and as specified in these special provisions of the tunnel from the KVM Switch of the SCADA submaster server.
3. The SCADA submaster server shall provides the ability for the operator to view only the status, alarms, the alarm history, and the event history of the individual call box operations, shown on the plans and as specified in these special provisions of the Tunnel from the KVM Switch of the SCADA submaster server.
4. The SCADA submaster server shall provide the functions specified in these special provisions under "DATA FUNCTIONS" to the fire control display station and the KVM Switch of the SCADA submaster server.

B. CO calibration server

1. The CO calibration server shall operate the CO Calibrator to remotely calibrate, perform instrument testing and diagnostics the CO Monitors.
2. The CO calibration server shall store the calibration; perform instrument testing and diagnostics data of the CO Monitors.
3. The CO calibration server shall set the Calibration of the CO Monitors to once a month.

C. PAC#1 and PAC#2

1. PAC#1 and PAC#2 shall pass control messages from the SCADA submaster server and the servers at the Caldecott tunnel to the Field Control Stations (FCSs) and data/status messages from the FCSs to the SCADA submaster server and the servers at the Caldecott tunnel.
2. PAC#1 and PAC#2 shall operate as a redundant pair. PAC#1 shall pass control messages from the SCADA submaster server and the servers at the Caldecott tunnel to the FCSs and data/status messages from the FCSs to the SCADA submaster server and the servers at the Caldecott tunnel. When PAC#1 becomes unavailable to pass control messages from SCADA submaster server and the Servers at the Caldecott tunnel to the FCSs and data/status messages from the FCSs to the SCADA submaster server and the servers at the Caldecott tunnel; PAC#2 shall pass control messages from SCADA submaster server and the servers at the Caldecott tunnel to the FCSs and data/status messages from the FCSs to the SCADA submaster server and the servers at the Caldecott tunnel; until PAC#1 becomes available again.
3. PAC#1 and PAC#2 shall provide the functions specified in these special provisions under "DATA FUNCTIONS" to the SCADA submaster server and the servers at the Caldecott tunnel.
4. Attention is directed to the "Serial Communication System" in these special provisions.

D. PAC#3

1. PAC#3 shall pass control messages from SCADA submaster server and the servers at the Caldecott tunnel to the operate the output points that are connected directly to PAC#3 as shown on the plans and data/status messages from the input status points that are connected directly to PAC#3 as shown on the plans to the SCADA submaster server and the Servers at the Caldecott Tunnel.
2. PAC#3 shall provide the functions specified in these special provisions under "DATA FUNCTIONS" to the SCADA submaster server and the servers at the Caldecott tunnel.
3. PAC#3 shall automatically operate the exterior lights (energize the contactor coil "WL" as shown on the plans), when PAC#3 indicates that the PEU is on or the PEU contact is closed.

E. tunnel fire alarm control panel

1. tunnel fire alarm control panel shall read the input status points of the following Addressable Devices as shown on the plans:

   a. Addressable pull stations
   b. Linear heat detector (LHD)
   c. Addressable contact input
   d. Addressable relay output
   e. Remote release module

   and pass the data/status messages from those input status points to the SCADA submaster server.

2. tunnel fire alarm control panel shall reset the Tunnel Fire Control System from the control messages of the SCADA submaster server.
3. Attention is directed to the "Tunnel Fire Alarm Control Panel" in these special provisions.

F. fire control display station

1. The fire control display station shall be a client to the SCADA submaster server and the servers at the Caldecott Tunnel to provided the ability for the operator to view only the status of all operations except for the Tunnel Fire Control System, shown on plans, and as specified in these special provisions.
2. The fire control display station shall be a client to the SCADA submaster server and the servers at the Caldecott tunnel to provided the ability for the operator to the status, alarms, the alarm history, and the event history, and provide control/reset commands of the tunnel fire control system.
3. The fire control display station shall operate the water releases for each of the fire zones in the tunnel.

DATA FUNCTIONS

A. SCREENS

1. The Contractor shall provide display screens for the network communication system fire control display station and the KVM switch of the SCADA submaster server components. The display screens shall consist of but not limited to the drawing on the plans for the callbox system, the tunnel fire control system, the tunnel CO monitoring system, the communication systems, the substation building and the power distribution system shown on the plans. The display screens shall include the system diagram drawings and the physical drawings of the systems shown on the plans and specified in these special provisions.

B. PASSWORDS AND USER NAMES

1. The Contractor shall creating and installing password for the network communication system components use for the SCADA System.
2. The passwords shall consist of the following:

   a. Level 1 shall allow the operator to view only the status, alarms, the alarm history, display screens and the event history of all operations.
   b. Level 2 shall allow the operator to operate devices, in addition to Level 1 functions.
   c. Leve1 3 shall allow the operator to configure the network communication system components use for the SCADA System, in addition to Level 1 and Level 2 functions.

3. The Contractor shall creating and installing user names for the network communication system components use for the SCADA System.

C. ANALOG POINTS

1. The Contractor display the following analog points from the FCSs in FCS#3 and FCS#4 Junction boxes as shown on the plans for the SCADA System:

   a. Vibration Monitoring System for each jet fan using the Two (2)-Wire, current-loop powered system.
   b. Velocity and over-temperature sensor for each jet fan using the two 100 Ω, 3-wire platinum RTD's in the stator winding of each phase.

2. The Contractor display the following analog points from the CO Monitors and from the CO Monitor Controller as shown on the plans for the SCADA system and per California Air Resources Board:

   a. The CO levels data from the CO monitors displayed at each CO Monitor.
   b. The CO levels for 8 hours data from the CO monitor controller displayed at each CO monitor.
   c. The CO levels for 60 minutes data from the CO monitor controller displayed at each CO monitor.
   d. The CO levels for 30 minutes data from the CO monitor controller displayed at each CO monitor.

D. ADDITIONAL I/O POINTS

1. The Contractor shall include up to 60 additional I/O points (50 inputs and 10 Outputs) for the display screens from the installed equipment from which the points are not shown on the plans.

WORK PERFORMED

A. The work to be performed by the Contractor on the components of the network communication system covered in this specification of these special provisions shall be all the work required to meet the topology and operation specified in the communication topology section and the operation section of this specification of these special provisions and as shown on the plans. The work shall also include but not be limited to creating and installing additional display screens that are not specified under "Data Functions" in these special provisions, but shall be required to display all of the I/O points, for the network communication system fire control display station and the KVM Switch of the SCADA submaster server components. Those additional display screens shall display the geographical and physical location and appearance of the devices the I/O points represents. The work shall finally include but not be limited to the debugging, and fine-tuning of the items (alarms, alarm histories, event histories, display screens, database screens, passwords, and all other parameters) for all the components of the network communication system.

QUALIFICATIONS, TESTING AND DOCUMENTATION

A. The contractor shall test the system and verify it's topology, and it's operation to the engineer such that it shall meets the topology and operation in these special provisions and as shown on the plans.
B. The contractor (verifying the results to the engineer) shall simulate each condition in which all the components of the system shall be required to operate using each topology as specified above, for a minimum of 24 hours per operational condition for each component.
C. The contractor shall provide all documentation for the system.
D. The Contractor shall be a registered member of the Control System Integrators Association and be (CSia) Certified.

ETHERNET ROUTER

The Ethernet router shall meet the following specifications:

DESCRIPTION

The Ethernet router shall be industrial router that shall provides a secure integrated networking solution for power utility substations, SCADA, remote device access, physical surveillance, metering and other applications can effectively share a single based network. The Ethernet Router shall provides IP routing services in both LAN and WAN applications. Ethernet ports shall operate in switched or routed mode as required. IP routing shall be provided on any combination of physical and virtual interfaces, including per VLAN, WAN interfaces include dual T1/E1 or dual DDS ports with integral CSU/DSU for access to public or private IP, TDM, frame relay or MPLS based services. IP/PPP/async shall be also supported on serial interfaces, which shall provides a dial up WAN option when combined with external AT compatible modems.

Ethernet router shall have cyber security capabilities cover both electronic perimeter protection for remote sites and management security for the stateful IP firewall, IP address translation and encryption options via IPsec, SSH and SNMPv3, multi level user via RADIUS and extensive local and remote logging and alerting. A flexible integrated protocol analyzer provides analysis.

Ethernet router shall be serial IP terminal services support diverse serial interfaces and protocols including DNP, telnet, raw mode, and Modbus SCADA Frame Forwarding feature.

TECHNICAL SPECIFICATIONS

A. ETHERNET INTERFACES
   1. 5 ports, all 10/100 TX auto sensing or 3 TX+ 2 100FX via SFPs
   2. Wire speed switching
   3. VLANs per 802.1Q
   4. Prioritization via 802.1p
   5. STP/RSTP per 802.1d (<5m sec/hop n rings)
   6. Port security

B. IP ROUTING SERVICES
   1. Routing per interface
   2. Routing per VLAN
   3. Static and dynamic routing
   4. RIP,RIP-II, OSPF, BGP
   5. Prioritization with Diffserv
   6. DHCP Server

C. WAN INTERFACE AVAILABLE
   1. 2 WAN ports shall be provided
   2. DDS:56/64 kbps
   3. T1/E1: 1.544 Mbps /2.048 Mbps G0.703
   4. Full rate and fractional
   5. Integral CSU/DSU
   6. Frame relay, IP
   7. SCADA frame forwarding (non routable serial/FR0)

D. SERIAL INTERFACES
   1. 12 ports, RS232 or RS485, software selectable
   2. 2- or 4+ wire w/ data set signaling
   3. 300 bps to 230.4 kbps.
   4. Serial IP terminal server
   5. Multicast, multi master
   6. DNP, Modbus, Telnet, Raw
   7. Modbus ASCII/RTU to Modbus/TCP
   8. PPP/async w/AT modem controls

E. IP FIREWALL/PERIMETER SECURITY
   1. Stateful firewall w/ logging
   2. IP address and port filtering
   3.]NAT/PAT IP address translation
   4. IP sec VOPNs
   5. SSH port forwarding
   6. Serial port SSL VPSs
   7. 3DES, AES, PSK, X.509

F. MANAGEMENT SECURITY
   1. HTTPS, SSH, S-FTS, SNMPv3
   2. Multilevel password
   3. RADIUS
   4. Management activity logging

G. MANAGEMENT AND DIAGNOSTICS
1. Wed based Graphical User Interface (GUI)
2. CLI access via TELNET/SSH
3. Built in protocol analyzer
4. SNMP MIB and traps
5. Syslog event logging
6. XML based config file
7. Multiple on board software and config files
8. Relay contact alarm

H. OPERATING TEMPERATURE
1. -40C to +85C, no fans

I. STORAGE TEMPERATURE
1. -40C to +85C

J. HUMIDITY
1. 95 percent Non condensing

K. POWER
1. AC Line : 90-250 V(ac) or V(dc), 50-60Hz, 1 A, 85 W
DC : 24-48 Vdc, 4.5 A, 81 W

3. Dual power supplies

a. One power supply for the primary connection
b. One DC power supply for the secondary connection

L. DIMENSIONS (Not to Exceed)
1. 18" W x 12"D x 3"H
2. 19 inch Rack Mount, 1.5 U

M. WEIGHT
1. IEEE 1613
2. IEC 61850-3

N. EMISSIONS
FCC Part 15A

O. CONFIGURATION
1. The Ethernet router wide area network (WAN) configuration shall be a frame relay connect to the industrial router.
2. The data rate shall be 1.544 Mbps.
3. The Ethernet router shall be configured for advanced encryption standard (AES).

P. CONNECTIONS
1. The Ethernet router shall be connected as shown on the plans.

ETHERNET SWITCH

The Ethernet Switch shall meet the following specifications:

GENERAL

Type of Ethernet switch:	Industrial Ethernet Managed Switch
Total Number of Ports:	10 Ports
Number of 10/100 base Tx; RJ45 Ports:	7 ports
Number of 10/100/100 base Tx; RJ45 Ports:	1 Port
Number of Combination Gigabit Ports:	2 Ports for Copper or Fiber Links

REAL-TIME SECURE PERFORMANCE

A. Real-Time-Ring or Rapid Spanning Tree (RSTP) for fast redundant ring or mesh networks
B. SNMPv1 and v2 network management
C. SNMPv3 authentication & encryption for security
D. SNMP notifications (traps) for report on event
E. Priority Queuing (QoS/CoS) for real-time operation
F. IGMP for Multicast filtering (snooping & querying)
G. VLAN for convenient traffic segregation
H. Broadcast & multicast storm protection
I. RMON & port mirroring for advanced diagnostics
J. True security with HTTPS, SNMPv3, SSH and more
K. Easy configuration via Web, Telnet or CLI
L. RS232 and USB console ports for local management
M. Free field-installable firmware upgrades

ETHERNET SWITCH SPECIFICATIONS

A. ETHERNET PERFORMANCE

1. 10 Ethernet ports with up to 8 Gigabit
2. Managed, store & forward, wire-speed
3. All IEEE 802.3 Ethernet protocols supported
4. RJ45 ports 1-7 (Shielded) 10/100 Base Tx
5. RJ45 Ports 8-10 (Shielded) 10/100/1000 Base Tx
6. RJ45 port speed auto-negotiation
7. RJ45 MDI/MDIX auto-crossover
8. RJ45 TD and RD auto-polarity
9. Ports 9 and 10 are combination gigabit port that shall have both a RJ45 connector and SFP fiber connector. For Ports 9 and 10 only one of the connectors (the RJ45 connector or the SFP fiber connector) can be used at a time. The SFP as specified in the special provisions shall be use for the SFP fiber connector.
10. Typical latency (varies on load & settings)

    a. @10 Mbps: 16 us + frame time
    b. @ 100 Mbps: 5 us + frame time

11. Full or half duplex operation configurable per port
12. MAC addresses supported 8192
13. Memory bandwidth 32 Gbps
14. Ethernet isolation 1500 VRMS 1 minute
15. Console ports – USB and RS232 (RJ45)

B. ETHERNET COMPLIANCE

1. IEEE 802.3z (Gigabit 1000 Mbps Ethernet connections)
2. IEEE 802.3u (Fast Ethernet 100Mbps for newer devices)
3. IEEE 802.3 (10Mbps Ethernet supports legacy devices)
4. IEEE 802.3x (Full-Duplex with Flow Control)
5. IEEE 802.1D/w (Rapid Spanning Tree for redundant rings
6. and Spanning Tree for interoperability)
7. IEEE 802.1p (Priority Queuing – QoS, CoS, ToS/DS)
8. IEEE 802.1Q (VLAN for traffic segregation)

C. REAL-TIME-RING

1. Link loss recovery: 30 ms plus 5 ms per hop
2. Switches in a ring: <50 for best performance
3. Multiple rings supported (Configurable)

D. "OK" ALARM OUTPUT

1. Indicates power & operational status
2. Voltage same as switch input voltage
3. Maximum current output:0.5 Amp

E. POWER INPUT

Input voltages:	10-30 V(dc)
Reverse polarity protection	
Power Supply:	1) Redundant input terminals
	2) Shall include a 120 V(ac)/24 V(dc)
	Wall plug in unit.
Input power:	7 W maximum
Surge protection:	1)Transient - 15,000 watts peak
	2) Spike - 5000 watts (10 times for
	10 us)

F. ENVIRONMENTAL

Operating temperature range:	-40 to +75 °C (cold startup at -40 °C)
Storage temperature range:	-40 to +85 °C
Humidity (non-condensing):	5 to 95 percent RH
Vibration and Shock:	IEC 60068-2-6,-27,-32

G. STANDARDS COMPLIANCE
1. Electrical safety – UL508
2. EMC – FCC part 15, ICES-003
3. Hazardous Locations -UL 1604(Class 1, Div 2)
4. Maritime-Designed for marine and offshore per ABS
5. ISO9001:2000 certified company

H. PHYSICAL
1. Mounting – DIN rail and direct panel mounting
2. Case – corrosion-resistant heavy-gauge aluminum
3. Case Protection: IP30/NEMA 2
4. Dimensions (not to exceed): 5.5"L x 6.5"W x 2"D

I. ETHERNET SWITCH CONFIGURATION AND INSTALLATION
1. The Ethernet switch shall be configured as shown on the plans and in accordance to the network communication system specified in these special provisions.
2. The Ethernet switch shall be installed and connected as shown on the plans.

ADDITIONAL EQUIPMENT

A. SFP

1. The Contractor shall provide Ethernet gigabit fiber transceivers that shall be use for the 1000 Base-X connection with the small form factor pluggable (SFP) as shown on the plans and the SFP fiber connection for the Ethernet switch as specified in these special provisions. The Contractor shall provide the number of Ethernet gigabit transceivers use for the SFP's shall be as shown on the plans.
2. The Ethernet gigabit fiber transceivers shall meet the following specification:

Type of Ethernet Gigabit Fiber Transceiver:	Single Mode
Connection Type:	Standard duplex LC receptacle
Operating Temperature:	-40 to +85 °C
Output Optical Power From Single Mode Fiber:	-4dBm to 2dBm
Output Center Wavelength:	1280 nm to 1355 nm
Maximum Spectral Width (-20dB):	1 nm
Side Mode Suppression Ratio (Min):	30dB
Output Eye:	Compliant with IEEE802.3
Optical Input Power (Max):	-3dBm
Operating Wavelength:	1260 nm to 1610nm
Loss of Signal-Asserted (Min):	-35dBm
Loss of Signal-Deasserted:	-45dBm to -23dBm

a. The Ethernet gigabit fiber transceivers shall be compatible with the Ethernet Switch.
b. The Ethernet gigabit fiber transceivers shall be Small Form Factor Pluggable MSA compliant.
c. The Ethernet gigabit fiber transceivers shall be fully compliant with IEEE 802.3z Ethernet standards.

B. LC Connector to ST Connector

1. The Contractor shall provide a LC Connector to ST Connector for each SFP that shall be able to interface with a ST Connector Panel.

INDUSTRIAL ROUTER

The industrial router shall enables remote network connectivity to substations, transportation systems, and other remote sites such as SCADA, metering, security surveillance and access control, non operational data collection using digital WAN services such as DDS, T1/E1, frame relay, TDM, IP and MPLS based VPN services.

TECHNICAL SPECIFICATIONS

WAN INTERFACE AVAILABLE
Wan ports optional
DDS: 56/64 kbps
T1/E1: 1.544 Mbps /2.048 Mbps G0.703
Full rate and fractional
Integral CSU/DSU
Frame relay, IP

SERIAL INTERFACES

4 ports, RS232 / RS485/RS422, software selectable
Signaling
300 bps to 230.4 kbps.
Serial IP terminal server/reverse terminal server
Multicast, multimaster DNP
Modbus, Telnet.
Modbus ASCII/RTU to Modbus/TCP

ETHERNET INTERFACES

4 ports, 10/100TX auto-sensing or fixed.
Wire speed switching
VLANs per 802.1Q
Prioritization via 802.1p
Static MAC port security
Port security per 802.1x

IP ROUTING SERVICES

Routing per interface
Routing Per VLAN
Static routing, RIP, RIP-II
OSPF, BGP
Diffserv prioritization
DHCP Server

IP FIREWALL/PERIMETER SECURITY

IP address and port filtering
NAT/PAT
IPsec VPPNs
Serial port SSL VPSs
3DES, AES, PSK, X.509

MANAGEMENT SECURITY

HTTPS, SSH, S-FTS, SNMPv3
Multilevel password
RADIUS
Management activity logging

MANAGEMENT AND DIAGNOSTICS

Web based Graphical User interface (GUI)
CLI access via TELNET connection
Protocol analyzer
Layer 1 through 3 statistics
SNMP MIB II and SNMP Traps
Syslog Event Logging
XML based configuration. Multiple on board software and config files
Relay contacts for alarms
Software controllable

OPERATING TEMPERATURE

-40 °C to +85 °C, no fans

STORAGE TEMPERATURE

-40 °C to +85 °C

HUMIDITY

95 percent non-condensing

INDUSTRIAL
IEEE1613
IEC 61850-3
IEC 610000-6-5

EMISSIONS
EN55022A, FCC Part 15A

SAFETY
UL60950-1
EN60950-1
CSA C22.2

TELECOM
UACTA TIA/EIA IS-968A
IC CS03 EN55022: 1998 Telco Port.

POWER
Low Voltage DC (L) 24-48 V(dc), 1.3 A, 31 W

DIMENSIONS (Not to Exceed)
10" W x 9.5"D x 2.0"H

MOUNTING
Panel Mount

CONFIGURATION

The industrial router wide area network (WAN) configuration shall be a frame relay connection to the Ethernet router.

The data rate shall be 1.544 Mbps.

RACK-MOUNTED ETHERNET SWITCH

The Rack-Mounted Ethernet Switch shall meet the following specifications:

GENERAL

Industrial Ethernet Managed Switch
26 Ports
Tx; RJ45 Ports: 18 ports
ase Tx; RJ45 Ports: 4 Ports
Gigabit Ports: 4 Ports for Copper or Fiber Links

REAL-TIME SECURE PERFORMANCE

Real-Time-Ring or Rapid Spanning Tree (RSTP) for fast redundant ring or mesh networks
SNMPv1 and v2 network management
SNMPv3 authentication & encryption for security
SNMP notifications (traps) for report on event
Priority Queuing (QoS/CoS) for real-time operation
IGMP for Multicast filtering (snooping and querying)
VLAN for convenient traffic segregation
Broadcast and multicast storm protection
RMON and port mirroring for advanced diagnostics
True security with HTTPS, SNMPv3, SSH and more
Easy configuration via Web, Telnet or CLI
RS232 and USB console ports for local management
Free field-installable firmware upgrades

RACK-MOUNTED ETHERNET SWITCH SPECIFICATIONS

ETHERNET PERFORMANCE

26 Ethernet ports with up to 8 Gigabit
Managed, store and forward, wire-speed
All IEEE 802.3 Ethernet protocols supported
RJ45 port speed auto-negotiation
RJ45 MDI/MDIX auto-crossover
RJ45 TD and RD auto-polarity
Typical latency (varies on load and settings) @ 100 Mbps: 5 µs + frame time
Full or half duplex operation configurable per port
MAC addresses supported 8192
Memory bandwidth 32 Gbps
Ethernet isolation 1500 V_{rms} 1 minute
Console ports – USB and RS232 (RJ45)

ETHERNET COMPLIANCE

IEEE 802.3z (Gigabit 1000 Mbps Ethernet connections)
IEEE 802.3u (Fast Ethernet 100 Mbps for newer devices)
IEEE 802.3 (10 Mbps Ethernet supports legacy devices)
IEEE 802.3x (Full-Duplex with Flow Control)
IEEE 802.1D/w (Rapid Spanning Tree for redundant rings and Spanning Tree for interoperability)
IEEE 802.1p (Priority Queuing – QoS, CoS, ToS/DS)
IEEE 802.1Q (VLAN for traffic segregation)

REAL-TIME-RING

Link loss recovery: 30 ms plus 5 ms per hop
Switches in a ring: <50 for best performance
Multiple rings supported

"OK" ALARM OUTPUT

Indicates power & operational status
Max. ratings
250 V(ac) or 220 V(dc)
2 A @ 30 V(dc) or 0.25 A @ 250 V(ac)
Minimum load 10 mV(dc), 10 µA

POWER INPUT

Input voltages:	18-36 V(dc) (24 V(dc) nominal)
Power Supply:	1) Dual input voltages 2) Shall include a 120 V(ac)/24 V(dc)

Transformer.

Input power consumption:	27 W maximum
Surge protection:	1)Transient - 15,000 W peak 2) Spike - 5000 W (10 times for 10 µs)

ENVIRONMENTAL

Operating temperature range:	-40 to +85 °C (no derating) (cold startup at -40 °C)
Storage temperature range:	-40 to +85 °C
Humidity (non-condensing):	5 to 95 percent RH
Vibration and Shock:	IEC 60068-2-6,-2-27; IEC 60970-2-2

STANDARDS COMPLIANCE (PENDING)

Electrical safety – UL508 / CSA C22.2/14; EN61010-1, CE
EMC – FCC part 15, ICES-003; EN61000-6-4, -2, CE
RoHS and WEEE compliant
ISO9001:2000 certified company

PHYSICAL

Mounting – 19" to 24" racks, EIA/WECO/ETSI supported
Case – corrosion-resistant heavy-gauge aluminum
Case Protection: IP30/NEMA 2

RACK-MOUNTED ETHERNET SWITCH CONFIGURATION AND INSTALLATION

CONFIGURATION

The Rack-Mounted Ethernet Switch shall be configured as shown on the plans and in accordance to the Network Communication System specified in these special provisions.

INSTALLATION

The Rack-Mounted Ethernet Switch shall be installed and connected as shown on the plans.

ADDITIONAL EQUIPMENT

SFP

The Contractor shall provide Ethernet Gigabit Fiber Transceivers that shall be use for the 1000 Base F connection with the Small Form Factor Pluggable (SFP) as shown on the plans. The Contractor shall provide the number of Ethernet Gigabit Transceivers use for the SFP's.

Data Rate: 1.25 Gbps

The Ethernet Gigabit Fiber Transceivers shall meet the following specification:

Type of Ethernet Gigabit Fiber Transceiver:	Singlemode
Connection Type:	Standard duplex LC receptacle
Operating Temperature:	-40 to +85 °C
Output Optical Power From Single Mode Fiber:	-4 dBm to 2 dBm
Output Center Wavelength:	1280 nm to 1355 nm
Maximum Spectral Width (-20 dB):	1 nm
Sidemode Suppression Ratio (Minimum):	30 dB
Output Eye:	Compliant with IEEE802.3z
Optical Input Power (Max):	-3 dBm
Operating Wavelength:	1260 nm to 1610 nm
Loss of Signal-Asserted (Min):	-35 dBm
Loss of Signal-Deasserted:	-45 dBm to -23 dBm

The Ethernet Gigabit Fiber Transceivers shall be compatible with the Rack-Mounted Ethernet Switch.
The Ethernet Gigabit Fiber Transceivers shall be Small Form Factor Pluggable MSA compliant.
The Ethernet Gigabit Fiber Transceivers shall be fully compliant with IEEE 802.3z Gigabit Ethernet standards.

LC Connector to ST Connector

The Contractor shall provide a LC Connector to ST Connector for each SFP that shall be able to interface with a ST Connector Panel.

TELEPHONE EXTENDER

The telephone extender shall enable telephone service over a LAN via 10Base-T Ethernet connections. The telephone extender shall have a built in Codec that digitizes voice and converts to packets for transmission between local and remote designated IP addresses. The telephone extender shall be compatible with PBX and Key Systems (POTS). LAN connections of the telephone extender shall be made by most types of full duplex Ethernet devices, including switches, routers, bridges, transceivers, etc. A web-based configuration user interface shall be provided to view network setting or change IP addresses from the factory default. Phone connection shall be automatic upon power-up or when network interruption is restored. Depending on network traffic, multiple pairs shall be used to set up individual point-to-point telephone links.

AUDIO BANDWIDTH

300 Hz to 3.4 kHz

ELECTRICAL

Phone connector:	RJ11 female
Ring voltage:	80 V_{rms} at 20 Hz
FXO input impedance:	600 Ω
FXS output impedance:	600 Ω
Ethernet (10Base-T):	RJ45 female
Rate:	10 Mbps

VISUAL INDICATORS

Off Hook, Ring, Master/Slave, Hot Link, Link Status, Tx and Rx volume, DHCP, off-hook, FXO, FXS, Alarm, Link, Sync, Activity, VccA, VccB, PWR A, PWR B

ALARM/RING

Dry contact: Normal open

POWER

Input Voltage: 12 V(dc)

DIMENSIONS (Not to Exceed)

Height:	1.5"
Width:	7.5"
Depth:	10"

TEMPERATURE

Operating:	-4 °F to 158 °F
Storage:	-40 °F to 194 °F
Humidity:	95 percent non-condensing

T1 FIBER OPTIC MULTIPLEXER

The T1 Fiber Optic Multiplexer shall be a 1 to 4 channel T1/E1 with diagnostics, extra data channels, power and optical redundancy, jitter removal and replaceable Line Interface module. Each channel shall offer six LED indicators to ease installation and troubleshooting – one each for RxD, alarm, T1/E1 signal loss, BPV violations, remote loopback and remote signal loss. Individual channels shall provide 4 DIP switches, accessible form the front panel, to control settings for line code, line length, local loopback or remote loopback. The extra out-of-band data channels shall be intended for multi-purpose communications. Up to eight RS-232 channels shall be available in addition to the T1/E1 channels.

DATA RATES

T1:	1.544 Mbps
E1:	2.048 Mbps
RS-232, RS-422 Async:	56 kbps

CHANNEL CAPACITY

T1, E1, or any combination:	4 Channels
RS-232, RS-422, TTL, Dry contact:	8 Channels

OPTICAL

Transmitter:	LASER
Receiver:	PIN Diode
Wavelength:	1300/1550 nm singlemode
Fiber Optic connectors:	ST
Loss budget:	9/125 μm – 20 dB

The T1 Fiber Optic Multiplexer shall provide for Optical Redundancy.

ELECTRICAL

T1/E1 connector (100/120 Ω):	Detachable terminal block
E1 connector (75 Ω):	Terminal block with BNC adapter
Interface:	T1/E1 (G.703)

SYSTEM

Bit error rate: 1 in 10^{10} or better
Built-in elastic buffer and jitter attenuator

ALARM

Dry contact: Normal Open

VISUAL INDICATORS

Channel status:	RxD, RLOS, LOS, RLPB, BPV, Alarm
System:	Power A & B, Vcc, VccA, VccB, Alarm
Optic:	SyncA, SyncB, Opitc in use RxA & RxB, VLIN

POWER

Input Voltage:	24 V(dc)
Max Input Power:	14.4 W or less

The T1 Fiber Optic Multiplexer shall have built-in Power Redundancy.
The Contractor shall provide a 115/230 VAC to 24 V(dc) external power supply. The power connection from the 115/230 V(ac) to 24 V(dc) external power supply shall be the primary power connection to the T1 Fiber Optic Multiplexer.

TEMPERATURE

Operating:	-4 °F to 158 °F
Storage:	-40 °F to 194 °F
Humidity:	95 percent non-condensing

DIMENSIONS (Not to Exceed)

Height:	2"
Width:	19"
Depth:	9"

FIXED WIRELESS TERMINAL

The fixed wireless terminal shall be flexible solution utilizing WCDMA/HSDPA networks and shall be capable for broadband for internet access with "always connected", voice and fax. The fixed wireless terminal shall provide wired or wireless connectivity to the user and shall enable the possibility of simultaneous HSDPA data access for multiple users. The fixed wireless terminal shall meet the following specifications below:

FEATURES

WCDMA/HSDPA frequency support, tri-band – 850/1900/2100 MHz
HSDPA, category 1-8 and 11/12, up to 7.2 Mbps (downlink)
WCDMA, up to 384 kbps
GSM/GPRS/EDGE frequency support, quad-band – 850/900/1800/1900 MHz
EDGE, multi-slot class 10 (4+1, 3+2) up to 237 kbps (downlink)
GPRS, multi-slot class 10 (4+1, 3+2) up to 86.2 kbps (downlink)
Two USB 2.0 ports (print sever and mass storage)
Wireless LAN access point IEEE 802.11 b/g
Four ports fast Ethernet switch (RJ45)
Protocols
Routing, NAT, ALG, DHCP and DNS server

Security

Internet security:	Firewall
Wireless security:	WEP, WPA/WPA2

Analog fax connectivity (RJ11)
Telephony access (RJ11)
Battery backup capability (voice operation only)
Remote management capability
Built in automatic software and configuration update functionality.

TECHNICAL SPECIFICATION

Dimensions not to exceed (H x W x D):	10" x 6.0" x 2.0"
Power adapter input:	100 – 240 V(ac), 50 – 60 Hz
Power plug:	US
Power adapter output:	12 V(dc)
Unit power input:	10 – 28 V(dc)
Power consumption data usage:	16.2 W or less
Operating temperature:	32 °F to +122 °F
Operating temperature with battery:	32 °F to 104 °F
Operating humidity:	5 – 95 percent
Storage temperature:	-49 °F to 185 °F
Storage humidity:	10 – 100 percent
SIM-card:	Standard SIM

ACCESSORIES

Outdoor roof mounted directional antenna shall be provided and install on the radio antenna pole with the connection to the fixed wireless terminal using the antenna cable.

Surge Protector shall be provided.

Mechanical anti-theft kit shall be provided.

CONFIGURATION

Telephone operation using both RJ11 Jacks (One per room connected to the fixed wireless terminal through the telephone extender for the Substation Room and directly connected to the fixed wireless terminal for the Tunnel Control and T.O.S Room).

Frame Relay connection to the Caldecott Tunnel for the SCADA System.

Frame Relay connection to the Manufacturers recommended site of the CO monitoring system and it components for the CO monitoring system.

Wireless connectivity to the Caldecott Tunnel for the SCADA System and the manufacturers recommended site of the CO monitoring system and it components for the CO monitoring system and be HSDPA.

T1 FIBER OPTIC MULTIPLEXER

The T1 Fiber Optic Multiplexer shall be a 1 to 4 channel T1/E1 with diagnostics, extra data channels, power and optical redundancy, jitter removal and replaceable Line Interface module. Each channel shall offer six LED indicators to ease installation and troubleshooting – one each for RxD, alarm, T1/E1 signal loss, BPV violations, remote loopback and remote signal loss. Individual channels shall provide 4 DIP switches, accessible form the front panel, to control settings for line code, line length, local loopback or remote loopback. The extra out-of-band data channels shall be intended for multi-purpose communications. Up to eight RS-232 channels shall be available in addition to the T1/E1 channels.

DATA RATES

T1:	1.544 Mbps
E1:	2.048 Mbps
RS-232, RS-422 Async:	56 kbps

CHANNEL CAPACITY

T1, E1, or any combination:	4 Channels
RS-232, RS-422, TTL, Dry contact:	8 Channels

OPTICAL

Transmitter:	LASER
Receiver:	PIN Diode
Wavelength:	1300/1550 nm singlemode
Fiber Optic connectors:	ST
Loss budget:	9/125 µm – 20 dB

The T1 Fiber Optic Multiplexer shall provide for Optical Redundancy.

ELECTRICAL

T1/E1 connector (100/120 Ω):	Detachable terminal block
E1 connector (75 Ω):	Terminal block with BNC adapter
Interface:	T1/E1 (G.703)

SYSTEM

Bit error rate: 1 in 10^{10} or better
Built-in elastic buffer and jitter attenuator

ALARM

Dry contact: Normal Open

VISUAL INDICATORS

Channel status:	RxD, RLOS, LOS, RLPB, BPV, Alarm
System:	Power A & B, Vcc, VccA, VccB, Alarm
Optic:	SyncA, SyncB, Opitc in use RxA & RxB, VLIN

POWER

Input Voltage:	24 V(dc)
Max Input Power:	14.4 W or less

The T1 Fiber Optic Multiplexer shall have built-in Power Redundancy.
The Contractor shall provide a 115/230 VAC to 24 V(dc) external power supply. The power connection from the 115/230 V(ac) to 24 V(dc) external power supply shall be the primary power connection to the T1 Fiber Optic Multiplexer.

TEMPERATURE

Operating:	-4 °F to 158 °F
Storage:	-40 °F to 194 °F
Humidity:	95 percent non-condensing

DIMENSIONS (Not to Exceed)

Height:	2"
Width:	19"
Depth:	9"

10-3.41 MISCELANEOUS

RADIO ANTENNA POLE

The radio antenna pole shall be a Type 21 standard that does not have a mast arm and a modified top to provide for mounting of two antennas (One for the rebroadcast antenna and One for the Fixed Wireless Terminal (FWT)). The contractor shall install the antennas, the antenna cables and connect the cables to the antennas.

RS-232 CABLE

The RS-232 cable shall be 24 AWG shielded twisted pair cable used for RS-232 applications and shall meet the following specifications below:

Conductor:	24 AWG Stranded Tinned Copper
# Of Pairs:	4
Insulation:	FEP Insulation
Shield:	Overall 100% Foil Shield + 65%, Tinned Copper Braid with drain wire (24 AWG stranded tinned copper).
Overall Jacket:	Flurocopolymer Jacket.
Nominal Outer Diameter:	0.29 in
Nominal Conductor DC Resistance:	23.98 Ω/kft
Nominal Shield DC Resistance:	4.51 Ω/kft
Nominal Velocity of Prorogation:	60.0 %
Nominal Capacitance between Conductors:	29.87 pF/ft
Nominal Capacitance between Conductor and Shield:	50 pF/ft
Nominal Input Impedance:	75 Ω
Standards:	UL AWM Style 2464 (300 V 80 °C)

RS-485 CABLE

The RS-485 cable shall be 22 AWG shielded twisted pair cable, rated for 300 V and used for RS-485 applications and shall meet the following specifications below:

Conductor:	22 AWG solid tinned copper conductor
Number of pairs:	2
Insulation:	FEP
Shield:	Overall 100% foil shield + 90% tinned copper braid with drain wire (22 AWG stranded tinned copper)
Overall jacket:	Flurocopolymer jacket
Nominal outer diameter:	0.36 in
Nominal conductor DC resistance:	14.69 Ω/kft
Nominal shield DC resistance:	1.4 Ω/kft
Nominal velocity of prorogation:	78.0 percent
Nominal capacitance between conductors:	11 pF/ft
Nominal capacitance between conductor and shield:	20 pF/ft
Nominal input impedance:	120 Ω

RS-232 TO RS-485 CONVERTER

The RS-232 to RS-485 converter shall be an industrial DIN rail mounted optically isolated RS-232 to RS-485 converter that optically isolate and convert an unbalanced, full or half-duplex RS-232 signals to optically isolated a balanced, full or half-duplex RS-422 or RS-485 signals with the following specifications:

Dimensions (Not to Exceed):	4.5"H x 3.5"W x 1"D
Temperature range:	-40 °C to +80 °C
Humidity Range:	0 to 95% non-condensing
Supply Voltage:	1) +10 to 30 V(dc) @ 100 mA, 2) +9 to 30 V(ac) @ 100 mA
Data Rates:	1) 1200 to 115.2 kbps, 2) 2400 to 19200 kbps - switch selectable.
Connectors:	Screw down terminal blocks for RS-232 and RS-485 sides
LED's:	Transmit Data, Receive Data, and Power
Isolation:	2000 V(ac) Optical Isolation of Data Signals and Ground
Surge Suppression:	1) 7.5V, bi-directional avalanche breakdown device, 2) 500 W peak power dissipation, 3) Clamping time < 1 picoseconds (theoretical)

RS-485 ISOLATOR

The RS-485 isolator shall be industrial DIN rail mounted optically isolated four-wire full or two-wire half-duplex RS-422/485 line isolator/repeater that shall have the following specifications:

Isolation	2, 000 Vrms for 1 minute optical isolation of data lines.
Surge Suppression	1) 6.5 V working peak voltage. 2) bi-directional over voltage suppressor. 3) 600 W peak power dissipation. 4) 3,000 pF maximum capacitance.
Data Rates	Switch selectable for 2400 to 115.2K baud, and up to 460.8K baud with additional resistor (connected to device).
Temperature Rating	0 °C to +80 °C
Humidity Rating	0 to 95% non-condensing
Power Requirements	+10 to 30 V(dc)(dissipates 800 mW max)
Current Draw	67mA @ 12 V(dc)
Dimensions not to exceed (L x W x H):	6" x 4" x 1"

SUBSTATION LIGHTING

Exit Light

The exit light shall be specified as the following:

DESCRIPTION
Single-Face

COLOR
Red

HOUSING
A. Fast Snap-In connection
B. UL 94V-0 Hi-Impact Thermoplastic
C. Universal Tope, Side, or Back Mounting
D. Stencil Face easily removable
E. Field selectable chevrons

BATTERY
A. Maintenance free sealed nickel cadmium
B. 12 year rated life
C. 20 C to 95 C operating range
D. Ideal for high ambient temp areas

ILLUMINATION

A. Long-lasting Light Emitting Diodes (LED's)
B. Internal light chamber eliminates hot spots
C. 25 year rated life (LED's & electronics)

ELECTRONICS

A. 120 V
B. Surge Protection
C. Battery backup

1. Low-Voltage disconnect
2. AC Lockout and Brownout protection
3/ Constant current charger

COMPLIANCE

A. UL 924 Listed, NEPA 70 and NEPA 101
B. NEC and OSHA Illumination Standards

Fluorescent Light Fixture

The fluorescent light fixture shall be a 4 foot long, 4 lamps and 120 V light fixture that shall meet the following specifications:

HOUSING

The fluorescent light fixture housing shall be fully assembled with rivets and screws. The fluorescent light fixture housing shall be made from heavy-duty 20 gauge cold rolled steel. The fluorescent light fixture finish shall be a high-gloss white baked enamel.

REFLECTOR AND OTHER LIGHTING FIXTURE PARAMETERS

The fluorescent light fixture reflector shall be a precision-formed segmented reflector; using Miro4 (0.02"thick reflectors) enhanced aluminum with 95% total reflectance. The fluorescent light fixture shall have up light slots. The fluorescent light fixture photometry shall be normal. The fluorescent light fixture shielding shall be Clear Acrylic.

LAMP AND BALLAST

The fluorescent light fixture shall have four 54 Watt High Output T5 lamps. The fluorescent light fixture shall have rotary-locking lamp holders. The fluorescent light fixture shall have electronic Class P, high power factor, non-PCB, sound-rated A type ballasts for high Output T5 Program-Starts. The fluorescent light fixture shall have Two Ballasts; One ballast for every two lamps. The Contractor shall connect the ballasts and lamps as shown on the plans.

ELECTRIAL AND MOUNTING

A. The fluorescent light fixture rated voltage shall be 120 VAC; 2 Wire. The fluorescent light fixture shall be UL Listed.
B. The fluorescent light fixture shall be designed to be suspended by rod or pendant. The fluorescent light fixture shall have monopoint hangers; and rods for each hanger. The Contractor shall mount the fluorescent light fixture to the height shown on the plans with the monopoint hangers and rods.

Wall Light Fixture

The wall light fixture shall be a wall-mounted luminaire that shall consist of a precisely contoured, specular anodized aluminum reflector, molded prismatic thermal shock-resistant, borosilicate glass refractor and integral HID ballast in weather-resistant, copper-free cast aluminum housing. The wall light fixture luminaire ballast and socket shall be pre-wired and the wall light fixture designed to mount directly on the surface wiring or over a recessed outlet box. The wall light fixture shall meet the following additional specifications:

GENERAL

A. Wattage: 70 W
B. Source: High Pressure Sodium (HPS)
C. Voltage: 120 V(ac)
D. Color: Black

FEATURES

A. Protected Starter
B. Under Pass Optics
C. Tamper-resistant screws

ADDITIONAL EQUIPMENT

The Contractor shall provide an outlet box as specified in these special provisions for each wall light fixture shown on the plans. The Contractor shall install the outlet box the inside of the Substation Building and shall install the conduit with conductors shown on the plans between the wall light fixture and the outlet box through the Substation building wall.

10-3.42 RADIO REBROADCAST SYSTEM

AM AND FM RADIO REBROADCAST SYSTEM

GENERAL

All of the designated enclosed highway sections (tunnels) shall employ an in-tunnel public safety land mobile radio rebroadcast system to enable first responders, highway patrol and maintenance personnel with bi-directional communications to/from the above ground agencies' network. Additionally, a commercial AM/FM radio rebroadcast system with emergency override capability shall allow the operations control center (OCC) to broadcast in-tunnel emergency messages to the commuters over the in-car commercial radio receiver for traffic advisories and alerts in case of emergency. An in-tunnel broadcast monitoring system (IBMS) shall be installed in order to allow the tunnel operator personnel at the operations control center to listen and verify the content and quality of the AM/FM rebroadcast transmission within the tunnel facilities.

The radio systems to be installed shall employ the latest digital signal processing and field reconfigurable semiconductor technology to be a future-proof system, compatible with current and new RF digital modulation schemes, reduced risks of technology obsolescence, based on the principles of software defined radio.

The Contractor shall be responsible for the supply, installation, testing, commissioning, training and documentation of the tunnel radio communications system. The Contractor shall appoint a radio specialist equipment supplier who shall advice, perform site surveys, supply radio and related equipment and specialty materials, supervise installation, test, commission, document as-built and train the on the radio systems as detailed in this specification.

The radio specialist equipment supplier shall provide O&M manuals, guarantees, warranties, test specifications, test reports and test certificates for all equipment including a recommended list of tools and spares holding.

Scope

The Contractor shall install and commission an 800 MHz 2-way radio signal booster system and an AM/FM radio rebroadcast signal repeater system with emergency override capability, to provide radio coverage within the limits of the project. The radio systems shall include antennas and masts; leaky coaxial (radiating) cable and tunnel radiator wires; coaxial transmission line, fiber optic and multi-conductor cables; multi-channel AM/FM digital rebroadcast head-end equipment; multi-channel 800 MHz bi-directional digital signal boosters; RF couplers, multi-coupling, splitter/combiners, filters and termination equipment; audio and networking equipment; discrete in-tunnel monitoring antennas and equipment; electronic equipment cabinets or enclosures; grounding and lightning surge protection devices; panel boards and power lines; support hardware (conduits, cable trays, cable supports, junction boxes, etc); testing and training.

The off-air interface antennas shall be installed at outside Battery substation to provide an air-interface path for 800 MHz trunked 2-way radio signals and AM/FM commercial radio reception for transmission into the tunnel antenna system.

The 800 MHz 2-way radio equipment, AM/FM rebroadcast/override head end equipment, RF over fiber-optic distribution and AM/FM IBMS equipment shall be installed at battery substation. The remote fiber-fed AM/FM power amplifiers and 800 MHz bi-directional amplifiers could be installed at tunnel as required. Discrete in-tunnel monitor AM/FM antennas shall be installed for the IBMS operation.

Submittals

The Contractor shall submit shop drawing, consisting of equipment list and drawings in conformance with this special provisions for "Equipment List and Drawings," of the Standard Specifications. The Contractor shall submit complete shop drawings for all proposed products to the Engineer for approval a minimum of 15 days before ordering or fabrication of equipment.

Manufacturer's technical data for each component in the system, including data on features, ratings, and performance shall be submitted for approval.

Shop wiring diagrams of power and signal wiring, differentiating between manufacturer-installed and field-installed wiring, shall be submitted for approval.

Coordination plans drawn to scale and coordinating locations of radio equipment, including leaky coaxial cable antenna hangers and method of attaching hangers to the building structure, and location of items requiring installation coordination, including lighting, access panels, and other architectural features, shall be submitted for approval.

Signal strength calculations shall be submitted for the path out of the tunnel and the path into the tunnel to verify system performance. Calculations shall be prepared using the signal strength from the base station for 800 MHz frequencies, measured near by the off-air antennas site.

The Contractor shall provide the Engineer a certificate of compliance from the manufacturer for each product shipment in conformance with the provisions of Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

QUALITY ASSURANCE

All electrical equipment shall be UL listed.

The system and components shall conform to the requirements in NFPA 70, NFPA 780, and all applicable FCC requirements.

The AM radio rebroadcast system shall conform to the requirements in CFR Title 47 Part 15, Subpart C, Sections 15.211 and 14.221.

The FM radio rebroadcast system shall conform to the requirements in CFR Title 47 Part 15, Subpart C, Sections 15.211 and 15.239.

Qualifications

The names and qualifications of the proposed manufacturers of system equipment shall be submitted to the Engineer for approval.

A radio specialist equipment supplier shall perform site surveys, supply radio and related equipment and specialty materials, supervise installation, test, commission, document as-built and train on the radio systems as detailed in this specification.

The radio specialist equipment supplier shall be an authorized system integrator of all major radio equipment components to be supplied, and shall have certified manufacturer's training for the installation and service of all radio equipment.

Reliability, Maintainability and Availability

Radio systems shall meet the following requirements for reliability, maintainability and availability:

A. The systems shall be reliable and provide full functionality in all operational and environmental conditions encountered in this contract.
B. The systems shall have a mean time between failure (MTBF) greater than 30,000 hours.
C. The systems shall have a mean time to repair (MTTR) less than 3 hours.
D. All main items of systems equipment shall employ a modular construction and be designed for field serviceability.

Environmental requirements

Outdoor equipment shall be rated for continuous operation under the following service conditions:

A. Temperature: -5ºC to +50ºC
B. Relative Humidity: 5 to 100 percent
C. Weather: Protect connections and equipment to prevent entry of moisture due to rain or fog

Indoor equipment shall be rated for continuous operation under the following service conditions:

A. Temperature: 0ºC to 40ºC
B. Relative Humidity: 0 to 95 percent

AIR-INTERFACE 800 MHz RADIO REBOADCAST SYSTEM

An air-interface bi-directional 800 MHz radio rebroadcast system shall be configured to meet the following system signal strength criteria and shall provide 95 percent probability of 2-way radio communication in 95 percent of the tunnel area:

A. Measured downlink signal strength in the tunnel shall be -90 dBm minimum, measured off a ¼ wave whip antenna tuned to the center of the band. The 95% percentile of the readings shall be above this threshold.
B. For Uplink, the tunnel antenna system must deliver a minimum signal level of -100 dBm, measured at the Uplink signal booster system service-side antenna input terminal. The 95% percentile of the readings shall be above this threshold.

Up to 16 radio channels shall be rebroadcast, the exact frequencies shall be indicated by the Engineer prior to the equipment submittal. The digital channelised bi-directional amplifier shall be provided with integral programmable narrowband filters to meet the Class A signal booster definition as per FCC 90.7.

A repeater amplifiers/line amplifiers shall be installed in the tunnel antenna system if required to meet the performance criteria based on the Contractor's signal strength calculations.

AM/FM RADIO REBROADCAST WITH OVERRIDE SYSTEM

The tunnel AM radio rebroadcast shall cover the frequency range from 0.53 to 1.7 MHz. The tunnel FM radio rebroadcast shall cover the frequency range from 87.5 to 108 MHz. The system shall provide 95 percent probability of AM/FM radio rebroadcast in 95 percent of the tunnel area without radiating outside the enclosed areas above the FCC limits.

Therefore, the following minimum field strength requirements apply starting from the insets defined below and into the enclosed areas.

	AM band	FM band
Inset from the portals and openings	20 ft	200 ft
Minimum field strength, 95% percentile of the readings over 100 ft longitudinal grid sections.	-100 dBm	-90 dBm
Measuring test probe standard	1-meter whip antenna installed on the roof of a car, connected via 50 ohms coaxial cable directly (without coupling or impedance matching) to the 50 ohms RF power meter input (narrowband detector).	98 MHz ¼ wavelength whip antenna installed on the roof of a car, connected via 50 ohms coaxial cable directly (without coupling or impedance matching) to the 50 ohms RF power meter input (narrowband detector).

MULTI-CHANNEL 800 MHz DIGITAL BI-DIRECTIONAL SIGNAL BOOSTER

Signal booster amplifiers with software-defined narrowband filters shall receive, amplify and transmit radio signals in their frequency range. The system shall provide a way in and out, to/from the above-ground radio network communications of the designated agencies on selected channels for all specified tunnels roadways.

The 800 MHz multi-channel bi-directional signal booster must perform channelization which includes the following operations on a per-channel basis: narrowband filtering, center frequency selection, received signal strength detection, automatic gain control with output level equalization and on-frequency (on-channel) re-transmission (repeater function).

A. The channelized signal booster shall comply with the following requirements:
B. Downlink Frequency Range: 851-866 MHz
C. Uplink Frequency Range: 806-821 MHz
D. Number of Narrowband Channels: 16 full-duplex
E. On Frequency repeater design with digital filtering technology
F. Employ Digital Signal Processing, field re-configurable
G. Channel frequency shall be programmable by user
H. Filter bandwidth and group-delay: firmware, field re-configurable
I. Channel Spacing: 12.5 or 25 kHz, as required by CALTRANS
J. Downlink Multi-carrier Power Amplifier: 20W minimum with output isolator
K. Uplink Multi-carrier Power Amplifier: 5W minimum
L. By-Channel Gain: 100 dB minimum
M. Automatic Gain Control: 40 dB minimum per channel
N. Broadband Gain Control Range: 20 dB minimum programmable in 1 dB digital steps
O. Input Automatic Limit Control: 20 dB minimum, broadband, non-spurious
P. Minimum sensitivity for 20 dB audio SINAD: -105 dBm, per channel
Q. RSSI Threshold, the channel opens (transmits) only if the receive signal is above the user preset threshold
R. Noise Figure: 10 dB maximum
S. Duty Cycle: 100% Continuous
T. Built-in internal duplexers
U. Input and Output Impedance: 50 ohms
V. RF Connectors: N-Type Female

W. Non-intrusive RF test (maintenance) ports
X. Built-in RF power monitors with forward and reverse power sensors
Y. Local LCD display and keypad shall allow stand-alone for basic operation setup and maintenance
Z. Discrete Alarm Interfaces: Voltage-free Dry Contact Local Alarm
AA. Data Ports: Ethernet 10/100 and RS-232
AB. Management support: web server and SNMP
AC. Power Supply: 120 V(ac) Power

Band-selective bi-directional radio amplifier

Remote fiber-fed bi-directional amplifiers may be used to deliver coverage in the Battery Tunnels as depicted in the overall system architecture block diagram. They shall meet the following minimum requirements:

A. Downlink frequency range: 851-866 MHz
B. Uplink frequency range: 806-821 MHz
C. Downlink multi-carrier power amplifier: 20W minimum with output isolator
D. Uplink multi-carrier power amplifier: 0.5W minimum
E. Gain: 70 dB minimum
F. Gain control range: 20 dB minimum programmable in 1 dB digital steps, broadband
G. Input automatic limit control: 20 dB minimum, broadband
H. Noise figure: 8 dB maximum
I. Duty cycle: Continuous
J. Built-in internal duplexers, if required
K. Input and output impedance: 50 ohms
L. RF connectors: N-type female
M. Built-in non-intrusive RF test (maintenance) ports
N. Built-in RF power monitors with forward and reverse power sensors
O. Local LCD display and keypad
P. Discrete alarm interfaces: voltage-free dry contact local alarm
Q. Data ports: Ethernet 10/100 and RS-232
R. Management support: web server and SNMP
S. RF over fiber-optic transceiver: system-ready option, with RS-232 sub-carrier
T. Power supply: 120 V(ac), 60 Hz
U. Mechanical: NEMA 4 wall mount enclosure

Multi-channel AM/FM Radio Rebroadcast with override system

The air-interface multi-channel AM/FM radio rebroadcast with override system aims at advising vehicular travelers within the tunnel of emergency conditions and providing instructions for proper actions to be taken. Under normal circumstances, the travelers in the tunnel will receive the FM or AM radio through the car radio. Wherever the situation requires special coordination, the system will allow AM and FM radio signals to be overridden within the tunnel for the purpose of dissemination of emergency information.

The system shall be capable of overriding the stations with separate independent content per tunnel or traffic direction, or keeping the normal off-air rebroadcast in one direction while the other is being overridden. In addition, the system shall be capable of overriding the stations in their normal broadcast language, by having up to four override language groups per traffic direction (i.e. English, Spanish, Chinese, other).

The air-interface multi-channel AM/FM radio rebroadcast with override system is comprised of an AM/FM digital channelizer with override generators (audio modulators), and a digital recorder and rebroadcast controller server.

The air-interface multi-channel AM/FM Radio Rebroadcast digital channelizer shall comply with the following requirements:

A. Antenna: independent AM and FM, broadcast quality
B. Frequency response: AM 0.53 – 1.7 MHz, FM 87.5 – 108 MHz
C. Number of channels: 22 AM, 36 FM
D. On frequency repeater design with digital filtering
E. Employ digital signal processing and field re-configurable technology
F. In order to avoid signal degradation, and reduce out of phase interference with the above ground signal near the tunnel portals it shall not employ demodulator / modulator devices to perform the repeater function.
G. Be of industrial/professional grade quality, designed and built for the intended purpose for which they are to be employed.
H. AM channel spacing: 20 kHz in 10 kHz steps

I. FM channel spacing: 400 kHz in 100 kHz steps
J. Automatic gain control: 40 dB min. per channel
K .Per channel gain: 80 dB minimum
L. Broadband gain control range: 20 dB minimum programmable in 1 dB digital steps
M. Input automatic limit control: 20 dB minimum, broadband
N. RSSI threshold: the channel opens (transmits) only if the receive signal is above the user preset threshold
O. Override generator: digital-based AM and FM modulators
P. Override audio inputs: balanced analog, + 4dBu drive level
Q. Number of override (tunnel) zone outputs: 2
R. Duty cycle: continuous
S. Input and output impedance: 50 ohms
T. RF connectors: N-type female
U. Built-in non-intrusive RF test (maintenance) ports
V. Built-in RF power monitors
W. Local LCD display and keypad
X. Discrete alarm interfaces: voltage-free dry contact local alarm
Y. Data ports: Ethernet 10/100 and RS-232
Z. Management support: web server and SNMP
AA. RF over fiber-optic transceiver: system-ready option, with RS-232 sub-carrier
AB. Power supply: 120 V(ac), 60 Hz

Digital Recorder and Rebroadcast Controller Assembly

The digital recorder and rebroadcast controller server shall be fully integrated with the AM/FM radio rebroadcast channelizer(s). The radio override sub-system shall be zoned which means that it has an independent audio source for each tunnel traffic-flow direction and language group. All AM and FM stations within the same tunnel or traffic flow direction will be overridden with the same advisory message, however it could be different for each tunnel bore, or one bore could be kept re-broadcasting the normal off-air station content while for the other bore all stations are being overridden with a voice break-in. In addition, the system shall be capable of overriding the stations in their normal broadcast language, by having up to four override language groups per traffic direction (for example: English, Spanish, Chinese).

Pre-recorded messages shall be bore-specific since confusion could result if the wording of the announcement may be misheard or misunderstood by others whom the broadcast was not intended. The tunnel operator shall be able to assign playback zones for each new message to be entered into the message registry or database. The radio override sub-system shall not allow to play messages for zones which they are not intended to be broadcast.

The digital recorder and rebroadcast controller server shall comply with the following minimum requirements:

A. Multi-channel audio playback and voice recording system
B. Independent override zone audio outputs
C. Recording/microphone input
D. Simultaneous multi-zone override capability, with the same or different pre-recorded message
E. Real-time microphone feed-thru (Mic-live) override on any single zone, or combination of multiple zones
F. Pre-recorded or microphone feed-thru (Mic-live) override on any combination of ones
G. Multi-zone override command capability
H. Single or loop playback capability
I. Override scheduler with date/time calendar
J. Audio monitor output and local monitoring speakers
K. Management functions: login users with privileges; message database, settings, etc
L. Audio outputs: balanced, + 4dBu drive level
M. Server architecture, full local control with a local Graphical User Interface (GUI). Remote control from optional client GUI workstations/consoles over the TCP/IP network. Standard input/output devices (LCD display, keyboard, pointing device). Data Ports: (1) Ethernet 10/100, (>=4) USB. Redundant hard-drive configuration.
N. Integrated IBMS control software
O. Remote management support: web server and SNMP
P. Discrete digital I/O ports 8 relay outputs and 8 opto-isolator inputs
Q. Duty cycle: Continuous
R. Power supply: 120 V(ac), 60 Hz

AM/FM Multi-carrier Power Amplifiers

The AM/FM multi-carrier power amplifiers shall boost commercial broadcast station signal transmitted from AM/FM rebroadcast and override head end equipment. The AM and FM amplifiers are independent of each other. AM/FM power amplifiers shall comply with the following:

A. Frequency response: AM 0.53 – 1.7 MHz, FM 87.5 – 108 MHz
B. Power output: 20W minimum
C. Gain: 50 dB minimum
E. Gain control range: 10 dB minimum
F. Noise figure: 10 dB maximum
G. Duty cycle: 100% Continuous
H. Input and output impedance: 50 ohms
I. RF connectors: N-type female
J. Non-intrusive RF test (maintenance) ports
K. Built-in RF power monitors with forward and reverse power sensors
L. Local LCD display and keypad
M. Discrete alarm interfaces: Voltage-free dry contact local alarm
N. Data ports: Ethernet 10/100 and RS-232
O. Management support: web server and SNMP
P. RF over fiber-optic transceiver: system-ready option, with RS-232 sub-carrier
Q. Power supply: 120 V(ac), 60 Hz

Multi-coupling point of interface

The Contractor shall furnish and install an RF multi-coupling system suitable to combine all RF sub bands that are to share a communal tunnel antenna system such as the radiating cable facilities in a single point of interface. The multi-coupling system shall meet design constraints to be determined at the design phase, and/or the minimum following requirements:

A. FM port pass-band : 87.5 – 108 MHz, 200 Watt input
B. 800 MHz port: 750-870 MHz, 200 Watt input
C. Insertion loss: less than 2 dB
D. Isolation: equal or greater than 60 dB
E. Impedance: 50 Ohms
F. RF connectors: Type-N female

TUNNEL ANTENNA SYSTEM

The tunnel antenna system shall consist of a “leaky” or “radiating” coaxial cable for FM and 800 MHz signals.

The AM tunnel radiator shall consist of loops of #8AWG copper building wire, as depicted in the contract drawings. Each AM loop has a radiator wire suspended off the ceiling and counterpoise wire installed in a conduit on the top of as shown on the plans. One AM radiator loop shall be installed per traffic lane if the wire is on the wall, or one per every two lanes is the ceiling radiator wire is installed a top the traffic lane divider.

Radiating and Coaxial cables shall be supported every 6 feet, or per the manufacturer’s recommendations. Hanger supports shall be non-metallic self-locking clicks and stainless steel mounting hardware, combined with one stainless clamps per every 10 plastic hangers. The clearance between the tunnel wall/ceiling and the center of the cable-antenna should be 4 inches typically, or as recommended by the cable manufacturer.

The “leaky” coaxial cable jacket shall be fire retardant, low smoke and fume, and shall be non-halogenated and meet the following minimum requirements:

A. Comply with: IEC 332-1, IEC 332-3, IEEE 323, and UL1600 standards
B. Nominal size: 1-1/4 inches or greater
C. Operating frequency band: 50 - 1000 MHz
D. Impedance: 50 ohms
E. Attenuation: At 850 MHz no greater than 3.0 dB per 100 m
F. Coupling loss: 95 percent at 2 m at 800 MHz: 66 plus/minus 10 dB
G. Type-N female connectors, with cold shrink weatherproofing

The AM band is rebroadcast by creating an electric or voltage field between two wire conductors and not by conventional RF propagation methods used at higher frequencies. The AM loop tunnel radiators shall employ transformer coupling devices to interface with coaxial feeders and provide proper impedance matching to the AM transmitters/amplifiers. AM loop radiator wire jacket shall be RHH/RHN for low smoke and low flammability. Wires shall be installed using means and methods pre-approved by the Engineer and as recommended by the manufacturer or radio equipment specialist supplier.

The radiator wire shall be supported every 20 ft and per the manufacturer's recommendations using stainless-steel supports/stand-offs and ceramic fasteners with a typical clearance of 10 inches, or as recommended by the radio equipment specialist supplier. The radiator wire shall run near the ceiling center, along the traffic lane center. If deviations are required to overcome obstructions due to traffic signs, ventilation machines, etc, they shall be accounted for and resolved during the site survey to be performed as part of the installation details submittal phase.

All connections/terminations shall be weatherproof as recommended by the supplier.

800MHz Discrete Antennas

The off-air interface 800 MHz antenna shall be installed at the location to be indicated by the Engineer. Directional or omni-directional antenna shall be used for effective reception. The antenna shall be of the highest industrial-grade quality.

Coaxial Transmission Lines (Feeder Cables)

Radio feeder coaxial cables for the 800 MHz lines shall comply with the following minimum requirements:

A. Type: fire-retardant, non-Halogen, low smoke jacket
B. Nominal Size: 0.87" minimum OD
C. Impedance: 50 ohms
D. Attenuation at 900 MHz: no greater than 4.5 dB per 100 m

The coaxial cable feeders for the AM band shall be 0.24" nominal OD, with fire-retardant, non-Halogen, low smoke jacket.

Fiber Transmission Equipment

Fiber optic interface unit shall convert RF signals to light signals on the transmit path and light signals to RF signals on the receive path. Fiber optic interface module(s) shall be provided as required. The fiber optic interface unit shall meet the following minimum requirements:

A. Frequency range (RF): 70 – 1000 MHz
B. Optical transmission wavelength: 1550 or 1310 nm
C. Optical path signal loss budget: 6 dB minimum
D. RF Impedance: 50 ohms

Single mode fiber optic cable shall be provided (24 fibers per cable) and shall meet the following minimum requirements:

A. The cable shall be All-Dielectric Cable in conformance with the requirements specified in

In-tunnel Broadcast Monitoring System

The Am and FM system shall also be provided with in-tunnel pick-up antennas and broadcast receivers to allow the operations control center to remotely monitor (listen to) the actual radio signals being broadcast in the tunnels:

A. An AM/FM broadcast radio receiver/tuner shall be installed in the equipment room to monitor the in-tunnel rebroadcast transmissions. A demodulated audio output shall be provided to feed the monitoring amplified speakers available on the digital recorder and rebroadcast controller server. IBMS software shall be fully integrated with the other AM/FM rebroadcast functions.
B. AM/FM broadcast radio receiver/tuner shall have a networked data port to allow automated access and control from the digital recorder and rebroadcast controller server and/or distant client workstations at the operations control center.
C. For complex multi-bore tunnel systems, a multi-port RF switch shall be provided in order to feed the AM/FM broadcast radio receiver/tuner. Switch path selection and monitoring shall be controlled by the digital recorder and rebroadcast controller server.
D. In-tunnel pick-up discrete antennas shall be provided and installed on key locations to asset proper monitoring. Antennas shall be suitable for wall-mounting installation. One antenna could be installed per tunnel zone.

E. By means of the software graphical user interface, either on the digital recorder and rebroadcast controller server or a distant client workstations at the operations control center, the operator shall be perform the following minimum operations:

1. Zone (tunnel) selection
2. AM / FM band selection
3. Station selection
4. Pre-set scan
5. Memory pre-set
6. Audio Mute

Installation

The Contractor shall determine the need to optimize radio coverage with the antennas installed within the project limits to maximize coverage while reducing interference resulting from inter-modulation / phasing issues.

The Contractor shall coordinate layout and installation of radio equipment and system components with other construction in the tunnel, including light fixtures, tunnel jet fans, fire-suppression, CCTV camera, VMS and detection system components. The Contractor shall coordinate layout and installation of radio antenna and building penetration with the Engineer.

Grounding:

Grounding shall be provided in accordance with NEC Article 250 and as recommended by the manufacturer.

Identification:

All system components, wiring, cabling, and terminals shall be identified with permanent labeling.

Field Quality Control

Manufacturer's Field Service:

A factory-authorized service representative shall inspect field-assembled components and connections, and supervise pre-testing, testing, and adjustment of the radio system equipment.

Pre-testing:

All equipment shall be inspected to verify it is properly installed, connected, and labeled, and that interconnecting wires and terminals are identified. After aligning and adjusting the system, components, wiring, and functions shall be pre-tested to verify conformance with these special provisions. Malfunctioning or damaged items shall be replaced and the system shall be retested.

Final Testing:

The Contractor shall schedule tests after pre-testing has successfully been completed and the system has been in normal functional operation for at least 14 days. The Contractor shall notify the Engineer in writing when the system is ready 10 days prior to final acceptance testing. The Contractor shall provide a proposed test procedure with the final test notice. Tests shall include field strength surveys for all tunnel sections and shall include both mobile and handheld radios. The path into the tunnel and out of the tunnel shall be tested to verify system performance.

The Contractor shall correct deficiencies identified by tests and observations and retest until specified requirements are met.

Report of Tests and Inspections:

The Contractor shall furnish, install and test all components required to implement a fully operable radio system.

The Contractor shall submit a written record of inspections, tests, and detailed test results in the form of a test log.

All equipment and other components that have satisfactorily completed testing shall be tagged to indicate completion of testing.

PAYMENT

The contract lump sum price paid for radio rebroadcast system shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in radio rebroadcast system, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-3.43 TUNNEL TRAFFIC OPERATIONS SYSTEM

Tunnel traffic operations system consists of call box installation, closed circuit television (CCTV) system, and temporary operations and maintenance center services installation.

The contract lump sum price paid for tunnel traffic operations system shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in tunnel traffic operations system, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

CALLBOX SIGN ASSEMBLIES

General

This describes the manufacturing and installation of brackets to be used in installing the Callbox / Caution Sign assembly in location as shown on the plans. The process shall contain the following:

A. Manufacturing of four brackets for each sign assembly
B. Drilling of five holes for each sign to accommodate anchors
C. Installation of five anchors, four sign brackets, and one catch cable with eye bolt
D. Documentation

Specification

All materials shall comply with Overhead Sign Structures requirements.

Bracket Assemblies

Brackets shall be manufactured using 3/8” mild steel. After fabrication material shall be cleaned of sharp edges and hot dip galvanized.

Hardware to assemble the brackets consists of:

A. 5/8” X 1-3/4” galvanized heavy hex head bolts (ASTM A325, Type 1)
B. 5/8” X 1-1/6” galvanized hex nuts (ASTM A563)
C. 5/8” X 1-5/16” galvanized washers (ASTM F436)

Catch Cable

The catch cable shall be made fro 3/16” stainless steel wire rope. Cable shall be installed in a loop connecting the eye nut installed in the ceiling and the eye bolt on the sign assembly with sufficient length for service of brackets.

Hardware to assemble the cable consists of:

A. 3/16” 302 stainless steel wire rope (1 X 19 strands), rated for 4,700 lbs
B. Two 3/16” 304 stainless wire rope clips
C. M12 X 125/30 eye nut, rated 4,300 lbs
D. M12 X 125/30 undercut mechanical anchor, rated 8,141 lbs

Anchor

The anchor system shall consist of five M12 X 125/30 undercut mechanical anchors. Anchors shall be of undercut style with brazed tungsten carbides on the embedded end that perform the self cutting process. Undercut portion of the anchor shall have a minimum projected bearing area equal to or greater than 2.5 times the nominal bolt area. The bolt shall conform to ISO 898 class 8.8 strength requirements.

The bracket shall be secured using the washers (DIN 6797) and nut (DIN 934, grade 8) supplied with bolt-anchor assembly.

Installation shall be in compliance with the anchor manufactures recommendations. The tools and process to be used shall comply with manufactures instructions.

Design load specifications shall be supplied by the anchor manufacture, minimum of 5,000 lbs tension – 2,300 lbs shear required for each anchor.

Traffic operations systems cameras are covered under "Camera Station" of these special provisions.

MAINTENANCE CAMERA UNIT

General

Each camera unit shall consist of a camera, lens, receiver/driver, pan/tilt assembly, environmental housing, and pigtail cable with connector. The camera shall be a precision mechanical Pan-Tilt-Zoom type. Any camera that is submitted by the contractor that is not one of the recommended on the list below, shall be stringently compared to the specifications set forth in these special provisions before it is approved by the Engineer.

Approved cameras:

Bosch, MIC400 Aluminum or Infrared Camera
Extreme CCTV, Moondance Ruggedized Pan-Tilt-Zoom Camera

Each maintenance camera unit shall be assembled, inspected, and tested in accordance with these special provisions prior to delivery to the job site. Installation, operations and maintenance manuals shall also be submitted at the time of delivery. The Contractor shall submit the applicable documents of the U.S. Military Specification (MIL-SPEC), Underwriters' Laboratory, Inc. (UL), Electronics Industries Association (EIA) Standards, and other Standards form parts of the specification to the extent specified in these standards. In the event of a conflict between the content of this section and the content of the specification, the standards defined in this section shall supersede.

Military Specification Documents	
MIL-I-45208A	Inspection System Requirements, Dec. 16, 1963
MIL-C-45662	Calibration System Requirements, June 10, 1980
MIL-STD-416A	Electromagnetic Interface Characteristics Requirements for Equipment, Subsystems & Systems, Aug. 1, 1968
MIL-E-5400T	Electronic Equipment, Airborne General Specification
MIL-STD-810	Environmental Test Methods, 19 July 1983
MIL-C-5541	Chemical Conversion Coatings on Aluminum Alloys, June 3, 1970

Underwriters' Laboratory, Inc. and other documents	
UL-796	Printed Circuit Boards
EIA-170A	Electrical Performance Standards Color Television Studio Facilities
EIA RS-330	Electrical Performance Standards for Closed Circuit Television (CCTV) Camera 525/60 Interlaced

	Other Specifications or Standards
IP68	**Dust proof and water submersible**

Camera

Each camera shall meet the following specifications at a minimum:

Technical Specifications

Software compatible: VIDOS, HIPER-Ring, VIMAS
Standard compliance: ROHS, CE, & FCC

Camera Module

Image sensor: 1/4 inch EXview CCD or 1/4 inch LXR CCD
Picture elements: 380K NTSC / 440K PAL (wide)
Horizontal resolution: 470 TVL NTSC / 460 TVL PAL (wide)
Filter: Automatic mechanical IR cut filter
Focus system: Auto or manual
Iris: Auto or manual with slow shutter integration modes
Synchronization: Internal / External (V-Lock) synchronization
Recommended illumination: 100 to 100,000 lux
Signal/Noise ratio: 50 dB or more

Back Light Compensation: (BLC) On/Off, Via photocell or User Selectable levels
White balance: Automatic
Automatic Gain Control: (AGC) -3 to -28 dB, 2 dB steps
Aperture control: 16 Step control
Day/Night: User Selectable from day mode (color) to night mode (monochrome)
Automatic Gain Control: from –3 to –28 Db in 2 dB steps
Presets: User Selectable 10 settings, shutter speed, color control for ANPR applications

Operational

Auto flip: User Selectable
Manual flip: User Selectable
Dynamic privacy zones: 3D privacy masking with infinite zones (using optional privacy card)
Presets: 64 telemetry presets utilizing resolve technology (using FV protocol), 10 camera set-up presets to allow ANPR, color correction etc.)
Preset tours: 6 tours each with up to 32 presets
Sector titles: Yes (64 sectors) 20 characters per title
Preset titles: 20 character caption for each of the 64 presets
Home position: Yes (preset 1 or tour)

Communication and Protocols

Communication: RS485 / RS422
Control protocol: Bosch, Pelco P and D or FV protocol cameras available. Bosch camera requires Biphase to RS485 converter (MIC‑ BP4) available separately. Other protocols supported. Others are options. Additional programmed Protocols: American Dynamics, Ernitec, Kalatel, Molynx, Panasonic, VCL, and Vicon

Connectivity

Video: Co-axial via composite cable
Telemetry: Twisted pair. Simplex, half and full duplex operation via composite cable
Power: Via composite cable

Alarms

Alarm inputs: 1 tamper input (4 alarm inputs possible with optional Power Supply Unit)
Alarm communication: Tamper switch (ground connection)

Mechanical

Drive unit: Integral pan/tilt motor drive
Pan angle: 360° continuous rotation
Pan speed: Up to 90° per second (variable)
Tilt angle: w/o IR illuminators 320° , with IR illuminators 186.6°
Tilt speed: 0.2° to 90° per second (variable)
Speed control: Closed loop electronics
Preset accuracy: Better than 0.08°
Proportional P/T to zoom: Yes
Motors: Brush-less, High reliable, Whisper-Quiet

Construction

Construction material: Machined 6 mm thick aluminum, Vandal Resistant
Viewing window: Tempered flat glass
Standard colors: User Select, Black(RAL9005), Gray (RAL7001) or White (RAL9003)
Standard finish: Powder coated
Dimensions: w/o IR illuminators 205 x 360 x 165 mm (WxHxD) 8 x 14.2 x 6.5 inches (WxHxD) (upright and inverted) with IR illuminators 403 x 360 x 165 mm (WxHxD) 15.2 x 14.2 x 6.5 inches (WxHxD) (upright and inverted)
Weight: w/o IR illuminators 5.5 kg (12 lb) including 4 inch pitch circle diameter (PCD) base. With IR illuminators 6.4 kg (14.3 lb) including 4 inch pitch circle diameter (PCD) base No pressurized chambers-Standard
Camera Mounting Hardware: Standard, Camera base 120mm (4 inch) diameter, 09.0x4.0mm on 101.6 dia. Circle, with m25x1.5 center hole, with predrilled hole for safety chain
Telemetry: control card Built-in standard

Telemetry Presets:

64 settings
Titles of 20 characters for each setting
Six tours for each 32 preset positions
Random tour functions
User Selectable Home position

Window wiper: Fitted as Standard, removable wiper blade
Privacy board: Standard, factory fit, scaling perspective with limit areas
Warranty Period: 3-year, without need for maintenance or replacement
Camera color system: User Select, NTSC or PAL Standard

Environmental

Operational temperature:

-20 ° C to +50 ° C (-4 ° F to +122 ° F)
(-30 ° C (-122 ° F) with optional heater)

Environmentally Rated: NEMA 4x / IP68

Electrical

Input voltage: 15 VAC / 18 VDC
Power consumption:

w/o IR illuminators and heater 25.2 W max
w/o IR illuminators 45.2 W max. with heater
with IR illuminators and heater approximately 50 W
Total power less than 75 W power

PCB: Standard, Internal Control processor, voltage regulator, brush-less motor drives, connectivity of ancillary items, such as heaters, infrared illuminators and speakers

Optional items

Zoom Module 18x or 36x: Optional

18x Optical Zoom Module: choose

Lens: F=4.1 mm (WIDE) to 73.8 mm (TELE), F1.4 to F3.0
Zoom:.. 18x optical (12x digital)
Angle of view: 48° (WIDE) to 2.8° (TELE)
Minimum illumination: 0.7 lux (F1.4, 1/60 s NTSC, 1/50 s PAL), 0.11 lux (F1.4, 1/4 s NTSC, 1/3 s PAL), 0.01 lux or less (F1.4, 1/4 s NTSC, 1/3 s PAL, ICR ON)
Shutter speed: 1/1 to 1/10,000 s (22 steps) NTSC, PAL

36x Optical Zoom Module: choose

Lens: F=3.4 mm (WIDE) to 122.4 mm (TELE), F1.6 to F4.5
Zoom: 36x optical (12x digital)
Angle of view: 57.8° (WIDE) to 1.7° (TELE)
Minimum illumination: 1.4 lux (1/60 s NTSC, 1/50 s PAL), lux (1/4 s NTSC, 1/3 s PAL), 0.01 lux or less (1/4 s NTSC, 1/3 s PAL, ICR ON)
Shutter speed: 1/4 to 1/10,000 s (20 steps) NTSC, 1/3 to 1/10,000 s (20 steps) PAL

IR Illuminators: Optional

LED: array High efficiency Surface Mount (SMT) LEDs No. of LEDs 7 per lamp, usually two lamps

Wavelength: 850 nm (semi-covert)
Beam angle: 30°
IR distance: 55 m

Weather proofing: IP68
Construction material: Aluminum with acrylic front window
IR technology: Black Diamond for even illumination across the entire scene
Power consumption: 9 W nominal per lamp on full power, 18 W total for twin IR
Current: 700 mA per lamp

IR Accessories: Optional

Mounting hardware: Compatible with all MIC1 series brackets
Cabling: Optional. Choose from 2M, 10M, 20M or 25M versions
Configurations mount: Upright mount or upright canted at 45° mount
Available: (Inverted mount is possible using software setting). Optional, For Pole, Wall, Ceiling, Corner, Extended Conduit Bracket Optional safety chain
Washer Unit: Optional
Washer pump drive card: Optional, in Power Supply Unit
Heater: Optional, factory fit inside head & body
Alarm card: Optional, fitted in Power Supply Unit
Sunshield: Optional, for areas with direct sunlight

Support Information: On all items Standard

Operation Manual
Quick Start Guide
Inspection Report

The maintenance camera unit shall have programmable camera movement sequences. The camera enclosure shall be designed to withstand the requirements of IP68. A sun shield or visor may be provided to shield the lens from direct sunlight.

Physical and Mechanical Requirements

Each maintenance camera unit shall be provided with four stainless steel hex head bolts M8x20mm to secure the maintenance camera unit to the adapter plate. All fasteners and nuts used in attaching the Ben's camera unit to the mounting plate shall be of stainless steel.

The camera base is 4inches in diameter, with four 9mm holes, on 101mm circle diameter, with the holes equal distant. A Nebar gasket or suitable silicone sealant is used to ensure a water tight seal. The camera pigtail cable is attached to the 12 pin Female connector in the center of the camera base.

Power Requirements

The maintenance camera unit shall operate on specified electrical power requirements. The maintenance camera unit shall meet the requirements of "transients, power service" of the NEMA standard TS-2 (1998). The line variation and surge performance shall be tested to meet these specifications by an outside agency, other than the camera manufacturer. The tests shall be provided upon request. The power consumption shall not exceed specified requirements.

Environmental Requirements

The maintenance camera unit shall operate in ambient temperature range from -20°C to +50°C and shall meet the requirements and ratings of IP68.

All qualifying testing and certifications shall be done by the contractor agent, other than the camera manufacturer.

Camera Pigtail and Connector

The camera pigtail cable shall conform to the specifications to meet the stated environmental requirements and the rating for IP68 in these special provisions. The length of the camera pigtail shall not be less than 2m. The terminating connector for the Pigtail shall be provided by the contractor.

The Contractor shall furnish the mating connector, for the Pigtail, with contact crimping sockets for each maintenance camera unit supplied in the contract.

The contract lump sum price paid for tunnel traffic operations system shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in tunnel traffic operations system, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-3.44 TUNNEL LIGHTING

Tunnel lighting shall include the lighting controller, lighting contactor, panelboards, enclosed circuit breakers, luminaires, luminaire lamps, lighting control equipment, programmable logic controller system, SCADA tunnel lighting system, and uninterruptible power supply, as shown on the plans and in conformance with these special provisions..

In addition, the following are defined under "Basic Materials and Methods," elsewhere in these special provisions:

Miscellaneous metal
Sealants and compounds
Concrete anchors
Metal junction boxes
Wireways, channel, strut, steel threaded rods and brackets
Protection of exiting electrical systems and facilities

LIGHTING CONTROLLER

The lighting controller shall meet the following specifications:

Description

The lighting controller shall automatically switches a dry contact in response to changes in natural daylight. The lighting controller shall provide and maintain a single pole, double throw "form C" relay output to drive electrically held contactors or relays, or inputs to energy management systems (EMS). The lighting controller shall be able to control incandescent, fluorescent and HID lighting.

The lighting controller shall require and the Contractor shall provide a remotely mounted photodiode sensor as specified in these special provisions. A "Hold On" timer shall be added to prevent the short cycling of HID lamps. The timer shall keeps the lights on for a minimum of 1/2 hour period.

Adjustability/Operation

The dual set point of the lighting controller shall precisely switches loads according to the selected light level configuration. LOW and HIGH light levels shall be calibrated to their set points at the control board of the lighting controller.

As the photodiode sensor detects a diminishing light level that corresponds with the LOW set point, the control board of the lighting controller matches the two signals and the lights are switched ON. As the photodiode sensor detects an increased light level, the control board's of the lighting controller HIGH set point switches the lights OFF. The LOW and HIGH set points shall be separated by a "dead band". This shall prevent the photodiode sensor from switching light levels between the set points, thus eliminating nuisance or intermittent changes.

Specifications

A status LED shall be mounted on the unit and indicates relay set or reset status by a two or nine second flash interval. A trouble condition shall inhibits the status LED completely.

Lighting Controller: Lighting controller shall be powered by 24 V(ac) or 24 V(dc), and shall have a separate high and low fully adjustable setpoints. Signal/setpoint and relay status indication shall be provided along with calibration input for adjustment. The lighting controller shall be enclosed in a plastic enclosure. The lighting controller shall provide a 10 A low voltage Form C relay output. A "Hold On" timer shall be provided to prevent the short cycling of HID lamps.

Photodiode Sensor: The photodiode sensor shall be a Class 2, low voltage, ambient light sensor designed to interface directly with the analog input of the energy management system and shall be listed for outdoor lighting controls. The photodiode sensor shall supply an analog signal to the EMS system proportional to the light measured. The photodiode sensor output shall provide for zero or offset based signal. The photodiode sensor shall be capable of a fully adjustable response in the range between 30 and 250 footcandles with a ±1 percent accuracy at 70 °F. The sensitivity adjustment of the photodiode sensor shall be at the photodiode sensor body, and outside of the photodiode sensor's viewing angle. The photodiode sensor housing shall be constructed from ABS, shall be flame retardant and meet UL 94 HB standards.

Technical Data

A. Operating Temp: From -13 °F to +140 °F.
B. Input Voltage: 24 V(ac) or 24 V(dc).
C. Dead Band: Adjustable from 5 percent to 95 percent.
D. Input Delay: 30 second sensor (removable for adjustment).
E. Dimensions (Not to Exceed): 5" (H) x 3" (W) x 2" (D).
F. Control Inputs: CES sensor.
G. Calibration/Simulator: Software shall be provided.

H. Indicator:

1. Green High and Low LEDs.
2. Green Circuit On LED.

I. Warranty: A 2 year warranty.

Installation and Setting

The Contractor shall set the high and low light levels of the lighting controller per manufacturers recommendation. The Contractor shall point the photodiode sensor north and install as shown on the plans.

LIGHTING CONTACTOR

The lighting contractor shall be an electrically held lighting contactor that shall be for lighting loads of 10-300 amperes. The lighting contactor shall be UL listed or recognized and shall comply with applicable NEMA standards and shall be rated greater than or equal circuit breaker. The contactor shall be designed to withstand large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contacts welding. Contactor shall be capable of accepting up to 8 auxiliary contacts – top or side up to 60 amperes and side only up to 300 amperes. Contactors shall be capable of being operated by ac or dc control.

PANELBOARDS

All panel boards shall be of the power distribution type as described by Article 384 of the NEC. They shall be of the capacity, phase, and type shown on the plans, with adequate spaces for all circuit breakers being installed. Modifications to the panel, if required, shall comply with the plans.

The panelboards shall be mounted in the locations depicted on the plans, and adjusted per field conditions with the Engineer's approval. Attachment to the wall shall be with 1/4" diameter bolts minimum, 1-3/4" long minimum, and per the manufacturer's specifications.

The panelboards shall be UL listed and meet all NEMA standards for panelboards. The main lugs shall be the mechanical solderless type approved for copper conductors. The main lugs shall be secured in line according to UL standards to prevent lugs from turning or loosening when cables are installed.

All panelboard box and covers shall be NEC code gauge galvanized steel, finished for indoor use.

Panelboards BES, BEN and BEU

These panelboard shall be NEMA1 indoors type, surface-mounted, factory assembled, three-phase, three-wire, 480-volt, AC panelboard shall not be over 72" high and at least 20" wide with forty-two branch circuits included spaces. Main breaker and branch breaker ampere are shown on the plans. The short circuit rating of the assembled panel board shall not be less than 18,000A rms symmetrical fully rated. The panels shall be Westinghouse, Siemens, General Electric, Cutter-Hammer, Square D or equal.

Enclosed Circuit Breakers

The lighting circuit shall be protected with an enclosed circuit breaker as depicted in the plans. The enclosed circuit breaker shall be enclosed in a NEMA 1 enclosure, minimum. The circuit breaker shall be of the three pole molded plastic type unless otherwise shown on the plans, and shall be amperage rated per the plans at the voltage depicted on the plans at 60 Hz. They shall have a UL listing for the interrupting rating (RMS symmetrical amperes) of 14,000 amperes.

WALL MOUNTED LUMINAIRES

All wall-mounted luminaires shall have a nominal wattage rating according to the plans, and comply with Section 86-6.01, "High Pressure Sodium Luminaires," of the Standard Specifications and the following:

All lighting fixtures shall be complete with ballasts, igniters, lamps, and other equipment and operate from a nominal 480 V, 60 Hz power source and shall be capable of starting and operating the specified lamp within the limits specified by the lamp manufacturer. The luminaries shall be suitable for wet locations per UL 1598A listed for 40°C Ambient at 100 percent rated lumen output comply with IP 65. for dust and water jet.

Materials

Materials within the luminaire shall be supplied in accordance with the following requirements:

A. The housing and door shall be die cast copper free aluminum alloy 360.1 or 383 with a minimum thickness of 1.8 mm. Door assembly shall have mechanical stops to limit gasket compression to 25 percent and prevent permanent distortion.
B. The reflector assembly shall consist of high purity aluminum of minimum 0.8 mm thick sheet. Aluminum used for the reflector shall be #3002 alloy.
C. All lighting fixtures shall be painted. Painted finishes of fixtures and accessories shall be applied such that the entire assembly is rendered completely corrosion resistant.
D. Where aluminum parts come in contact with bronze or stainless steel parts, apply to both surfaces a coating of corrosion protection material.
E. Components and hangers required shall be Type 316 stainless steel.
F. Fasteners shall be Type 316 stainless steel or polymer coated steel of the "TAPTITE" type.
G. Lamp holders and lamp sockets shall hold lamps securely.
H. Gasketing shall be extruded Silicone Rubber. All shapes used shall be completely cover flange to which gasket is fixed.

Finish

The luminaire housing shall be finished with a polyester powder paint, which shall be electrostatically applied and cured. The paint shall pass the ASTM D522 flexure test.

Lampholders

The lampholders shall be porcelain keyless medium or mogul construction, as required by lamp size, wired with high temperature 16 Gauge wiring minimum. The sockets shall be pulse rated at 4 kV. The screw shell shall be nickel-plated brass and shall incorporate anti-vibration grips.

Ballasts

The ballast shall comply with Section 86.601A, "High Pressure Sodium Ballast," of the Standard Specifications with the following modifications.

The ballast shall conform to the applicable requirements of UL 1029. The Ballasts and all related electrical components should be removable and replaceable as a single unit without disturbing the aiming.

Wiring

The fixture wires shall be stranded tinned-copper construction, not smaller than No. 16 AWG. The insulation shall be cross linked polyolefin (UL style 3321) rated 150°C or higher or type SEO cable rated at 105°C. Wireways and wiring channels shall have rounded edges or bushed holes wherever conductors pass through. Insulated Bushings shall be installed at points of entrance and exit of wiring. Each luminaire shall be fused internally with 2 fast-acting type fuses to disconnect the luminaire from the branch circuit in case of ballast failure or other electrical problem within the luminaire.

Fixture Hardware

Screws, bolts, or other assembly and mounting parts, shall be Type 316 stainless steel.

Welding

Locate weld inside assemblies to be anodized to conceal visible discoloration in the heat affected zone. Where weld metal will be exposed after anodizing, select a filler alloy to closely match composition of the base metal and comply with parent metal manufacturer's recommendations for such filler alloys.

Mechanical Construction

The housing shall be heavy-duty die-cast copper free aluminum. All electrical components shall have a Molex disconnect plug and shall be hinged or slotted for installation or removal. A quick disconnect terminal block including fuses shall be provided for disconnected power before changing components. The door shall be provided with single point positive acting latch and locking set screw attached the latch. If the door swings downward, it shall be provided with two safety chains, one on each end of the door, to prevent dropping. The conduit connection shall be National Pipe Thread type typical for conduit, and shall be sized to match the attaching conduit. Note that the attaching conduit is of various sizes so that not all conduit connections will be the same. Field modification is prohibited.

Lens Assembly

The optical assembly shall be fully enclosed with gaskets. It shall include an anodized reflector. The reflector shall have transverse elliptical fluting to minimize re-direction of light energy through the arc tube and to provide even illumination on the lighted surface, free from streaks or striations. The lens shall be 0.125" minimum thickness minimum impact resistant borosilicate prismatic glare.

Optical Control/Photometric Performance

The luminaries shall have a symmetrical photometric distribution. The Isolux curve of the luminaires shall match those in the plans.

Mounting Brackets For Fixture Supports

If mounting brackets are required; the brackets shall be integral to a bolted metal framing system. The fixture shall fit the mounting bracket without modification. All channel fittings and hardware to be type 316 stainless steel. Luminaire mounting plate shall be of type 3004 stainless steel.

Igniters

The device(s) which interface the ballast with the tube, sometimes called the "starter" or "ignitor" shall be called the ignitor for the purposes of these Special Provisions, and shall have the following characteristics:

A. Be designed to eliminate stress on the ballast due to a missing or burned out tube by directing the high voltage spike directly to the lamp without being directed to the lamp through the ballast windings, or by stopping the starting cycle.
B. Be capable of being used with the type of ballasts used in this project.
C. Be designed so that a cycling or extinguishing lamp shall not adversely affect the ignitor or ballast
D. Be UL listed or UL Component Recognized and CSA Certified.
E. Be warranted against defective materials and workmanship for a period of at least five years.

Fuse Block

All luminaires shall have a fuse block installed inside the electrical section of the housing. The fuse block shall comply with Section 86-605G, "Fuse Block," of the Standard Specifications with the following modifications:

A. Shall be UL listed and shall have two spaces for fuses.
B. Each terminal lug shall be large enough to accept conductors as depicted on the plans and shall be rated 600 volts.
C. Shall have fuses installed with the amperage rating as shown on the plans.

Installation

The installation of the luminaires shall be according to the plans, the manufacturer's instructions, and adjusted per field conditions with the Engineers approval.

Qualifying Luminaires

The manufacturer of the luminaires shall meet the following qualifications:
Shall have no less than 10 years experience in manufacturing tunnel lighting.

Certificate of Compliance

The Contractor shall provide the Engineer with a Certificate of Compliance from the manufacturer in accordance with the provisions of Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for all of the luminaires furnished for the project.

Warranty

The entire luminaire shall be having a complete warranty of at least 5 years.

LUMINAIRE LAMPS

All luminaires shall have a lamp installed. The lamps shall comply with Section 86.601B, "High Pressure Sodium Lamps," of the Standard Specifications with the following modifications:

A. The type of lamp shall be high-pressure sodium with the wattage rating as shown on the plans.
B. All lamps shall be manufactured specifically for the type of luminaire selected.

C. Modification of the lamp or luminaire is prohibited.
D. 150 W HPS luminaries shall be dual arc tube design that provided 40,000-hour life minimum with a permanent label, "Install dual arc tube only". The dual arc tube shall fit standard HPS socket.

Wiring Method

The Contractor shall uniquely identify all phases of all channels in such a manner that each conductor may be easily identified, such as unique insulation colors or stripes. The Contractor shall submit to the Engineer for approval the method selected to uniquely identify all conductors.

Lighting Current Testing

After all of the luminaires on a circuit have been installed, the Contractor shall make and record true RMS current measurements in the presence of the Engineer with all luminaires illuminated. The Contractor shall provide a typed or computer generated form on which the measurements are to be recorded. The Contractor shall provide a true RMS current meter for this purpose.

The measurements shall be taken on all phases at the lighting control enclosure. The current measurements shall demonstrate that the load nearly match the loads depicted in the panel schedules.

LIGHTING CONTROL EQUIPMENT

The Contractor shall install any and all devices and equipment required to make the lighting circuits fully functional. All control equipment shall be UL listed.

Enclosure

Enclosure shall be NEMA 1, metal enclosed type requirements of local, state and county ordinances. All connections shall be front accessible. All hinges and screws shall be stainless steel. Service section and pull section bussing must meet all requirements of the serving utility company.

Labeling and Wiring

Wiring shall be neatly bundled or run in plastic wire-ways. Wires shall be color coded per UL standards and shall be standard MTW with 19-strand wire for all hinges wiring. All wires shall be permanently numbered with slip clip wire markers. Terminal strips shall be numbered to match wire numbers. Common wires shall be of common color and number throughout the system. All devices shall be permanently labeled. All door-mounted devices shall be labeled with black and white, screw fastened, engraved, plastic nameplates. Stick on labels, wire fasteners, or wire numbers are not acceptable. All wiring and drawing shall be NEMA Class II C requirements and shall show the complete system including external equipment. All components associated with a particular compartment's function shall be mounted in that compartment; i.e. control relays, lighting contractors shall be mounted in the control section compartment or accordance with the plans. Spacing of components shall be in accordance with UL standards.

Electrically Held Lighting Contactors

All lighting contactors shall be manufactured specifically for the purpose of controlling sodium vapor lighting loads. The contactor amperage shall be rated per the plans 480 V, 60 Hz, and have a control circuit voltage of 120 V, 60 Hz unless otherwise shown on the plans. They shall be the electrically or magnetically held type, and shall have three poles for controlling lighting power, and two poles for control circuit use unless otherwise shown on the plans.

All lighting contactors shall be of the same manufacturer and model number for each size.

Mechanically Held Lighting Contactors

All mechanically held lighting contactors shall be provided with effective control in lighting application. Mechanically held operation shall assure that the contactor will not switch to OFF during control circuit power failure. Contacts shall remain closed during loss of control power and allow load to operation as soon as power is restored. The contactor amperage shall be rated per the plans 480 V, 60 Hz, and have a control circuit voltage of 120 V, 60 Hz unless otherwise shown on the plans. They shall be the electrically or magnetically held type, and shall have three poles for controlling lighting power, and two poles for control circuit use unless otherwise shown on the plans. All lighting contactors shall be of the same manufacturer and model number for each size.

Auxiliary Contacts

All auxiliary contacts shall be manufactured specifically for the purpose of circuit control. The contactor amperage shall be rated 10 A minimum 120 V, 60 Hz. They shall be manufactured specifically for attachment to the existing contactor depicted in the plans, and electrical configuration shall be as depicted in the plans.

All auxiliary contactor shall be of the same manufacturer and model number for each size.

Control Relays-120 V

All control relays shall be rated 10 A or more, 120 V 60 Hz. It shall be the electrically or magnetically held type, and shall have contacts as shown on the plans. It shall be the general-purpose plug-in type, life rating 50 million mechanical and 500,000 electrical, minimum.

Control Relays-480 V

All control relays shall be rated 10 A minimum, 480 V, 60 Hz. It shall be the electrically or magnetically held type, and shall have contacts as shown on the plans. It shall be the high-speed protective type, average pickup time less than 16 milliseconds.

All control relays shall be of the same manufacturer and model number for each voltage rating.

Selector Switches

All selector switches shall be the 30.5 mm heavy-duty type, rated 10 amperes 120 V, 60 Hz rated for 1 million operations or more. They shall have poles and interconnections per the plans, and shall have legend plates installed and labeled per the plans. The legend plates shall be an integral part of the switch, and not a separate label.

Indicating Lights

All indicating lights shall be the 30.5 mm heavy-duty full voltage type. The lamps shall be the LED type, color per the plans. All indicating lights shall have lens installed.

All indicator lights and lamps shall be of the same manufacturer.

Control Circuit Transformer

All lighting circuit control transformers shall be manufactured specifically for the purpose of powering lighting or motor control circuits. The transformers shall be rated per the plans, 120 V, 60 Hz, of the 55°C rise 105°C class, and shall have a fuse block that is an integral part of the unit, and the fuse block shall have all the fuses installed.

All control circuit transformers shall be of the same manufacturer and model number, or have identical mounting dimensions.

Control Circuit Transformer Fuses

All lighting circuit control transformer fuses shall be manufactured specifically for the purpose of protecting control transformers. The primary fuse amperage shall be per the plans, and the secondary fuse amperage shall be per the plans - time delay type.

All lighting circuit control transformers shall be of the same manufacturer and model number, or have identical exterior dimensions.

D.C Power Supply-24 VDC

The power supply shall produce 3.6 A minimum at the output of 24 V(dc). The ripple and noise on the output shall be with 3.0 mVpk-pk plus 0.02 percent of output voltage. The output voltage adjustments shall be made to within ±5 percent of normal voltage. The power supply shall be UL, CSA, EN and IEC listed.

Terminal Blocks

All terminal blocks shall be rated minimum 600 V, 30 A with compressing type barrel lugs and wire guide tangs for ease of maintenance. All control wires entering and leaving a compartment shall terminate on terminal blocks with wire numbers on terminals and both ends of all wires.

GFCI

GFCI shall be rated 15 A Specification Grade 120 V, ivory color, suitable for installation in industrial control equipment as required by UL. The GFCI shall be mounted as depicted in the plans and shall have a suitable receptacle plate installed.

Programmable Logic Controller System

PLC shall control tunnel lighting shall be controlled by a programmable logic controller system as described elsewhere in these Special Provisions.

Substitutions

Substitutions for the control circuit transformer VA capacity only (and related fuses) may be made if the Contractor demonstrates to the Engineer by using the manufacturer's data that the proposed lighting contactors and indicator lights will function correctly using a 90 percent secondary voltage and the published sealed and inrush currents of the devices. The Contractor shall match the primary and secondary fuses to the proposed transformer using manufacturer's data and the appropriate NEC requirements. All substitutions are subject to the approval of the Engineer.

PROGRAMMABLE LOGIC CONTROLLER SYSTEM

The Contractor shall furnish photo-sensor based lighting Programmable Logic Controller (PLC). The controller shall switch each tunnel direction's portal, threshold and transition zone lighting proportionally to light level conditions. The controller system shall consist of installing and testing, but not limited to enclosures, lighting contactors, switches, lamps, fuses, cables and conductors, transformers, protectors, controllers, input/output modules, DC power supplies, terminal blocks, labels and plates, luminance sensors units (including all associated equipment, mounting, aligning), assembly, programming, delivery, wiring, design and testing, submittals, as-built Engineering, startup, commissioning, warranty, and training. Attention is directed to the "Evaluation Period of the Programmable Logic Controller and Modified SCADA software" of these Special Provisions for special conditions relating to cost breakdown and payment.

The Programmable Logic Controller System shall be designed with equipment compatible with the existing Posey and Webster Tube Lighting control system. To assure compatibility with the SCADA system, the Contractor shall procure the Programmable Logic Controller System from the similar Tunnel Lighting Control supplier that furnished the Posey and Webster Tube Lighting Control System. The Programmable Logic System controller and all of the corresponding components within the family of controller products shall be offered by a company who regularly manufactures and services this type of equipment. The Contractor shall consult the Engineer for recommendation.

The lighting in the tunnel shall be controlled by a microprocessor-based controller called a Programmable Logic Controller (PLC) for these Special Provisions. The PLC shall be located inside a cabinet with all associated control equipment as depicted on the plans. The PLC shall have an Operator Interface Panel where lighting parameters may be entered or reconfigured. The PLC shall be programmable from both the Operator Interface Panel and by serial interface. The PLC shall have a manual override for all of the lighting circuits on the front of the control panel as depicted on the plans.

Microprocessor

The microprocessor shall receive inputs from an exterior luminance sensor and other points per the plans. The microprocessor shall have outputs, which control the lighting using lighting contactors. The controller shall be designed for at least 5 levels of outdoor lighting control (called channels). Each channel shall be adjustable from 0 to 99 minute input time delay to prevent intermittent controller switching. Each channel shall have from 0 to 240 minute hold-on timer to prevent short cycling of the lighting. Each channel shall have a separate on and off set point, which can be configured for night or daytime contrast lighting. All configured values shall be saved in memory and battery backed up for a minimum of 2 years. The programming shall be permanently stored in EEPROM.

The photo sensor lighting controls shall be capable of independently switching five levels of lighting circuits in response to the available daylight. The controls shall be capable of utilizing a luminance sensor input, measuring candelas/m^2.

CONTROL SETPOINT	SWITCHING LEVEL			
CD/M2	On	Off	CONDITION	MODE
Level 1	50	45	Night	Contrast
Level 2	250	225	Dim Daylight	Contrast
Level 3	750	675	Foggy Daylight	Contrast
Level 4	2000	1800	Bright Day	Contrast
Level 5			Continuous Night	Night

Operator Interface Panel

The Operator Interface Panel (OIP) shall allow all adjustable parameters to be viewed and changed. Access to change the operating parameters shall have password protection available. The OIP shall display (as a minimum) the current light level and the output status. The display shall be liquid crystal or light emitting diode type utilizing alphanumeric characters and English language prompts (not symbols). The OIP shall have a numeric keypad and arrow keys for input (as a minimum). All channels shall have the following adjustable parameters: Operation (program, test, run), Mode (night or contrast), Time Delay, Low set point, High Set point, Hold on Timer.

Output Modules

The Output Module (s) shall be manufactured specifically to interface the proposed microprocessor with the intended load. The output module shall be the relay type, rated at least 4 amperes at 120/240 volts, with at least 8 points available. The response time shall be 15 milliseconds on and off, maximum.

Input Modules

The Input Module (s) shall be manufactured specifically to interface the proposed microprocessor with the intended inputs. The input module (s) shall be capable of both analog and contact closure detection. The input module (s) shall be manufactured specifically to interface with the proposed luminance sensor unit. The input module (s) shall be capable of detecting contact closures, and response time from contact closure to output to the microprocessor shall be less than 1 millisecond. The input module (s) shall have the number and type of inputs as depicted on the plans, minimum.

Special Programming

Special programming shall be required to facilitate the unique features of this application. The special programming shall make use of sensors and devices installed at various points in the system. Load alternating programming shall be utilized to rotate the channels such that the total on time for each channel is approximately the same.

Load alternating programming shall be utilized to rotate the channels such that the total on time for each channel is approximately the same.

In the event that normal power is restored from failure (automatically and manually), the controller shall determine which lighting channels shall be energized, and at the same time obey the above programming rules.

Control Switching Level

The final switching levels shall be determined by the manufacturer and programmed by the manufacturer's authorized representative.

Control Switching Delays

The final switching times shall be determined by the manufacturer and programmed by the manufacturer's authorized representative.

Recording Parameters

The final programmed parameters shall be recorded on a typed or computer generated form. The form shall be placed in a rack, pocket, or pouch within the cabinet. The form shall depict the final values of all parameters that can be changed.

Controller Outputs

Each output circuit shall have a 4-ampere inductive load rating; capable of operating electrically held contactors. Interposing relays rated 20 amperes shall drive the lighting contactors.

Control Panel Operators and Indicators

The lighting control cabinet front panel shall include On/Off/Auto switches and indicators according to the plans. All indicators and switches shall have a corresponding legend and indication nameplate.

Luminance Sensor

The luminance sensor shall be a low voltage ambient light sensor. The luminance sensor shall supply an analog signal (from 4 mA to 20 mA) to the microprocessor that is proportional to the ambient light. The luminance sensor shall be located per the plans, and mounting shall be per the manufacturer's specifications. The luminance sensor shall contain an eye-corrected silicon cell to measure the luminance in a 20 degree conical field from 1 cd/m^2 to 10,000 cd/m^2 with a resolution of 2 cd/m^2.

Luminance Sensor Enclosure

The weatherproof enclosure with mounting hardware shall be constructed from die cast and extruded aluminum and designed to accept coupled charge device (CCD) cameras with either fixed focal length lenses or motorized zoom lenses. The enclosure opens from the rear by unlatching the rear-mount latch. Opening shall be assisted by a unique gas spring, which shall securely hold the lid when fully opened. The forward opening lid shall allow for maximum accessibility during installation adjustment for lens if necessary. The camera sled shall be removable and shall be inverted to accommodate various camera and lens combinations. The enclosure shall be heated and thermostatically controlled.

A. Luminance Sensor Cable (LSP) shall be 18 gauge 4 wire shielded copper cable unless otherwise specified by the manufacturer.
B. Surge protection shall be provided at the voltage inputs of the luminance sensor. Circuit breakers shall isolate control circuits from the luminance sensor. Contractor shall provide DC power supply if for luminance sensor if it is required.
C. The housing for the luminance sensor shall be sealed to tightness equal to IP55 per IEC publication 529 and NEMA 4. The lens shall be tempered. The mounting bracket shall be a painted steel bracket arm, which shall allow for the aiming of the luminance sensor in at least 90° angles rotation.
D. The sensor transmitter shall be capable of providing a luminance measurement 200 meters without signal loss. In the event of a failure of a luminance sensor, the opposite portal luminance meter shall be used as a backup manual transfer from the SCADA workstation
E. All exterior mounting hardware shall be stainless steel access and shall be by means of continuous hinge, with a one-piece compressible neoprene gasket.
F. The luminance sensor shall be capable of field calibration and verification using a reference luminance photometer.

SCADA TUNNEL LIGHTING SYSTEM

SCADA tunnel lighting system shall have a distinctive graphic representation page on the computer screen and shall provide a real time statues of the elements connected to local PLC system located on the battery substation . It shall provide the operator the ability to manually control each device as shown on the plans using a mouse. Such access shall be password protected.

The graphic presentation shall be color coded to provide a distinction between ON or OFF status. Alarm status, historical information and other notations for each status change shall be displayed, and recorded on hard disk.

Wiring diagrams shown on the plans for input and output modules are diagrammatic only. External network necessary to counteract induced signals on the conductors for proper operation of the input or output modules as recommended by the manufacturer is not shown. The Contractor shall be responsible for including such devices on the circuits as the field conditions dictates.

During the construction, all the operation the new installed 12 kV switches gears and emergency telephone and fire alarm system shall not be affected by the construction work. If the schedule of the Contractor should require interruption of the power distribution system, fan control system for an overnight period, manual operation of all the above system shall be conducted with a duty electrician.

As the work progresses, the Contractor shall maintain a record of all deviations in the work from the shown on the plans. Final locations of all underground work shall be recorded by depth from finished grade and by offset distance from permanent surface structures (i.e. buildings, curbs, walks, etc). Under floor conduits and other features within the building shall be recorded by off set distance from building walls.

Earthwork, foundations, sheets metal, painting, mechanical and such other work incidental and necessary to the proper installation and operation of the electrical work shall be done in accordance with the requirements, specified for similar work in the standard specifications and elsewhere in these special provisions.

SCADA Lighting General Functions

The exact locations, arrangements, and dimensions of the device symbols, messages, display screen controls and other items on the display screens along with the drawings of the display screens shall be submitted by the Contractor to the Engineer for approval. The SCADA lighting menu shall be mouse driven with the following major functions:

A. Password Screen to enter User ID and password.
B. Overview Screen showing graphically the system's current status using color coded symbols, icons and figures, including:

    1. Luminance meter sensor values and primary or backup operating mode.
    2. Lighting controller mode of operations Run, Test, Program).
    3. Lighting contactor panel status (Manual, Auto).

4. Lighting output level and feedback from lighting contactors.
5. Alarm summary window showing latest alarms.
6. Pop up menu symbols to allow for complete level override.
7. An arrow indicating the traffic direction entrances and exits of at each tunnel display.

C. Alarm Handler/event log screen using color-coded text messages with a date/time stamp, status, priority, description, tag name and value. Alarms shall be latched and logged to disk in a daily alarm file and store detail information along with data, such as tunnel name, portal building, device name and number, date and time. Alarms shall be displayed on the SCADA monitor for a day alarms can be retrieved form the SCADA PC's hard disk drive. A distinct alarm sound shall allow operator to distinguish to the existing alarm sounds. The Alarm Handler/Event log shall show a minimum of the following:

1. Alarm summary, segregated by priority.
2. Event log, showing output status and contactor feedback.
3. Alarm history showing by date and timestamp, an event sequence and locations.
4. Alarm state with unacknowledged, acknowledged and return to normal separately colored messages.

D. Trend Graph screen showing instantaneous values of the luminance meter sensor, along with controller output response. Each controller output level shall be color-coded. The trend graph shall have a minimum resolution of 1 minute. The time base of the trend graph shall be selectable,
E. Equipment Status screen shows the front panel view of each lighting contactor cabinet. Remote override of individual lighting contactors shall be accomplished when the local panels Manual/Auto selector switch position is in the AUTO position. Indicator light symbols shall show the status of lighting contactors.
F. Report Screen allowing the operator to select between pre-configured reports that are event based (alarm reports), time based (period and accumulated runtime hours) and operator based (operator log). Each operator interface screen shall also be capable of printing to the system printer. The SCADA shall allow the user to edit, print view, delete and create reports and have Pop-up when an alarm is acknowledged
G. Lighting controller-programming screens to provide equipment mode and control settings, and individual light level set point and timing parameter.
H. The system shall link to a master Database, to retrieve point details for every point displayed on the screens, this database maybe located remotely at another site if necessary, or locally on the SCADA PC. The database should provide further design and maintenance information for each point in the system, as well as trouble shooting in case of a point failure.

General Lighting Software Requirements

The tunnel geometric and lighting descriptions within this portion of the special provisions are consistent with RP-22 (2005) of the Illuminating Engineering Society of North America.

This portion of the special provisions described the general requirements for the software as controlling the tunnel is concerned. Where programming requirements described elsewhere in this special provisions conflict with portions of this section, this section shall have control and precedence. The Engineer shall make a final decision when a conflict exists.

Battery Tunnel

A. Threshold and Transition Zones:

Circuits include 1A, 1B, 1C, 1D, 1E and 1F. There are 12 circuits total, and all circuits shall control HPS lighting on south sides throughout the Battery Tunnel. The programming shall control all of these circuits. The programming shall energize the circuits depending upon the ambient lighting conditions outside the tunnel at levels depicted in the plans. The order of energizing shall be 1A, 1B, 1C, 1D, 1E, then 1F. De-energizing shall be reverse of energizing.

B. Interior Zone:

Circuits include 1X and 1Y, and 4 circuits total. All circuits shall control HPS lighting on south sides through out the Oakland side of Tunnel. The programming shall control all of these circuits. 1X and 1Y shall be energized all time regardless day or night light condition except for the special condition on the following:

1. Maintenance: Maintenance shall have the capability to energize or de-energize circuits at the Lighting Contactor Panel (CP#1).
2. UPS: In the event of UPS failure, the program shall continue energize 1Y circuit which is supplied by utility power, and program shall not be disturbed by any status such as alarming through the SCADA system. The alarm is automatically shut off when the programming determines UPS is operating normally.
3. Black Out: In the event of lost utility power, the program shall automatically detect the power failure and without disturbing 1X circuit.
4. 1X circuitry: The circuit is provided with mechanically held contactor. Therefore, the program shall provide setting the circuit, or re-setting the circuit when the circumstance is permitted.

Communication Break Down

In case of lost communication between SCADA and local PLC system or failure of Local PLC system, the hardware of relay logic will select certain circuits to maintain some lights in the tunnel. The software on SCADA shall provide warning signal to maintenance person.

Software Maintenance

The lighting control system and SCADA system software shall maintained for the SCADA PC. Master program databases and development editors shall be provided, as well as runtime executable programs. Password protection of the source code shall be maintained for the duration of the warranty period.

Warranty

The system shall be warranted for a period of two years after commissioning. During this period, owner maintenance personnel and Contractor shall be assisted by the control system manufacturer to diagnose and remedy system problems via telephone modem and dialup remote control. The manufacturer will replace spare parts that are used to effect repairs during the warranty period

Commissioning

The Engineer shall review complete system test procedures for lighting control hardware, fiber optic and wire communication. Lighting controller sequence software and SCADA operator interface design test forms shall be approved before commissioning. SCADA database and representative operator screens are and reports shall be approved.

Automatic script procedures shall be utilized to test lighting control hardware and software elements, log system response and generate commissioning reports.

Training

Three training courses shall be developed and given to State personnel by the Contractor. First training course shall be on the theory and operation of all systems. It will be designed for Engineer and supervisory personnel. It will be a one day, approximately eight hours, hands-on training on the use of the computer. It will included setting of point values on PLCs, and parameters on the SCADA system as permitted by the various security levels of the system. Six Engineer and managers will attend this course. Each attendee will be given a copy of the approved Operation Manual. The second and third training will be a day each. Six employees will attend the each training for dispatchers, maintenance and operation personnel. The course will included training on how to obtain data from the computer, how to respond to alarms, the use of SCADA system to monitor and control all the devices, step by step review and demonstrations of the maintenance required by the manufacturer of the major components of all systems. In addition the training will include testing to identify and locate failed components to the circuit board level. The Contractor shall furnish each employee one copy of the approved Operation and Maintenance Manual. Training shall be video recorded and edited to be played as an mpeg on compact disk.

TUNNEL LIGHTING UNINTERRUPTIBLE POWER SUPPLY

The Contractor shall supply and install an uninterruptible power supply (UPS) as described in this special provision at each location depicted on the plans. The UPS shall supply continuous, regulated AC power to HPS lighting-type loads with reliable and precise AC power under normal and abnormal conditions including but not limited to the temporary loss of utility AC power.

The UPS shall always be on-line, conditioning and regulating incoming AC power as required to keep the HPS lighting in continuous operation. It shall provide a reliable source of uninterruptible power with no fluctuations in output AC power during complete or partial interruption of the incoming power. The output of the UPS shall not be affected by the quality of the AC input.

Standards

Each UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

A. ASME ANSI C62.41 (IEEE 587).
B. FCC Part 15, Class A.
C. IEC 1000-4-5.
D. ISO 9001.
E. NEC (NFPA-70).
F. NEMA PE-1.
G. OSHA.
H. UL Standard 1778.
I. CSA 22.2, No. 107.1.

UPS System Requirements

Voltage

Input/output voltage specifications of the UPS system (consisting of the UPS and Maintenance Bypass Cabinet) shall be:

A. System input: 480 V(ac), 3 phase, 3 wire plus ground.
B. System output: 480 V(ac), 4 wire plus ground.

Output Load Capacity

Specified output load capacity of the UPS shall be 30 kVA at 0.8 lagging power factor.

Battery

A. Battery cells– sealed lead acid, valve regulated.
B. Reserve time– 9 minutes at full load, 0.8 power factor and with ambient temperature of 25 °C.
C. Recharge time- to 95 percent capacity with ten times discharge time.

Modes of Operation

The UPS shall be designed to operate as an on line, double conversion and reverse transfer system in the following modes:

A. Normal- The critical AC load is continuously supplied by the UPS inverter. The rectifier/charger derives power from a utility AC source and supplies DC power to the inverter while simultaneously float charging the reserve battery.
B. Emergency- Upon failure of utility AC power, the critical AC load is supplied by the inverter, which without any switching obtains power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.
C. Recharge- Upon restoration of utility AC power, after a utility AC power outage, the rectifier/charger shall automatically restart, walk in, and gradually assume the inverter and battery recharge loads.
D. Bypass- If the UPS must be take out of service for maintenance or repair, or should the inverter overload capacity be exceeded, the static transfer switch shall perform a reverse transfer of the load from the inverter to the bypass source with no interruption in power to the critical AC load.

Performance Requirements

AC Input to UPS

A. Voltage configuration for standard units- three phase, 3 wire plus ground
B. Voltage range- From +10 percent to -20 percent of nominal
C. Frequency- nominal frequency ± 5 percent
D. Power factor- up to 0.99 lagging at nominal input voltage and full rated UPS output load
E. Inrush current- 800 percent of full load current maximum
F. Current limit- 125 percent of nominal AC input current maximum
G. Input current walk-in- 20 seconds to full rated input current maximum and field selectable 5 through 20 seconds
H. Current distortion- 4 percent reflected THD maximum at full load
I. Surge protection- sustains input surges without damage per criteria listed in IEC 1000-4-5

AC Output, UPS Inverter

A. Voltage configuration- three phase, 4 wire plus ground.
B. Voltage regulation-

1. ±1 percent three phase RMS average for a balanced three phase load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.
2. ±2 percent three phase RMS average, for a 100 percent unbalanced load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.

C. Frequency- nominal frequency ±0.1 percent.
D. Frequency slew rate- 1.0 Hz per second maximum and field selectable form 0.1 to 1.0 Hz per second.
E. Phase displacement:

1. ±0.5 degree for balanced load.
2. ±1.0 degree for 100 percent unbalanced load.

F. Bypass line sync range:

1. ±0.5 Hz.
2. Field selectable ±0.5 to 5.0 Hz.

G. Voltage distortion:

1. 1 percent total harmonic distortion (THD) for linear loads.
2. Is less than 4 percent THD for 100 percent nonlinear loads (3:1 crest factor) without kVA/kW derating.

H. Load power factor range- 0.7 lagging to .0.95 leading without derating.
J. Output power rating- rated kVA at 0.8 lagging power factor.
K. Overload capability:

1. 125 percent for ten minutes (without bypass source).
2. 150 percent for one minute (without bypass source).

L. Inverter output voltage adjustment- ±5 percent manual adjustment.
M. Voltage transient response:

1. 100 percent load step ±4.0 percent.
2. loss or return of AC input power ±1.0 percent.
3. manual transfer of 100 percent load ±3.0 percent.

N. Transient recovery time- within 1 percent of output voltage and within one cycle.
O. Voltage unbalance- 100 percent unbalanced load ±1 percent.

Environmental Conditions

The UPS shall be able to withstand the following environmental conditions without damage or degradation of operation characteristics:

A. Operating ambient temperature:

1. UPS module- From 32 °F to 104 °F.
2. Battery- 77 °F ±9 °F.

B. Storage/transport ambient temperature:

1. UPS module- -4°F to 158°F.
2. Battery- -4°F to 92°F.

C. Relative humidity- From 0 to 95 percent non-condensing.
D. Audible noise- Noise generated by the UPS under any condition of normal operation shall not exceed 54 dBA measured 1 meter from surface of the UPS.

Static Transfer Switch

General

A static transfer switch and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be a naturally commutated high speed static (SCR-type) device rated to conduct full load current continuously. The switch shall have an overload rating to clear a 20 ampere load branch circuit breaker.

The static transfer switch control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals and operating alarm conditions. This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass source without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS, or for bypassing the UPS for maintenance.

Uninterrupted Transfer

The transfer control logic shall automatically turn on the static transfer switch transferring the critical AC load to the bypass source after the transfer logic senses any of the following conditions:

A. Inverter overload capacity exceeded.
B. Critical AC load overvoltage or undervoltage.
C. Battery protection period expired.
D. UPS fault condition.

The transfer control logic shall inhibit an automatic transfer of the critical load to the bypass source if any of the following conditions are present:

A. Inverter/bypass voltage difference exceeding preset limits.
B. Bypass frequency out of limits.
C. Bypass out of synchronization range with inverter output.

Uninterrupted Retransfer

Retransfer of the critical AC load from the bypass source to the inverter output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following conditions exists:

A. Bypass out of synchronization range with inverter output.
B. Inverter/bypass voltage difference exceeding preset limits.
C. Overload condition exists in excess of inverter full load rating.
D. UPS fault condition present.

Maintenance Bypass Switch

General

A manually operated maintenance bypass switch shall be incorporated into the UPS cabinet to directly connect the critical load to the bypass AC input power source, bypassing the rectifier/charge, inverter and static transfer switch.

Isolation

All energized terminals shall be shielded to ensure that maintenance personnel do not inadvertently come in contact with energized parts for terminals. A means to de-energize the static switch shall be provided when the UPS is in the maintenance bypass mode of operations

Maintenance Capability

With the critical load powered from the maintenance bypass circuit, it shall be possible to check out the operation of the rectifier/charger, inverter, battery, and static transfer switch. When the application calls for the maintenance bypass switch to be bolted to the UPS cabinet, the interconnecting cables are to be provided, precut and prelugged.

Internal Battery Power Pack

The battery power pack shall internal to the UPS system and shall include sealed, lead-acid valve regulated battery cells housed in a separate cabinet. Battery cell shall be mounted on slide-out trays for ease of maintenance. The UPS shall automatically be disconnected from the battery when the battery reaches the minimum discharge voltage level.

External Maintenance Bypass Cabinet

A matching external maintenance bypass cabinet shall be provided to enable the UPS module to be completely isolated from the electrical system while the critical load is powered through the external maintenance bypass line. This cabinet shall provide make-before-break operation for transfers to and from the external maintenance bypass line with a single rotary switch. The following components shall be standard input and output circuit breakers, input isolation transformer, single rotary switch with auxiliary contacts, inter-cabinet wiring, casters, and leveling feet. This matching cabinet shall bolt to the side of the UPS module with a barrier shield to separate the two cabinets. Only front access shall be required for installation and service.

Batteries and Battery Charger

The UPS batteries shall have the following specifications:

A. The batteries shall be sealed, maintenance-free, high-rate discharge type.
B. The expected life shall be 200 complete full load discharge cycles.
C. Recharge time shall be less than 13 times discharge time.
D. The batteries shall be protected with a DC circuit breaker.
E. The batteries shall have a minimum capacity of 10 minutes at full load.

Controls

The UPS controls and indicators shall have the following specifications:

A. The UPS shall be microprocessor controlled.
B. The UPS shall have a front panel display, with the following minimum displays:

    1. UPS status.
    2. Battery status.
    3. Alarm and event queue.
    4. Active alarms.
    5. UPS configurations.
    6. Metering.
    7. Normal/Bypass mode.
    8. Utility/Battery mode.
    9. Load/Overload condition.
    10. Audio alarm control.

Protection

The UPS input shall be protected by an input current limiting circuit breaker.
The UPS input shall be protected from surges such as lightning strikes and switching surges.
The UPS output shall be protected by a current limiting circuit breaker.

Communications

The UPS shall have an EIA-232 serial asynchronous communications port for connection to a remote computer. The port shall be mounted on the exterior of the cabinet. The UPS shall send the following operations to the computer, at the request of the computer:

A. Alarm status and information.
B. Utility input data.
C. UPS output data.
D. Battery status.

Installation

The UPS and battery cabinets shall incorporate seismic anchoring methods. The UPS equipment shall be started by a customer support representative from the UPS equipment manufacturer. The UPS installation shall include all conductors, cables, connectors, conduits, and other equipment and materials as required making the UPS fully functional. The UPS installation shall include a load test described elsewhere in these Special Provisions.

Schematics, Documentation, and Training

The Contractor shall supply detailed circuit schematics, documentation, and system drawings with the UPS. The documentation shall include wiring installation, maintenance, and troubleshooting of the battery unit. All circuit schematics, documentation, and system drawings submitted are subject to the approval of the Engineer.

The Contractor shall provide 8 hours of training not including breaks on the maintenance and operation of the UPS. The training site shall be located at the Caldecott tunnel maintenance office area and UPS location, and shall include hands on training on one UPS. The Contractor shall provide 10 training manuals for the class, however, as many as 20 may participate in the training. The class agenda and schedule shall be approved by the Engineer 10 working days before the class may begin.

The Contractor shall provide the Engineer with a Certificate of Compliance from the manufacturer in accordance with the provisions of Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The Certificate of Compliance shall contain any and all of the items contained within this Special Provision.

Testing

The Contractor shall test each UPS under full load conditions, during daylight hours. The load shall be the normal HPS lighting load. The tests, methods, and criteria shall be submitted in writing to the engineer for approval 10 days before the test is to begin. The Contractor shall schedule a time when the engineer shall be present for the entire test.

Test No. 1

The test shall include the removal of the input power for five minutes, then the re-energizing of the input power. The Contractor shall demonstrate by using the manufacturer's published information and submitted criteria, that the UPS is capable of continuing to supply power to the load for an additional 5 minutes.

If any of the HPS luminaires extinguish for any reason during the test period, then the UPS will be rejected. If the contractor cannot demonstrate that the UPS can continue to supply power to the load for an additional 5 minutes using the manufacturer's published information and accepted criteria, then the UPS will be rejected.

Test No. 2

The test shall include the removal of the input power for five seconds, then the re-energizing of the input power. This cycle shall be repeated 10 times at various intervals, and the entire test completed within 10 minutes of the completion of test #1.

If any of the HPS luminaires extinguish for any reason during the test period, then the UPS will be rejected.

Warranty and Service

The manufacturer shall guarantee the UPS unit to be defect-free in materials and workmanship for 12 months after the project is accepted. The UPS manufacturer shall guarantee the UPS batteries for a minimum of 5 years (full replacement, transportation and labor) and an additional 5 years of pro-rated warranty by the battery manufacturer. The total warranty shall be 10 years or longer, and shall begin following the acceptance of the project.

The manufacturer shall have an established network of service centers capable of servicing the UPS. The service personnel shall be on call 24 hours a day, 365 days a year. Personnel shall be factory trained and certified in the maintenance and repair of the equipment.

The contract lump sum price paid for tunnel lighting shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in tunnel lighting, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-3.45 GROUNDING, CONDUITS EMBEDDED IN STRUCTURES

Grounding and conduits embedded in structures shall include conductive cement, ground clamp, grounding electrode system testing, ground well, grounding bar, and grounding electrode as shown on the plans and in conformance with these special provisions.

CONDUCTIVE CEMENT

Conductive cement shall consist of furnishing, mixing and placing conductive cement as shown on the plans and shall conform to the provisions in Section 86, "Signals, Lighting and Electrical Systems," "Section 90-2.03, "Water," Section 90-6.05, "Hand-Mixing," these special provisions, and as directed by the Engineer.

The Contractor shall use conductive cement from one of the following products or equal:

A. SAN-EARTH M5C Conductive Cement
Sankosha U.S.A., Inc.
406 Amapola Avenue, Suite 135
Torrance, CA 90501
Tel: 310-320-1661
Toll Free: 888-711-2436
Fax: 310-618-6869
http://www.sankosha-usa.com/sanearth.asp

B. Conducrete
SAE Grounding Systems, Inc.
19 Churchill Drive, Barrie, Ontario,
CANADA L4M 6E7
Tel: 705-733-3307
Fax: 705-733-1218
http://www.saeinc.com/Conducrete

Conductive cement shall be mixed and placed in conformance with the manufacturer's instructions.

GROUND CLAMP

The ground clamp shall be as shown on the plans. The ground clamp shall be UL 467 Listed for direct burial in earth and concrete. The ground clamp shall adhere to NEMA: FB-1, Fed. Spec: A-A-50552, and NEC Section 250.70 third party standards.

Irreversible Compression Group Tap

The irreversible compression ground tap shall be as shown on the plans. The irreversible compression ground tap shall meet all IEEE 837 requirements, and be UL 467 listed for direct burial applications in earth or concrete.

Tinned Copper Braid

The tinned copper braid shall be a 1" wide by 12" long by 0.187" thick extra flexible tinned copper grounding wire with pre-fabricated solid ends to accept bolts or screws for connection to equipment as needed.

Exothermic Weld

General

The contractor shall use an exothermic welding system for making electrical connections as shown on the plans. The exothermic welding system supplied in these special provisions shall include weld metal, molds, tools and accessories as required.

Standards

The exothermic welding system furnished as specified in these special provisions shall meet the applicable requirements of ANSI IEEE Standard 80 "IEEE Guide for Safety in AC Substation Grounding" and IEEE Standard 837 IEEE "Standard for Qualifying Permanent Connections Used in Substation Grounding". Independent test data showing conformance to IEEE Std. 80 and IEEE Std. 837 shall be readily available.

An OSHA nationally recognized test laboratory such as Underwriters Laboratories to ANSI UL 467 "Grounding and Bonding Equipment" shall approve the exothermic welding system supplied as specified in these special provisions.

Application

The exothermic welding system shall be used for making electrical connections of copper to copper, copper to steel or copper to cast iron for grounding and cathodic applications as shown on the plans.

A. Exothermic welding connections shall be suitable for exposure to the elements of direct burial in earth or concrete without degradation over the lifetime of the grounding system.
B. Welded connections are metallurgically similar to exothermic welding connections as specified in part "A" but are designed primarily for indoor or confined spaces. Exothermic welds shall use weld metal with no starting material. Molds shall use a dual element filter system that removes 97 percent of the smoke.

Material

Exothermic welding system molds shall be made from:

A. Graphite material capable of withstanding high temperatures that are capable of providing an average life of not less than fifty separate exothermic welds.
B. Cordierite, refractory ceramic or other material suitable for a single connection.

Starting material (where used) shall consist of aluminum and copper and iron oxides. It shall not contain phosphorous, magnesium or any caustic, toxic or explosive substances.

Low voltage battery starting (where used), shall use an electric ignition system that does not use starting material.

Weld metal used for grounding connections shall contain copper oxide, aluminum and not less than 3 percent tin as the wetting agent. Weld metal used for cathodic connections shall not contain tin, but shall contain vanadium.

Quality Control

Weld metal shall be controlled at the factory and subjected to routing and rigid quality control inspection procedures. The batch control lot number shall be packaged with the product for shipment from the factory.

A. Manufacturers shall be ISO9001: 2000 certified.
B. Manufacturers shall have been engaged in the design and manufacturing of exothermic connection systems for project of equal size and complexity to the work shown on plans. Also the contractor shall provide a minimum of five certified resumes (That shall included but not be limited to information of the company name, contact names and phone numbers, and description of the project that is of equal size and complexity to the work shown on plans) of those projects.

Marking

Graphite molds shall bear permanent marking indicating the name of the manufacturer, the mold part number, the type and size of welding mixture compatible with the welding process and the size of the cable or bus connection. Labels on the package shall identify ceramic molds. Instructions detailing general safety information, connection preparation and welding procedures shall be provided with each mold.

Weld metal packages shall be identified as to the part number (size) and type of metals to be connected, such as copper to copper or copper to steel, cast iron, etc.; or shall be marked for their intended use – such as cathodic connections.

Package and Shipping

Containers for weld metal shall be moisture resistant and shall be packaged to prevent damage or spillage during shipping.

Weld metal and starting material (if used) shall be pre-measured and packaged to prevent spillage during shipping.

Training

Use of the exothermic connection system shall require minimal training. Factory trained personnel shall respond to field calls quickly and provide training for construction crews on the proper techniques for making exothermic welding connections.

GROUND WELL

The ground well shall meet the following specifications:

General

A. Ground well: electrolytic maintenance free.
B. Components: Ground well electrode with 500 kcmil Cu exothermically welded pigtail, protective box and backfill material.

Products

A. General

1. Self contained grounding electrode using electrolytically enhanced grounding shall be provided where specifically indicated on the plans.
2. The grounding electrode shall operate by hygroscopically extracting moisture from the air to activate the electrolytic process improving performance.
3. Ground well shall be UL listed and manufactured for ten years or more.
4. Ground well and well manufacturer shall be ISO 9002 certified.
5. Ground well shall be 100 percent self-activating and maintenance free. No additions of chemical or water solutions required.

B. Electrode Unit

1. The copper grounding electrode shall consist of a 2" nominal diameter hollow copper tube with a wall thickness of not less than 0.082" . The tube shall be permanently capped on the top and bottom. Air breather holes shall be provided in the top of vertical portion of the tube and drainage holes shall be provided along the bottom length of the tube for electrolyte drainage into the surrounding soil.
2. The grounding electrode shall be filled from the factory with non-hazardous Calsolyte to enhance grounding performance.
3. Grounding electrode shall be a minimum of 3 meter long with a vertical riser 1 m in length.
4. A stranded 500 kcmil Cu ground wire shall be exothermically welded to the side of the vertical portion of the electrode for electrode conductor connection.

C. Ground Access Box - Precast concrete box with slots for conduit entrances. Minimum size 10" diameter by 1' high, cast iron grate flush cover with "breather" slots.

D. Backfill Material

1. Natural non-corrosive form of bentonite clay grout backfill material free of polymer sealants.
2. Shall absorb approximately 14 gallons of water per 50 lb bag for optimal 30 percent solids density.
3. PH value 8-10 with maximum resistivity of 3 ohm-m at 30 percent solids density.

Electrolytic Grounding System

Information and Specifications

A. Shaft Configuration: Straight-Shaped.
B. Length: as shown in the plans.
C. UL Listing: 467.
D. ISO 9002 Certified.
E. Material: Type K Copper 0.082" wall thickness.
F. Construction: Hollow tube, 2" O.D., filled with Carsonite.
G. Ground wire termination: Exothermic welded connection to 500 kcmil Cu conductor.
H. Minimum life expectancy: 30 years.

Installation

A. General: Install grounding electrode system in compliance with manufacturer's instructions or recommendations.
B. Excavation:

1. Excavate a 6" diameter hole 6" deeper than the length of the electrode to be buried. This insures that the top of the copper grounding electrode will not come in contact with the metal grate of the protective box or hand-hole cover.
2. Remove sealing tape from leaching holes.

C. Backfill

Place grounding electrode unit in hole, so top of unit is about 6" -below grade.
Lynconite-The ground well manufacturer's recommended backfill is a specific clay included with the system. Mix each 50 lb backfill material with 14 gallons water to form a thick slurry and pour around grounding electrode up to 'bury to here sticker".
Place protective box so top is flush with grade level and finish.
Remove sealing tape from top breather holes to activate.

D. Connection

Connect grounding electrode conductor(s) to grounding electrode pigtail exothermically welded (Cadweld or thermOweld or equal) as shown on the plans.
Bury grounding conductor 750 mm below grade. Cover conductor(s) (as shown on the plans) with a small amount of backfill for protection against corrosion.

GROUNDING BAR

The grounding bar shall be a ground busbar as shown on the plans and shall meet the following specifications:

Materials

A. Busbars

1. 1/4" thick copper
2. ASTM B187-C11000
3. Electro-tin plated

B. Insulators

1. The grounding bar shall be manufactured of rugged polyamide, an environmentally friendly, halogen-free nylon material which is reinforced with glass fiber.
2. The grounding bar shall have a 2" standoff height.
3. The grounding bar shall meet the requirements of UL 94 VO for self-extinguishing materials.

C. Brackets

1. Type 304 Stainless Steel
2. 1/8" thick

D. Fasteners: Type 304 Stainless Steel

Size

The grounding bar shall be 12" in length unless otherwise shown on the plans.

Standards

A. UL Listed to UL467
B. TIA/EIA 607

Installation

A. For the grounding bars installed in the electrical niches in the tunnel, the Contractor shall mounted the grounding bar shown on the plans in each electrical niche in the tunnel; exothermic weld the grounding electrode conductor shown on the plans in each electrical niche in the tunnel to a lug; and bolt the lug with the conductor to the grounding bar.
B. For the grounding bars installed in the substation that are not shown on the plans connected to the grounding electrode conductor, the Contractor shall mounted the grounding bar shown on the plans at that location in the substation; exothermic weld the grounding electrode conductor to a lug; and bolt the lug with the conductor to the grounding bar.
C. For the grounding bars not installed as specified in section A and B, the Contractor shall mounted the grounding bar shown on the plans at that location.

GROUNDING ELECTRODE

The grounding electrode shall be a 10' long by 1" in diameter sectional threaded copper clad grounding electrode that shall consist of a steel core with copper plating included finishing, and markings as specified below; and also shall meet the standards and references as specified below:

Steel Core

A. 1035 Cold drawn steel – Cold drawn to ASTM A1080 and ANSI C1017 standards
B. The minimum tensile strength shall be 620 Map.

Copper Plating

The copper shall be applied electrolytically, forming a metallurgical bond between the steel core and the copper. The copper shall be type DHP alloy #122CDA and s-rated at 99.95 percent copper. The end result shall be a high quality bond between copper, nickel, and steel.

Plating Thickness: The copper plating shall be controlled to the thickness levels of 0.01" +0.001"/-0.000" and is continuous over the electrode with the exception of the pointed and chamfered ends.

Diameter: The measurements of the grounding electrode diameter shall be based on finished plated average root diameter of 0.91" .

Finishing

The grounding electrodes shall be roll-threaded to provide American Standard coarse thread requirements with a Class 2 fit. One end of the grounding electrode shall be with a "flat" point and the other end shall be a threaded chamfered end. The length tolerance of the grounding electrode shall be +0.625"/–0.000" .

Marking of Electrode

The grounding electrode shall be imprinted within 12" of the top of the electrode with: part number indicating electrode diameter and length, manufacturer logo and UL mark.

Standards and References

A. Underwriters Laboratories (UL) 467.
B. National Electrical Manufacturers Association (NEMA) 8CC-5/GR-1.
C. American National Standards Institute (ANSI) C33-8 ASTM A1080; ANSI C1017 for steel.
D. Naval Facility Engineering Command NAVFACENGCOM 12.1.
E. Military Handbook MILHANDBOOK 419.

GROUNDING ELECTRODE SYSTEM TESTING

The Contractor shall perform the following on the grounding electrode system for the Doyle Drive Battery substation and the Southbound Battery tunnel as specified below:

A. Certified measurements shall be taken and submitted prior to connection to main service utility ground. Grounding electrode system resistance shall not exceed 1 ohm.
B. The testing of the grounding electrode system for the battery substation and the southbound battery tunnel shall utilize an earth resistance meter and shall be conducted in accordance with the IEEE Standard 3-point fall of potential method
C. Notify the Engineer three days prior to the scheduled testing date so they may be present at the time of testing for the substation on the battery substation and the southbound battery tunnel.
D. The grounding electrode system for the substation on the battery substation and the southbound battery tunnel shall pass a "Sixty two Percent Fall-of–Potential" test. The minimum length of the test conductors shall be 300'. The Contractor shall have a curve of resistance vs. distance prepared. The Contractor shall immediately notify the Engineer if the measured resistance is above 1 ohm.

An independent testing firm shall be employed for the testing and report. The Contractor shall submit a copy of test report to the Engineer within 10 days after testing and before the grounding electrode system for the battery substation and the southbound battery tunnel becomes inaccessible. In addition, the Contractor shall submit a copy of test report to the Engineer within 10 days after testing and completion of the installation of the grounding electrode system for the battery substation and the southbound battery tunnel .

The contract lump sum price paid for grounding and conduits embedded in structures shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in grounding and conduits embedded in structures, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

SECTION 10-5. TUNNEL MECHANICAL

10-5.01 MECHANICAL MATERIALS AND METHODS

GENERAL

Mechanical materials and methods shall include furnishing and installing components needed for complete installation of systems in conformance with the details shown on the plans and the requirements specified in these special provisions. The following items and components shall be included:

A. Piping materials and installation instructions common to most piping systems.
B. Concrete base construction requirements.
C. Escutcheons.
D. Dielectric fittings.
E. Flexible connectors.
F. Mechanical sleeve seals.
G. Operation and maintenance manual requirements.
H. Nonshrink grout for equipment installations.
I. Field-fabricated metal equipment supports.
J. Installation requirements common to equipment specification sections.
K. Cutting and patching.
L. Firestopping sealants and caulks.
M. Touchup painting and finishing.

The following definitions are used:

A. Finished spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
B. Exposed, interior installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
C. Exposed, exterior installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations and piping within tunnels.
D. Concealed, interior installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
E. Concealed, exterior installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters within niches and cabinets in tunnels.
F. CR: Chlorosulfonated polyethylene synthetic rubber.
G. EPDM: Ethylene propylene diene monomer rubber.

SUBMITTALS

The Contractor shall submit manufacturer's technical data of all pipe and pipe fittings, pipe joining materials, valves, and other in-line components, pipe supports, dielectric fittings, flexible connectors, mechanical sleeve, piping specialties, grout, firestopping and sealants. In addition, brochures or other information describing the materials, construction methods and the general characteristics of the pipe and pipe fittings shall be submitted. Samples of color, lettering style, and other graphic representation required for identification of materials and each device shall also be submitted. The Contractor shall submit a complete list of all materials to be provided.

The Contractor shall submit working drawings in conformance with Section 5-1.02 "Plans and Working Drawings" of the Standard Specifications and these special provisions.

Working drawings shall include complete details, information, drawings and equipment selection criteria for mechanical materials and methods as specified in these special provisions. The working drawings shall include the following:

A. Detail fabrication and installation drawings for metal supports and anchorage for mechanical materials and equipment.
B. Coordination drawings for access panel and access door locations.

C. Coordination drawings showing major elements, components, and systems of mechanical equipment and materials in relationship with other systems. The drawings shall show space requirements for installation removal and maintenance access. The following additional features shall be included in the drawings:

1. Piping layout, showing valve and specialty locations and valve-stem movement.
2. Clearances for installing and maintaining insulation.
3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly as required for periodic maintenance.
4. Equipment and accessory service connections and support details.
5. Exterior wall and foundation penetrations.
6. Fire-rated wall and floor penetrations.
7. Sizes and location of required concrete pads and bases.
8. Scheduling, sequencing, movement, and positioning of large equipment into structures during construction.
9. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

D. For all supports in the tunnel final lining, the depth of embedment and anchor bolt pattern, sizing and spacing shall be shown. The anchor bolt embedment shall not penetrate the tunnel waterproofing.

Where submittals and working drawings are required, after complete working drawings and supplement are received by the Engineer, the Contractor shall allow the Engineer 30 working days to review the submittal. No construction of item of work the working drawings are submitted for review and approval shall begin until complete working drawings and supplement are reviewed and approved, in writing, by the Engineer.

Project record drawings shall be submitted in accordance with the requirements specified under "Project Record Drawings," in Section 12-1, "General Requirements," of these special provisions.

As the work progresses, the Contractor shall maintain a record of all deviations in the work from that shown on the plans. Final location of all underground work shall be recorded by depth from finished grade and by offset distance from permanent surface structures.

An operation and maintenance (O&M) manual shall be provided that includes every piece of mechanical equipment having specific operating procedures, or requiring maintenance, inspection or adjustment. O&M manuals shall also be provided for each item of equipment in a system as specified in other sections. The Contractor shall furnish 3 copies, bound in hardback binders or an accepted equivalent. The Contractor shall furnish one complete manual 3 months prior to performance of systems or equipment tests, for review. The Contractor shall furnish the remaining manuals with installation, start-up and test data and settings, prior to contract completion. The following identification shall be inscribed on the cover: the words "OPERATION AND MAINTENANCE MANUAL," the name and location of the system, name of the Contractor, and contract number. The manual shall include the names, addresses, and telephone numbers of each of the local representatives for the system or equipment. A table of contents shall be included and the manual assembled to conform to the table of contents, with the tab sheets placed before instructions covering the subject. The instructions shall be legible, with large sheets of drawings folded in. The manual shall include:

A. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the system or equipment.
B. Description of the function of each principal item of equipment including, a control sequence describing normal startup, operation, and shutdown, and emergency procedures.
C. Installation and maintenance instructions.
D. Safety precautions.
E. Diagrams and illustrations.
F. Testing methods.
G. Performance data and settings "as installed."
H. Cleaning and lubrication schedule including type, grade, temperature range, and frequency.
I. List of items requiring scheduled maintenance such as V-Belt drives and bearings in spreadsheet form. Spreadsheet shall include frequency of lubrication and instructions for performing the maintenance.
J. List of initial settings for vibration and temperature alarms, low temperature and high temperature cut-outs and other similar devices. The manual shall list acceptable range for these set points.
K. List qualified permanent servicing organizations for support of the equipment, including addresses, telephone numbers and certified qualifications.
L. Each piece of mechanical equipment shall include a copy of the stamped approved submittal as part of its section.

Operating instructions shall be furnished for systems and equipment listed in the technical sections of these special provisions for use by the State's operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Operating instructions shall be printed or engraved, and framed under glass or in approved laminated plastic. Operating instructions shall be attached or posted adjacent to each principal system and equipment including startup, proper adjustment, operating, lubrication, shutdown, safety precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each system or equipment. Weather-resistant materials or weatherproof enclosures shall be provided for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

The Contractor shall provide lesson plans and training manuals for the training described in these special provisions. Training manuals shall contain lists of reference materials pertaining to sections of O&M manual to be addressed. The final O&M data shall be approved prior to the scheduling of training.

The Contractor shall provide all equipment, materials and personnel to visually and audibly record all training sessions. Video recordings shall be produced in DVD-R format. Each system or piece of equipment covered shall be recorded as a single program and correlated with the O&M manuals. An identification label shall be affixed to the DVD and be shown on the first two minutes of recording. The label shall identify the project/contract number, equipment or system discussed, length of recording, and reference O&M manual.

The Contractor shall conduct training sessions on the following equipment items and systems for the minimum duration indicated. The training sessions shall be scheduled with at least seven days advance notice. Three separate training sessions shall be required, one for each of three working shifts covering 24 hour continuous operation. These 3 shifts shall be day shift, swing shift and night shift. Training times shall be during each shift's regularly scheduled work time. Training materials shall be provided for up to six (6) persons per session (shift), as follows:

Equipment or System	Class Duration per System per Shift
Tunnel Fire Protection Systems	12 Hour
Roadway Drainage Systems	4 Hour

QUALITY ASSURANCE

Identification devices shall conform to the requirements in ASME A13.1 for lettering size, length of color field, colors, and viewing angles.

Where testing is required elsewhere in these special provisions, the test shall be performed by a testing firm or an engineer who is registered as a Civil or Mechanical Engineer in the State of California. The Contractor shall furnish all test instruments, materials and labor necessary to perform the specified tests. All tests shall be performed in the presence of the Engineer. All instruments shall have been calibrated within a period of one year preceding testing. Calibrations shall be traceable to the National Institute of Standards and Technology (NIST).

Pipes and tubes shall be delivered with factory-applied end caps. End caps shall be maintained through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

Pipes and tubes in storage shall be protected from moisture and dirt and elevated above grade. Structural capacity of floors shall not be exceeded. Flanges, fittings, and piping specialties shall be protected from moisture and dirt. Plastic pipes and ducts shall be stored protected from direct sunlight, and supported to prevent sagging and bending.

Sequencing and scheduling shall conform to the following:

A. Coordinate mechanical equipment installation with other tunnel construction components.
B. Arrange for pipe spaces, chases, slots, and openings in the tunnel structures during progress of construction to allow for mechanical installations.
C. Coordinate installation of required supporting devices and set sleeves, embedded struts and embedded pipe in cast-in-place concrete and other structural components, as they are constructed.
D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning before the equipment chambers are closed in.
E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces.
G. Coordinate installation of identifying devices after completing covering and painting.

PRODUCTS

Pipe threads shall be ASME B1.20.1 for factory-threaded pipe and pipe fittings.

Joining materials shall conform to the following:

A. Pipe-flange gasket materials: Designed for chemical and thermal conditions of piping system contents, as follows:

1. ASME B16.21, nonmetallic, flat, asbestos-free, 3.2 mm maximum thickness, unless thickness or specific material is indicated on the plans.
2. Full-face type: for flat-face, Class 125, cast-iron and cast-bronze flanges.
3. Narrow-face type: for raised-face, Class 250, cast-iron and steel flanges.
4. AWWA C110, rubber, flat face, 3.2 mm thick, and full-face or ring type, unless otherwise indicated in these special provisions or shown on the plans.

B. Flange bolts and nuts: ASME B18.2.1, carbon steel, unless otherwise indicated in these special provisions or shown on the plans.
C. Solder filler metals: ASTM B 32, and as follows:

1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.

D. Brazing filler metals: AWS A5.8, as follows:

1. BCuP Series: copper-phosphorus alloys.
2. BAg1: silver alloy.

E. Welding filler metals: comply with AWS D10.12 for welding materials, wall thicknesses and chemical analysis of steel pipe being welded.
F. Solvent cements: manufacturer's standard solvent cements for the following:

1. VC piping: ASTM D 2564. Include primer according to ASTM F 656.

G. Plastic pipe seals: ASTM F 477, elastomeric gasket.
H. Flanged, ductile-iron pipe gasket, bolts, and nuts: AWWA C110, rubber gasket, galvanized carbon-steel bolts and nuts.
I. Couplings: iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes, with the following:

1. Sleeve: ASTM A 126, Class B, gray iron.
2. Followers: ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 536 ductile iron.
3. Gaskets: rubber.
4. Bolts and nuts: AWWA C111.
5. Finish: enamel paint for above grade applications hot dip galvanized for buried applications.

Dielectric fittings shall conform to the following:

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
B. Description: combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types matching the piping system materials.
C. Insulating material: designed for system fluid, pressure, and temperature.
D. Dielectric unions: factory-fabricated, union assembly, for 250 psi minimum working pressure at 180°F.
E. Dielectric flanges: factory-fabricated, companion-flange assembly, for 150 or 300 psi minimum working pressure as required for system pressures specified elsewhere in these special provisions.
F. Dielectric-flange insulation kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Provide separate companion flanges and steel bolts and nuts for 150 or 300 psi minimum working pressure as required for system pressures.
G. Dielectric couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300 psi minimum working pressure at 225°C.
H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 2070 kPa minimum working pressure at 107°C.

Flexible connectors shall conform to the following:

A. General: fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125 psi minimum working-pressure rating. End connections shall be as follows:

1. 2 inches and smaller: threaded.
2. 2.5 inches and larger: flanged.
3. Option for 2.5 inches and larger: grooved for use with keyed couplings.

Mechanical sleeve seals shall be modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates. Use mechanical sleeve at all pipe penetrations of buried pipe into concrete vaults and man holes unless grouting around the pipe opening is specifically called for and shown on the plans.

Piping specialties shall conform to the following:

A. Sleeves: The following materials shall be for wall, floor, slab, and roof penetrations:

1. Steel sheet metal: gauge 24 minimum thickness, galvanized, round tube closed with welded longitudinal joint.
2. Steel pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
3. Cast iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
4. Stack sleeve fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
5. PVC: Manufactured, permanent, with nailing flange for attaching to wooden forms.
6. PVC pipe: ASTM D 1785, Schedule 40.

B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type as required to conceal protruding fittings and sleeves, including the following:

1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
2. OD: Completely cover opening.
3. Cast brass: One piece, with set screw, finish rough brass or polished chrome-plate.
4. Cast brass: Split casting, with concealed hinge and set screw, finish rough brass or polished chrome-plate.
5. Stamped steel: One piece, with set screw and chrome-plated finish.
6. Stamped steel: One piece, with spring clips and chrome-plated finish.
7. Stamped steel: Split plate, with concealed hinge, set screw, and chrome-plated finish.
8. Stamped steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.
9. Stamped steel: Split plate, with exposed-rivet hinge, set screw, and chrome-plated finish.
10. Stamped steel: Split plate, with exposed-rivet hinge, spring clips, and chrome-plated finish.
11. Cast-iron floor plate: One-piece casting.

Grout shall conform to the following requirements:

A. Nonshrink, nonmetallic grout: ASTM C 1107, Grade B.
B. Characteristics: post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
C. Design mix: 5000 psi, 28-day compressive strength.
D. Packaging: Premixed and factory packaged.

Firestopping material shall be asbestos-free and capable of maintaining an effective barrier against flame and gases. Provide joint sealants with fire resistance ratings of minimum 2 hours, as determined per ASTM E 119, but not less than that equaling or exceeding the fire-resistance rating of the assembly in which firestop material is installed. Provide products with flame-spread values of less than 25 and smoke-developed values of less than 50, as determined per ASTM E 84.

A. Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at project site to form a non-shrinking, homogeneous mortar.
B. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant.
2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

Piping shall be installed in conformance with the following requirements:

A. Piping shall be installed at the slope shown on the plans.
B. Components shall be installed with pressure rating equal to or greater than system operating pressure.
C. Piping shall be installed in concealed interior and exterior locations, except in equipment rooms and service areas, unless otherwise shown on the plans.
D. Piping shall be installed free of sags and bends.
E. Exposed interior and exterior piping shall be installed at right angles or parallel to building or tunnel walls. Diagonal runs are prohibited, unless otherwise shown on the plans.
F. Piping shall be installed tight to slabs, beams, joists, columns, walls, and other building or tunnel elements.
G. Piping shall be installed to allow application of insulation plus one-inch clearance around insulation.
H. Groups of pipes shall be located parallel to each other, spaced to permit valve servicing.
I. Fittings shall be installed for changes in direction and branch connections.
J. Couplings shall be installed in accordance with manufacturer's written instructions.
K. Pipe escutcheons shall be installed for pipe penetrations of concrete and masonry walls in accordance with the following:

    1. Uninsulated piping wall escutcheons: cast brass or stamped steel, with set screw.
    2. Uninsulated piping floor plates in utility areas: cast-iron floor plates.
    3. Piping in utility areas: cast brass or stamped steel, with set-screw or spring clips.

L. Sleeves are not required for core drilled holes.
M. Sleeves shall be installed for pipes passing through concrete and masonry walls, and concrete floor and ceiling slabs, as follows:

    1. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs. Cut sleeves to length for mounting flush with both surfaces, except extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
    2. Build sleeves into new walls and slabs as work progresses.
    3. Install sleeves two pipe sizes larger than pipe to be installed. Use the following sleeve materials:
    4. Steel pipe sleeves: for pipes smaller than 6 inches.
    5. Hot dip galvanized pipe sleeves: For pipe penetrations through tunnel walls.
    6. Stack sleeve fittings: for pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 6 inches above finished floor level.
    7. Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.
    8. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants in conformance with these special provisions.

N. Aboveground, exterior-wall, pipe penetrations: seal penetrations using sleeves and mechanical sleeve seals. Size sleeve two pipe sizes larger than pipe to be installed for installing mechanical sleeve seals, and as follows:

    1. Install steel pipe for sleeves smaller than 6 inches in diameter.
    2. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

O. Underground, exterior-wall, pipe penetrations: install epoxy coated ductile-iron "wall pipe" or Schedule 40 hot dip galvanized pipe for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve two pipe sizes larger than pipe to be installed for installation of mechanical sleeve seals. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

P. Fire-resistive joint sealants: Comply with ASTM C 1193, and with sealant manufacturer's installation instructions and drawings pertaining to products and applications listed in this special provision. Install joint fillers to provide support of sealants during application and at position required to protect the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required. Install sealants using the manufacturer's recommended techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint width that allow optimum sealant movement capability. Install sealants at the same time joint fillers are installed. Tool non-sag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. The Contractor shall not use tooling agents that discolor sealants or adjacent surfaces or that are not approved by the sealant manufacturer.

Q. Piping joint construction: Join pipe and fittings as follows and as specifically required in other sections of these special provisions:

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Construct soldered joints according to AWS's "Soldering Manual," chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
4. Construct brazed joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
5. Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows: Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint; Apply sealing tape or thread compound to external pipe threads, unless dry seal threading is required by the specific application; Align threads at point of assembly; Tighten joint with wrench; Apply wrench to valve end into which pipe is being threaded.
6. The Contractor shall not use pipe or pipe fittings with threads that are corroded or damaged. The Contractor shall not use pipe sections that have cracked or open welds.
7. Construct welded joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to the "Quality Assurance" article in the referenced publication.
8. Install flanged joints by aligning flange surfaces parallel. Select gasket material, size, type, and thickness for service application described in other sections of these special provisions. Install gasket concentrically on the flange. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
9. Install plastic piping heat-fusion joints after clean and dry joining surfaces by wiping joint surfaces with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions. Plain-End Pipe and Fittings: Use butt fusion. Plain-End Pipe and Socket Fittings: Use socket fusion.

R. Piping connections: Make pipe connections according to the following, unless otherwise specified in these special provisions or shown on the plans:

1. Install unions, in piping 2 inches and smaller, adjacent to each valve and at final connection to each piece of equipment with 2 inches or smaller threaded pipe connection.
2. Install flanges, in piping 2.5 inches and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in wet piping systems.

Exposed and concealed piping shall be painted in conformance with the provisions in Section 59 "Painting" of the Standard Specifications, and the following requirements:

A. Interior, ferrous piping: The Contractor shall furnish semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
B. Interior, galvanized-steel piping: The Contractor shall furnish semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
C. Interior, ferrous supports: The Contractor shall furnish semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.

D. Exterior, ferrous piping: The Contractor shall furnish semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
E. Exterior, galvanized-steel piping: The Contractor shall furnish semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
F. Exterior, ferrous supports: The Contractor shall furnish semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.

Piping specialties with factory-applied finish or stainless steel piping shall not be painted. Marred and damaged factory-painted finishes shall be repaired with materials and procedures to match original factory finish.

INSTALLATION

Equipment shall be installed in conformance with the following requirements, unless specified otherwise in these special provisions:

A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated in these special provisions or shown on the plans.
B. Install equipment level and plumb, parallel and perpendicular to other tunnel or building systems and components in exposed interior spaces, unless otherwise shown on the plans.
C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment to facilitate disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
D. Install equipment giving right of way to piping installed at required slope.

Concrete equipment pads shall be constructed with the dimensions as shown on the plans, but not less than 4 inches in height and not less than 6 inches larger in both directions than the supported unit. Coordinate size of equipment pads with approved equipment submittals. Supported equipment manufacturer's setting templates shall be used for anchor bolt and tie locations. Concrete for bases shall be minimum 3000 psi, 28-day compressive-strength concrete and reinforced as shown on the plans.

Miscellaneous metal supports shall be cut, fit, and placed accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

Anchorages shall conform to the provisions for concrete anchorage devices in Section 75-1.03, "Miscellaneous Bridge Metal" of the Standard Specifications and these special provisions.

Floors, walls, partitions, ceilings, and other surfaces shall be cut, channeled, chased, and drilled as necessary for mechanical installations. Cut surfaces shall be repaired to match adjacent surfaces.

Grout shall be placed in conformance with the following requirements:

A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
B. Clean surfaces that will come into contact with grout.
C. Provide forms as required for placement of grout.
D. Avoid air entrapment during placing of grout.
E. Place grout, completely filling equipment bases.
F. Place grout on concrete bases to provide smooth bearing surface for equipment.
G. Place grout around anchors.
H. Cure placed grout according to manufacturer's written instructions.

DEMONSTRATION AND TRAINING

Upon completion of the work, and after all tests, the Contractor shall demonstrate and instruct the Department's designated operating, maintenance, and training personnel in the adjustment, operation, and maintenance of systems and equipment, including pertinent safety requirements. The training shall start after completion of the final acceptance tests. The field instruction shall cover all of the items contained in the operating and maintenance manuals as well as demonstrations of routine maintenance and servicing operations. The Engineer shall be notified at least 45 days prior to the proposed date and time for the training.. The instruction shall include, as a minimum, the following:

A. Description of each basic mechanical system including startup, normal operation, normal shutdown, emergency startup, emergency shutdown, normal testing and trouble-shooting conditions.
B. Explanation of the identification system.
C. Description of interfaces with electrical system including interlocks, sequencing, start-up, shut-down, emergency, safety, system failure, security and other provisions.

D. Outlining of basic maintenance procedures including adjustments to optimize output and efficiency of systems.
E. Conducting a detailed review of preventative maintenance measures.
F. Reviewing trouble modes and remedies.

PAYMENT

Full compensation for mechanical materials and methods shall be considered as included in the contract lump sum prices paid for tunnel fire protection system and roadway drainage system and no additional compensation will be allowed therefor.

10-5.02 MECHANICAL IDENTIFICATION

GENERAL

This work shall consist of furnishing and installing mechanical identification equipment, including identifying devices and labels in accordance with the details shown on the plans and these special provisions.

SUBMITTALS

The Contractor shall submit manufacturer's technical data of identifying devices and labels, valve tags and equipment signs and markers. In addition, brochures or other information describing the materials, construction methods and the general characteristics of the identifying devices and labels, valve tags and equipment signs and markers shall be included. Samples of color, lettering style, and graphic representation required for each identification material and device shall also be included.

The Contractor shall submit working drawings consisting of complete details, information and equipment selection criteria for the mechanical identification equipment including the following:

A. Valve schedules shall be furnished for each piping system. Standard-size bond paper shall be reproduced.
B. Tabulation of valve number, piping system, system abbreviation as shown on tag, room or space location of valve, and variations for identification.
C. Marking of valves intended for emergency shutoff and similar special uses.
D. Additional copies for maintenance manuals as specified in these special provisions.

QUALITY ASSURANCE

Identification shall conform to the requirements in ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

PRODUCTS

Identifying devices and labels shall conform to the following:

A. Equipment Nameplates: Nameplates shall be constructed of metal and shall be permanently fastened to equipment with data engraved or stamped as follows:

    1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
    2. Location: Accessible and visible.
    3. Stencils: Standard stencils, prepared with letter sizes conforming to ASME A13.1. Minimum letter height is 1.25 inches for ducts, and 3/4-inch for access door signs and operational instructions.
    4. Material: Fiberboard or brass.
    5. Stencil paint: Exterior, oil-based, alkyd gloss black enamel, unless otherwise shown on the plans or specified in these special provisions. Paint in pressurized spray-can form is acceptable.
    6. Identification paint: Exterior, oil-based, alkyd enamel in colors in accordance with ASME A13.1.

B. Pressure-sensitive pipe markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive, vinyl type with permanent adhesive.
C. Pipes with outer diameter (OD), less than 6 inches: Full-band pipe markers, extending 360 degrees around pipe at each location.
D. Pipes with OD, 6 inches and larger: Full-band pipe markers of length required to accommodate entire label.
E. Lettering: Use piping system terms shown on the plans or specified in these special provisions and abbreviate only as necessary for each application length.
F. Arrows: Either integrally with piping system service lettering, to accommodate both directions, or as separate unit, on each pipe marker to indicate direction of flow.
G. Plastic duct markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: cold-air supply.
2. Yellow: hot-air supply.
3. Blue: exhaust, outside, return, and mixed air.
4. Terminology: include direction of airflow; duct service such as supply, return, and exhaust; duct origin, duct destination, and design flow.

H. Plastic tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 0.003-inch thick:

1. Width: 1.5 inches on pipes with OD, less than 6 inches; 2.5 inches for larger pipes.
2. Color: comply with ASME A13.1, unless otherwise shown on the plans or specified in these special provisions.

I. Valve tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Tags shall include 3/16-inch hole for fastener. Material shall be 1/16-inch thick, stainless steel. Size shall be 1.5 inches diameter, except 2 inches square for fire protection system.
J. Valve tag fasteners: Brass, wire-link or beaded chain; or brass S-hooks.
K. Valve schedule frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule, including screws, and as follows:

1. Frame: Hardwood or extruded aluminum.
2. Glazing: ASTM C 1036, Type I, Class 1, Glazing quality B, 0.1-inch, single-thickness glass.

L. Engraved plastic-laminate signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, and the following:

1. Provide holes for mechanical fastening.
2. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
3. Thickness: 0.08-inch, for units up to 20 square inches or 8 inches in length, and 0.12-inch for units larger than 20 square inches.
4. Fasteners: self-tapping, stainless-steel screws or contact-type, permanent adhesive.

M. Plastic equipment markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Yellow: heating equipment and components.
2. Terminology: Match schedules and include the following: Equipment No., description of equipment service, design capacity, pressure drop, entering and leaving conditions, and speed.
3. Size: 2.5 inches by 4 inches for control devices, dampers, and valves; 4.5 inches by 6 inches for equipment.

N. Plasticized tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish designed for writing, as follows:

1. Size: 3.5 inches by 5.75 inches.
2. Fasteners: brass grommets and wire.
3. Nomenclature: large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

O. Lettering and graphics: Coordinate names, abbreviations, and other designations used in mechanical identification with designations shown on the plans and operation and maintenance manuals.
P. Multiple systems: Identify individual system number and service if multiple systems of same name are shown on the plans.

Labeling and identifying piping systems shall conform to the following:

A. Install pipe markers on each system. Include arrows showing normal direction of flow.
B. Marker type: stenciled markers complying with ASME A13.1.
C. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations in accordance with the following:

1. Adjacent to each valve and control device.
2. Adjacent to each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
3. Adjacent to penetrations through walls, floors, ceilings, or non-accessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Adjacent to major equipment items and other points of origination and termination.
6. Spaced at a maximum of 50 feet intervals along each run. Intervals shall be reduced to 25 feet in areas of congested piping and equipment.

Valve tags shall conform to the following:

A. Install on valves and control devices in piping systems, except the following: check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in valve schedule.
B. Valve tag captions shall conform to the details shown on the plans.
C. Tag color: in accordance with the following:

1. Cold water: blue.
2. Fire protection: red.

D. Letter color: in accordance with the following:

1. Cold water: white.
2. Fire protection: black.

E. Install mounted valve schedule in each major equipment room.

Engraved plastic-laminate signs or equipment markers shall be installed on or near each major item of mechanical equipment, and as follows:

A. Include signs for the following general categories of equipment:

1. Main control and operating valves, including safety devices.
2. Fire department hose valves and hose stations.
3. Meters, gages, thermometers, and similar units.
4. Pumps, and similar motor-driven units.
5. Fans, blowers, primary balancing dampers, and mixing boxes.
6. Packaged HVAC zone-type units.
7. Strainers, filters, water-treatment systems, and similar equipment.

B. Optional Sign Types: Stenciled signs may be provided instead of engraved plastic, at Installer's option, where lettering larger than one-inch high is needed for proper identification because of distance from normal location of required identification, as follows:

1. Lettering size: minimum 1/4-inch for name of units if viewing distance is less than 24 inches, 1/2-inch for viewing distances up to 6 feet, and proportionately larger lettering for greater viewing distances. The Contractor shall include secondary lettering two-thirds to three-fourths the size of principal lettering.
2. Terms on signs: distinguish between multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

C. Plasticized tags: If equipment to be identified is concealed above acoustical ceiling or similar concealment, the Contractor shall install tags within concealed space, to reduce amount of text in exposed sign outside concealment. Tags shall be installed to identify operational valves and similar minor equipment items located in unoccupied spaces, including machine rooms.
D. Duct systems: identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows showing service and direction of flow. The Contractor shall locate signs near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

INSTALLATION

Installation of identifying devices shall be coordinated with completion of covering and painting of surfaces where devices are to be applied. Identifying devices shall be installed before installing ceilings and similar concealment.

The Contractor shall relocate mechanical identification materials and devices that have become visually blocked by subsequent work, and shall clean faces of identification devices and glass frames of valve charts.

PAYMENT

Full compensation for mechanical identification shall be considered as included in the contract prices paid for tunnel fire protection system and roadway drainage system and no additional compensation will be allowed therefor.

10-5.03 FIRE EXTINGUISHERS

GENERAL

This work shall consist of furnishing and installing fire extinguishers with mounting brackets in accordance with the details shown on the plans and these special provisions.

REFERENCES

Fire Extinguishers shall conform to the requirements in California Code of Regulations, Title 19 Division 1, Chapter 3, "Portable Fire Extinguishers" and NFPA 502.

SUBMITTALS

Manufacturer's descriptive product data and installation instructions shall be submitted for approval.

QUALITY ASSURANCE

Fire extinguishers shall be Underwriters Laboratories or Factory Mutual Laboratories approved for the type, rating and classification of extinguisher specified.

MANUFACTURER'S

Acceptable Manufacturers: Subject to contract compliance, manufacturers shall be J. L. Industries; Larsen's Manufacturing; Potter-Roemer; or equal.

COMPONENTS

Fire extinguisher shall be fully charged, multi-purpose dry chemical type, with charge indicator, hose and nozzle, and attached service record tag. Fire extinguisher shall be of the capacity and type rating shown on the plans.

Mounting bracket shall be the manufacturer's standard painted, surface mounted type.

INSTALLATION

Fire extinguishers shall be installed in locations and at mounting heights shown on the plans, or if not shown, at a height of 48 inches from the finished floor to the top of the fire extinguisher.

Fire extinguisher mounting brackets shall be attached to structure, square and plumb, in accordance with the manufacturer's recommendations.

IDENTIFICATION

Bracket-mounted: Extinguishers shall be identified with red letter decals spelling "FIRE EXTINGUISHER" applied to wall surface. Letter size, style and location as selected by the Engineer.

SERVICING

Fire extinguishers shall be serviced, charged, and tagged not more than 5 days prior to contract acceptance.

PAYMENT

Full compensation for fire extinguishers shall be considered as included in the contract lump sum price paid for tunnel fire protection system and no separate payment will be made therefor.

10-5.04 HANGERS AND SUPPORTS

GENERAL

Hangers and supports shall include furnishing and installing of concrete-embedded and surface-mounted structural members for support of mechanical system piping and equipment in conformance with the details shown on the plans, the provisions in Section 75 "Miscellaneous Metal" of the Standard Specifications and these special provisions.

Anchorages shall conform to the provisions for concrete anchorage devices in Section 75-1.03, "Miscellaneous Bridge Metal" of the Standard Specifications and these special provisions.

The following definitions shall apply to this section:

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
B. Terminology: as defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."
C. NFPA: National Fire Protection Association.

Pipe support systems shall be capable of supporting combined weight of supported systems, system contents and test water, and shall include seismic restraint hangers and supports designed for the piping and equipment. Pipe support systems shall be designed in accordance with NFPA 13, "Standard for the Installation of Sprinkler Systems," 2002 Edition.

SUBMITTALS

The Contractor shall submit manufacturer's technical data of manufactured hangers and support systems, miscellaneous materials, thermal shield inserts and hanger support applications. In addition, brochures or other information describing the materials, construction methods and the general characteristics of the manufactured hangers and support systems, miscellaneous materials, thermal shield inserts and hanger support applications shall be included. Copies of welding certificates for welding procedures and operators shall also be included.

The Contractor shall submit working drawings including complete details, information and equipment selection criteria for the hangers and supports as shown on the plans and as specified in these special provisions:

Drawings of piping supports and hangers in the tunnel shall be signed by an engineer who is registered as a Civil Engineer or Mechanical Engineer in the State of California. In addition, the Contractor shall provide design calculations and indicate size and characteristics of components and fabrication details for all piping supports and hangers.

QUALITY ASSURANCE

Welding processes and operators shall be qualified according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

The Contractor shall prepare the working drawings and design calculations for each pipe support, trapeze, and seismic restraint not fully detailed on the plans. The working drawings and design calculations shall be signed by an engineer who is registered as a Civil Engineer or Mechanical Engineer in the State of California.

PRODUCTS

Manufactured hangers and support systems shall conform to the following:

A. Pipe hangers, supports, and components: MSS SP-58, factory-fabricated components, as follows:

   1. Galvanized, metallic coatings (hot dipped galvanized type): for all support systems used in the tunnel.
   2. Nonmetallic coatings: on attachments, for electrolytic protection where attachments are in direct contact with copper tubing.
   3. Welded pipe support assemblies shall be hot dipped galvanized after assembly to avoid damage to coating.
   4. Field process shall not damage hot-dipped galvanized coating.

B. Channel support systems shall consist of factory-fabricated components for field assembly in conformance with the following:

1. Embedded inserts shall be capable of taking a load of 2000 lbs in each foot of length with a minimum safely factor of 3. Embedded struts shall have concrete anchor tabs spaced a minimum of 4 inches on center.
2. All nuts, bolts, screws, clamps, brackets and miscellaneous hardware in the tunnel shall be hot dipped gavlvanized.
3. Nonmetallic coatings: on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

Miscellaneous materials shall consist of the following:

A. Powder-actuated drive-pin fasteners: Powder actuated drive-pin fasteners are prohibited in tunnel.
B. Concrete and masonry anchor bolts and studs: insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used, as follows:

1. Dry locations: steel-expansion wedge type.
2. Tunnel anchor bolts: anchor bolts in the tunnel shall be stainless steel mechanical undercut anchor type bolts rated for dynamic loading.
3. Mechanical anchor bolts: mechanical anchor bolts shall be stainless steel hex head finished bolt with a longitudinally tapered threaded end and a spring loaded multi-part conforming threaded zinc expander nut. Anchor shall meet Federal Specification FF-S-325, Group II, Type 2 Class 2, Style 1, be heat treated to SAE Grade 5 and zinc plated in accordance with ASTM B633-78, Type III, Class Fe/Zn 5, SC-I.
4. Epoxy anchor bolts: epoxy anchor bolts shall be stainless steel all-thread, encapsulated epoxy type with embedment length and drilled hole diameter per the manufacturer's recommendations. Polyester and vinyl resin will not be permitted.
5. Unless otherwise shown on the plans minimum anchor bolt size shall be 5/8-inch.
6. Epoxy anchor bolts are prohibited in tunnel.

C. Structural steel: ASTM A 36/A 36M, steel plates, shapes, and bars, hot dip and galvanized after fabrication.
D. Grout: ASTM C 1107, Grade B, factory-mixed and pre-packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout, as follows:

1. Characteristics: post hardening and volume adjusting; with manufacturer recommendations for both interior and exterior applications.
2. Properties: nonstaining, noncorrosive, and nongaseous.
3. Design mix: 5000 psi, 28-day compressive strength.

Hangers shall be furnished and installed in conformance to the following requirements:

A. Equipment selections and applications shall be in conformance with Manufacturers Standardization Society (MSS) SP-69 for pipe hanger selections and applications that are not specified in piping system special provisions or shown on the plans.
B. Equipment selections and applications for horizontal-piping hangers and supports: Install the following types of hangers and supports unless otherwise indicated and except as specified in piping system special provisions or shown on the plans:

1. Adjustable steel clevis hangers (MSS Type 1): for suspension of noninsulated or insulated stationary pipes, 1/2-inch to 12 inches nominal size. For suspension of stainless steel pipe, provide non-metallic sleeve to prevent direct contact between stainless pipe and galvanized hanger.
2. Carbon- or alloy-steel, double-bolt pipe clamps (MSS Type 3): for suspension of pipes, 3/4-inch to 12 inches nominal size, requiring clamp flexibility.
3. Pipe hangers (MSS Type 5): for suspension of pipes, 1/2-inch to 4 inches nominal size, to allow off-center closure for hanger installation before pipe erection.
4. Adjustable swivel split- or solid-ring hangers (MSS Type 6): for suspension of noninsulated stationary pipes, 3/4-inch to 8 inches nominal size.
5. Split pipe-ring with or without turnbuckle-adjustment hangers (MSS Type 11): for suspension of noninsulated stationary pipes, 3/8-inch to 8 inches nominal size.
6. U-bolts (MSS Type 24): for support of heavy pipe, 1/2-inch to 12 inches nominal size.
7. Clips (MSS Type 26): for support of insulated pipes not subject to expansion or contraction.
8. Pipe stanchion saddles (MSS Type 37): for support of pipes, 4 inch to 12 inches nominal size, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.

9. Adjustable pipe saddle supports (MSS Type 38): for stanchion-type support for pipes, 2.5 inch to 12 inches nominal size, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
10. Single pipe rolls (MSS Type 41): for suspension of pipes, one-inch to 12 inches nominal size, from two rods if longitudinal movement caused by expansion and contraction might occur.
11. Adjustable Roller Hangers (MSS Type 43): for suspension of pipes, 2.5 inch to 12 inches nominal size, from single rod if horizontal movement caused by expansion and contraction might occur.
12. Complete pipe rolls (MSS Type 44): for support of pipes, 2 inches to 12 inches nominal size, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
13. Pipe roll and plate units (MSS Type 45): for support of pipes, 2 inches to 12 inches nominal size, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
14. Adjustable pipe roll and base units (MSS Type 46): for support of pipes, 2 inches to 12 inches nominal size, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

C. Vertical-piping clamps shall be installed with the following types:

1. Extension pipe or riser clamps (MSS Type 8): for support of pipe risers, 3/4-inch to 12 inches nominal size.
2. Carbon- or alloy-steel riser clamps (MSS Type 42): for support of pipe risers, NPS 3/4-inch to 12 inches nominal size, if longer ends are required for riser clamps.

D. Hanger-Rod attachments shall be installed with the following types:

1. Steel turnbuckles (MSS Type 13): for adjustment up to 6 inches for heavy loads.
2. Steel clevises (MSS Type 14).
3. Swivel turnbuckles (MSS Type 15): for use with MSS Type 11, split pipe rings.
4. Malleable-iron sockets (MSS Type 16): for attaching hanger rods to various types of building attachments.
5. Steel weldless eye nuts (MSS Type 17).

E. Building attachments shall be installed with the following types:

1. Side-beam or channel clamps (MSS Type 20): for attaching to bottom flange of beams, channels, or angles.
2. Center-beam clamps (MSS Type 21): for attaching to center of bottom flange of beams.
3. Welded beam attachments (MSS Type 22): for attaching to bottom of beams if loads are considerable and rod sizes are large.
4. Side-beam clamps (MSS Type 27): for bottom of steel I-beams.
5. Steel-beam clamps with eye nuts (MSS Type 28): for attaching to bottom of steel I-beams for heavy loads.
6. Linked-steel clamps with eye nuts (MSS Type 29): for attaching to bottom of steel I-beams for heavy loads, with link extensions.
7. Malleable beam clamps with extension pieces (MSS Type 30): for attaching to structural steel.
8. Welded-steel brackets: for support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads unless specific sizes are shown on the plans.
9. Light (MSS Type 31): 250 pounds.
10. Medium (MSS Type 32): 1500 pounds.
11. Heavy (MSS Type 33): 3000 pounds.
12. Plate lugs (MSS Type 57): for attaching to steel beams if flexibility at beam is required.

F. Saddles and shields shall be installed with the following types:

1. Steel pipe-covering protection saddles (MSS Type 39): to fill interior voids with insulation that matches adjoining insulation.
2. Protection shields (MSS Type 40): of length recommended by manufacturer to prevent crushing insulation.
3. Thermal-hanger shield inserts: for supporting insulated pipe, 360-degree insert of high-density, 100 psi minimum compressive strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

INSTALLATION

Pipe hanger and support installation shall conform to the following:

A. Install hangers and supports in conformance with MSS SP-69 and MSS SP-89. Hangers, supports, clamps, and attachments shall be installed to support piping from building structure or the tunnel structure.
B. Install building attachments to structural steel. Unless otherwise shown on the plans, building attachments shall be spaced within maximum piping span length indicated in MSS SP-69. Additional supports shall be installed at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Concrete inserts shall be installed before concrete is placed and fasten inserts to forms.
C. Install powder-actuated drive-pin fasteners after concrete is placed and completely cured. Inserts shall be installed by operators that are licensed by powder-actuated tool manufacturer. Fasteners shall be installed according to powder-actuated tool manufacturer's operating manual.
D. Install expansion anchors in concrete after concrete is placed and completely cured. Fasteners shall be installed in accordance with to manufacturer's written instructions.
E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of flexible couplings, expansion loops, expansion bends, and similar units.
G. Load distribution: install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
H. Pipe slopes: install hangers and supports to provide pipe slopes as shown on the plans, and in conformance with ASME B31.9, "Building Services Piping," for maximum pipe deflections.

Miscellaneous metal fabrications shall be cut, drilled and fit for heavy-duty steel trapezes and equipment supports, fitting exposed connections together to form hairline joints.

Fabrication shall conform to AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and the following:

A. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
B. Obtain fusion without undercut or overlap.
C. Remove welding flux immediately.
D. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
E. Hot dip galvanize after fabrication.

Hangers shall be adjusted to distribute loads equally on attachments and to achieve indicated slope of pipe.

PAINTING

Painting shall conform to the provisions in Section 59 "Painting" of the Standard Specifications and these special provisions, and the following:

A. Touching up: clean and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
B. Apply paint by brush or spray to provide a minimum dry film thickness of 0.002-inch.
C. Galvanized surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

PAYMENT

Full compensation for hangers and supports shall be considered as included in the contract lump sum prices paid for tunnel fire protection system and roadway drainage system and no additional compensation will be allowed therefor.

10-5.05 MECHANICAL VIBRATION CONTROLS AND SEISMIC RESTRAINTS

GENERAL

Mechanical vibration controls and seismic restraints shall include furnishing, installing, and testing of vibration isolators, vibration isolation bases, and seismic restraints and snubbers. All equipment and installation shall conform to the provisions in Section 75 "Miscellaneous Metal" of the Standard Specifications and these special provisions.

Seismic bracing shall be provided in conformance with the requirements in the California Building Code. The following criteria shall apply:

A. Component Seismic Coefficient (Table 16 Q): 0.48
B. Seismic Importance Factor (I_p, Table 16 K): 1.00
C. In-Structure Component Amplification Factor (a_p, Table 16-O): 1.00

SUBMITTALS

The Contractor shall submit manufacturer's technical data of isolator pads, spring isolators, restrained spring isolators, rubber hangers, spring hangers, resilient isolation washers and bushings and restraining cables. Technical data shall include brochures or other information describing the materials, construction methods and the general characteristics. Manufacturers' technical data shall indicate types, styles, materials, and finishes for each type of isolator specified, including load deflection curves.

The Contractor shall submit working drawings including complete details, information and equipment selection criteria for the mechanical vibration controls and seismic restraints as shown on the plans and as specified in these special provisions. Working drawings shall be signed by an engineer who is registered as a Civil Engineer or Mechanical Engineer in the State of California, and shall include the following:

A. Design calculations for selection of vibration isolators, design of vibration isolation bases, and selection of seismic restraints. Calculation details shall include combining shear and tensile loads.
B. Seismic restraint details including fabrication and attachment of restraints and snubbers.

QUALITY ASSURANCE

Seismic restraint devices shall have horizontal and vertical load testing and analysis performed in conformance with the requirements of OSHPD (Office of Statewide Health Planning & Development for the State of California) and shall bear anchorage pre-approval "R" number, from OSHPD showing maximum seismic restraint ratings. Ratings shall be based on independent testing. Testing and calculations shall include both shear and tensile loads and at least one test or analysis at 45 degrees to the weakest mode.

Ductwork, piping and equipment shall be seismically restrained to resist lateral forces acting in any direction in conformance with the requirements in Section 1632 of the 2007 California Building Code. An engineer who is registered as a Civil Engineer or Mechanical Engineer in the State of California shall prepare seismic calculations for equipment restraints to determine the restraint loading results from seismic forces. A certificate signed by the Registered Engineer shall be submitted stating that the seismic calculations for equipment have been completed in conformance with the requirements of the California Building Code.

PRODUCTS

Isolator pads for vibration isolators shall be oil and water resistant and factory cut to sizes that match requirements of the equipment supported, and shall conform to the following:

A. Rubber isolator pads: elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
B. Fiberglass or cork isolator pads: molded cork or glass fiber not less than one-inch thick and precompressed through 10 compression cycles at 3 times the rated load.
C. Load range: from 10 to 50 psi and a deflection not less than 1/16-inch per inch of thickness. Load on isolator pad shall not exceed a loading of 50 psi.
D. Rubber isolator mounts: double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top and baseplates. Rubber isolator mounts shall be factory-drilled and tapped top plate for bolted equipment mounting and include factory-drilled baseplate for bolted connection to structure. Rubber isolator mounts shall be color-coded to indicate capacity range.

Restrained spring isolators for vibration isolators shall be vertically restrained, freestanding, laterally stable, steel open-spring-type isolators, in conformance with the following:

A. Housing: welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Housing shall have factory-drilled baseplate for bolting to structure and shall be bonded to a 1/4-inch thick, rubber isolator pad attached to the underside of the baseplate. Housing shall include adjustable equipment mounting and leveling bolt.
B. Outside spring diameter: not less than 80 percent of the compressed height of the spring at rated load.

C. Minimum additional travel: 50 percent of the required deflection at rated load.
D. Lateral stiffness: more than 0.8 times the rated vertical stiffness.
E. Overload capacity: support 200 percent of rated load, fully compressed, without deformation or failure.
F. Finishes: baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.

Spring hangers for vibration isolators shall be combination spring and elastomeric hangers with coil springs and elastomeric inserts in compression, in conformance with the following:

A. Frame: formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
B. Outside spring diameter: not less than 80 percent of the compressed height of the spring at rated load.
C. Minimum additional travel: 50 percent of the required deflection at rated load.
D. Elastomeric element: molded, oil-resistant rubber or neoprene.
E. Finishes: baked enamel for metal components. Finishes shall be color-coded to indicate capacity range.

Resilient isolation washers and bushings shall be factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings, in conformance with the following:

A. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
B. Resilient isolation washers and bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 60, plus or minus 5.

Restraining cables for seismic restraint devices shall be galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.

Anchors shall be seismic-rated, drill-in, and stud-wedge or female-wedge type with strength required for anchor and as tested according to ASTM E 488/E 488M.

INSTALLATION

The Contractor shall install and anchor vibration-, sound-, and seismic-control products according to manufacturer's written instructions.

Mounts, isolators, hangers, and snubbers shall be anchored to vibration isolation bases. Isolator baseplates shall be bolted to structural floors.

Pipe connectors shall be installed at connections for equipment supported on vibration isolators. Seismic snubbers shall be installed on isolated equipment and bolted to equipment base and supporting structure. Seismic snubbers shall be installed at locations that minimize the distance between the snubbers and installed vibration isolators.

Restraining cables shall be installed at each trapeze and individual pipe hanger. At trapeze anchor locations, piping shall be shackled to trapeze. Cables shall be installed so they do not bend across sharp edges of adjacent equipment or building structure.

Steel angles or channels, sized to prevent buckling, shall be clamped with ductile-iron clamps to hanger rods for trapeze, individual pipe hangers and hanging equipment. At trapeze anchor locations, piping and hanging equipment shall be shackled to trapeze. Angles shall not be welded to rods.

Resilient bolt isolation washers shall be installed on equipment anchor bolts.

The Contractor shall adjust and clean anchor vibration-, sound-, and seismic-control products according to manufacturer's written instructions and requirements specified in the following:

A. Limit stops on restrained spring isolators shall be adjusted to mount equipment at normal operating height. After equipment installation is complete, limit stops shall be adjusted so they are out of contact during normal operations. Thrust restraints shall be adjusted for a maximum of 1/4-inch of movement at start and stop.
B. Active height of spring isolators and snubbers shall be adjusted according to manufacturer's written recommendations. Seismic restraints shall be adjusted to permit free movement of equipment within normal mode of operation.
C. Anchor bolts shall be tightened according to equipment manufacturer's written recommendations to resist seismic forces.

PAYMENT

Full compensation for mechanical vibration controls and seismic restraints shall be considered as included in the contract price paid for tunnel fire protection system and no additional compensation will be allowed therefor.

10-5.06 TUNNEL FIRE PROTECTION SYSTEM

GENERAL

Tunnel fire protection system shall consist of furnishing, installing and testing a tunnel wet standpipe fire protection system and tunnel fixed fire suppresion (deluge sprinkler system) including all piping, valves, valve trim, connections, supports, appurtenances, accessories as required for a complete and functional system in conformance with the details shown on the plans and the requirements specified in these special provisions. Tunnel fire protection system shall consist of all work downstream of points of connection to the water supply including backflow preventers.

SUBMITTALS

The Contractor shall submit manufacturer's product technical data for all items listed under "Products" of these special provisions. The equipment manufacturer's product data submittal shall include the following:

A. Catalog Cuts.
B. Wiring diagrams for the components requiring electrical connections.
C. Description of installation and operation.
D. Maintenance data to be included in the maintenance manual.

The Contractor shall submit working drawings in conformance with Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications and these special provisions.

Working drawings shall include complete details, information, drawings, and substantiating calculations of proposed materials, facilities, equipment to be used and method of construction.

The working drawings shall include the following:

A. A scalable plan and section (1/4"=1' minimum) of a typical 200 feet section of tunnel showing standpipe and deluge sprinkler piping and components buried both in walls and roadway, within niches, and attached to walls and ceilings.
B. Details of supports used for holding piping and components in place shall be included.
C. Details and sections of the niches at a minimum of 1/2"=1' scale. Detail design of the pipe and accessories shall comply with the design concept and structural requirements.
D. Full details of concrete cover and penetration of concrete structures for the straight pipe, and details of special fittings and connections, including temporary and permanent supports.
E. Fire department connection including standpipe and deluge sprinkler system to be reviewed and approved by State Fire Marshal.

The Contractor shall allow 12 weeks after complete drawings and all support data are submitted for the review and approval of the proposed tunnel fire protection system. No tunnel fire protection system work shall begin until complete working drawings are reviewed and approved, in writing, by the Engineer and the State Fire Marshal.

QUALITY ASSURANCE

The following codes, regulations, reference standards and specifications shall apply:

A. Manufacturers equipment, specialties and accessories shall be listed by product name and manufacturer in the UL Fire Protection Equipment Directory and the FM Approval Guide.
B. Equipment, specialties and accessories shall have label or approval stamp of listing agency. The terms "Listed" and "Labeled" shall be as defined in "National Electric Code," Article 100.
C. Equipment, accessories, installation and testing shall comply with the following NFPA standards:

    1. NFPA 13 "Standard for the Installation of Sprinkler Systems", 2007 Edition.
    2. NFPA 14 "Standard for the Installation of Standpipe and Hose Systems", 2007 Edition.
    3. NFPA 70 "National Electric Code", 2008 Edition.
    4. NFPA 502 "Standard for Road Tunnels, Bridges and Other Limited Access Highways", 2008 Edition.
    5. NFPA 1963 "Standard for Fire Hose Connections", 2009 Edition.

Hose threads, installation inspections and testing shall comply with the requirements of the State Fire Marshal and the Presidio Fire Department.

Fire protection piping and equipment shall be installed, serviced and repaired by a qualified firm that has experience of a minimum 5 previous projects involving the installation of major fire protection systems similar in size and scope to this project. Such qualifications shall be submitted to the Engineer.

PRODUCTS

Ductile iron pipe buried underground or in concrete shall be centrifugally cast in 18 feet or 20 feet nominal lengths conforming to AWWA C151, shall be seal coated, and shall have a double thickness cement mortar lining conforming to AWWA C104. Pipe shall be special thickness Class 52. Pipe shall be provided with restrained joint ends.

In special cases such as vaults and niches where mechanical grooved coupling and valves with mechanical grooved ends or flanged ends are specified, pipe shall be standard thickness Class 53. Pipe ends shall be prepared for mechanical grooved couplings. Where space permits, flanged ends will be allowed in lieu of mechanical grooved ends.

The exterior surfaces or the pipe and fittings shall have the following factory coating system in conformance with the requirements in AWWA C210:

A. Surface preparation shall be Solvent Clean (SSPC-SP-1) followed by abrasive blast-cleaning to Near White Metal (SSPC-SP-10) with an anchor profile between 0.003-inch and 0.004-inch. The Contractor shall conform to the National Association of Pipe Fabricators (NAPF) Standard 500-03 and the pipe manufacturer's recommendations prior to any blast cleaning of the ductile iron pipe.
B. Two (2) uniform coats of coal tar epoxy conforming to AWWA C210 shall be applied to a total dry film thickness of 0.02-inch to 0.03-inch.
C. The drying time between coats shall be 12 hours minimum and 24 hours maximum at 70°F. Intercoat drying time is critical and shall be in accordance with manufacturer's recommendations.
D. A double layer of 0.008-inch low density polyethylene wrap shall be provided over all the ductile iron fire protection pipe and fittings buried in the concrete or beneath the roadway slab. The Contractor shall conform to AWWA C105 in the application of the polyethylene wrap and use heat shrink joint closure sleeves.

Fittings for ductile iron pipe (buried service) shall be ductile iron of Class 250 gray iron conforming to AWWA C110 and C111; fittings shall be seal coated and shall be double thickness cement mortar lined conforming to AWWA C104.

Restrained joints fittings for pipe buried in concrete shall conform to the details as shown on the plans. Joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which when activated imparts a multiple wedging action against the pipe increasing its resistance as the pressure increases. Restrained device shall meet requirements of ANSI/AWWA C111/A21.10. Glands shall be of ductile iron conforming to ASTM A536.80 and shall be seal coated equal to that on the connecting pipe. The mechanical joint restraint device shall have a minimum working pressure of 250 psi.

Restrained push-on joints for pipe and fittings shall consist of stainless steel locking segments, integrally molded into the gasket. Restrained push-on joints shall be capable of being deflected after assembly.

Joints for ductile iron pipe buried underground shall be restrained push-on joints conforming to ANSI/AWWA C111/A21.11. The joints shall be boltless, non-compression, non-thread with synthetic rubber gasket seals and have a positive-locking device to keep the connection from separating. The pipe joints shall be designed for a working pressure of 350 lbs and be capable of deflecting after assembly. Fittings and flanges for ductile iron pipe shall conform to ANSI/AWWA C110/A21.10, except for the manufacturer's proprietary design dimensions for restrained push-on joint pipe.

Flanged fittings in vaults shall conform to AWWA C115. Mechanical grooved end fittings shall be an acceptable alternate to flange fittings for use in vaults. Restrained and flanged joint fittings shall be compatible with the mating restrained and flanged joint pipe system used.

Gate valves for general shut off shall be iron body resilient seated solid wedge gate valves with a cast iron wedge fully encapsulated with molded rubber, designed to work equally well with pressure on either side of the gate. Valves shall be of the OS & Y type, complete with UL listed and FM approved supervisory switches.

Gate valves shall have flanged and gasketed ends in conformance with ANSI B16.1, Class 125. Valves shall be designed for a working pressure of 250 psi.

Bronze for interior parts of valves shall contain no more than 6 percent zinc.

All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 0.01-inch. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials shall be 100 percent powder AWWA C550, and shall be certified to ANSI/NSF 61.

Valves shall conform to the requirements of AWWA C509, UL 262 and FM 1120/1130.

Concrete thrust blocks and anchors for use on the buried pipeline shall be located as shown on the plans and at all changes in direction for the ductile iron pipe buried in soil.

Fire Hose Valves (FHV) shall be used as fire department outlet connections. Valves shall be 2.5 inches angle or straight type as shown on the plans, and shall be made of cast brass with a rough chrome plated finish. Valves shall be furnished with red handwheel, cap, chain, and Presidio Fire Department compatible male hose thread outlet. Two 3" San Francisco Fire Department compatible hose adapters shall be provided in each cabinet. Valve shall be rated to 300 psi. Valves shall be UL listed and FM approved.

Fire Department Connections shall be two-way inlet type cast brass body with drop clappers. Furnish with two or four 2.5 inches inlets and one 6 inches bottom outlet or back outlet connection as shown on the plans. Free standing inlets shall be complete with 18 inches long cover sleeve, identification base plate with "STANDPIPE" or "DELUGE SPRINKLER" lettering, brushed brass snoot, pin lug hose thread swivel, pin lug plugs and chains. Unit shall be UL Listed.

Iron Pipe Size (IPS) piping system for piping serving tunnel fire protection systems shall conform to the following:

A. Pipe shall be Schedule 40, ASTM A53, Grade B, seamless or ERW, hot dipped galvanized steel pipe in nominal 20 feet lengths. Pipe and fittings shall be roll groove or cut groove ends as appropriate for the pipe material, wall thickness, thermal expansion and pressures. Pipe ends shall be grooved in conformance with the requirements in ANSI/AWWA C-606.
B. All grooved components shall be of one manufacturer, and shall conform to the requirements of ANSI-B31.1 and be UL/FM listed for use in fire protection systems. Manufacturer shall be ISO-9001 certified.
C. Grooved fittings shall be ASTM A234, Grade WPA or WPB steel, butt welding ends with grooved tangents welded to the ends or ductile iron grooved end fittings conforming to ASTM A-536 and as manufactured by the grooved end coupling manufacturer.
D. Mechanical transition couplings for joining ductile iron to galvanized steel pipe shall be rigid hot dip galvanized couplings, conforming to the requirements in ASTM A 536. Minimum pressure rating coupling transitioning from ductile iron to a Schedule 40 steel pipe shall be 500 psi.
E. Couplings used to connect steel pipe to steel pipe shall be made of ductile iron conforming to ASTM A 536, hot dip galvanized outside and inside in conformance with the requirements in AWWA C 210. Minimum pressure rating shall be 700 psi. Couplings shall be flexible type unless otherwise noted.
F. Mechanical coupling bolts shall be Type 316 stainless steel, hex head machine bolts per ASTM A-193, Grade B-8, Class 2. Nuts shall be Type 316 ASTM A-194 B8M.
G. Flange adapters for connection of grooved joint pipe and components shall be ANSI Class 125/150 flanged components. Cast of ductile iron shall conform to ASTM A-536 or malleable iron conforming to ASTM A-47. Flange adapter coating, bolts, nuts and washers and sealing gaskets shall be the same as that specified for the rigid and flexible grooved couplings.
H. Gaskets for grooved couplings shall be Grade "E" EPDM compound (green color coded).
I. Fittings shall be smooth turn full flow galvanized steel or ductile iron fittings with grooves designed to accept grooved end couplings. Fittings shall conform to the requirements in ASTM A-234, Class WPA or WPB.

Supervised butterfly valves shall be rated for 300 psi, and shall be "offset" type ductile iron body with grooved ends and disc conforming to the requirements in ASTM A-536. The valve body shall be coated with polyphenylene sulfide blend. The disc shall be ductile iron with a nickel coating conforming to ASTM B733. The seat shall be EPDM. The valve shall be UL listed.

The valve shall have a gear operated actuator and handwheel. The actuator housing shall be plated steel. The valve shall be furnished complete with a supervisory switch wired to a junction box. The valve shall be capable of being padlocked in the open position.

Check valves shall be made of ductile iron conforming to the requirements in ASTM A-536, Grade 65-45-12. The body seat shall be welded on nickel alloy. The disc shall be totally encapsulated with a Grade "E" EPDM coating. The valve shall be provided with stainless steel shaft and spring and be designed with a non-slam feature.

Check valves shall be furnished with upstream and downstream 1/2" diameter drain and plug, and shall be carbon steel zinc-plated in conformance with the requirements in ASTM B 633. Check valves shall be UL listed.

Backflow preventer shall be an AWWA and Presidio Trust approved device, shall be listed by the USC Foundation for Cross-Connection Prevention, and shall be double check valve with gate type isolation valves. The backflow preventer assembly shall generate a maximum pressure drop of 6.5 psi at 3,500 gpm. Provide 18 inches clearance on all sides, top and bottom.

Combination Air/Vacuum valves, shall have double orifice in a single body allowing large volumes to escape out the large orifice when filling the pipeline and close when liquid enters the line. When the valve is closed and pressurized, the small air release orifice will allow small pockets of air to escape automatically and independently of the large orifice. The large orifice shall also allow large volumes of air to enter during pipeline drainage to break vacuum. The body inlet shall be baffled to protect the float from the direct forces of rushing air and water to prevent premature valve shut off.

Body and cover shall be of cast iron ASTM A126 Grade B. Float shall be stainless steel ASTM A240 and needle and seat shall be Buna-N. The plug center guided in hex bushings shall be of bronze, Leverage frame assembly shall be made of acetate resin engineering plastic (Delrin) and Cast Iron.

Valve shall be furnished with NPT threaded inlet and outlet connections and factory applied red oxide primer paint.

Ball valves shall be standard port, end-entry valve with ductile iron body and end cap. Ball and stem shall be made of 316 stainless steel and seat shall be made of Tyflon. Valve shall be UL Listed and FM approved ball valve for fire line service and drain service on fire protection systems. Drain valves shall be of sizes as shown on the plans and shall be provided with locking mechanism in operator to lock in closed position.

Deluge valve shall have remote On-Off electronic control. Valve actuation shall be accomplished by a fully peripherally supported, one-piece balanced rolling diaphragm, vulcanized with a radial seal disk. The On-Off deluge valve shall be an elastomeric type globe valve with a rolling diaphragm. The diaphragm assembly shall be the only moving component in the valve. The valve shall have an unobstructed flow path with no stem guide or supporting ribs. The valve shall have a removable cover enabling all necessary inspections and servicing. Control trim materials shall be 316 stainless steel tubing and fittings and plated brass accessories, including Y-strainer, 3-way solenoid, accelerator, and hydraulic relay valve and manual emergency release. The valve shall have an automatic drain feature to drain downstream piping after closing. Valve shall be equipped with pressure gauges indicating both upstream and downstream pressure. The trim shall be supplied as an assembly, pre-assembled and hydraulically tested at an ISO 9000 and 9001 certified factory. On-Off deluge valve shall be UL Listed.

Spray nozzles shall be open directional type. The nozzle installed shall be UL listed and Factory Mutual approved. Spray nozzles shall be of all brass frame construction. Spray nozzles with non-metallic materials shall not be used. Spray nozzles shall have a nominal K-factor and spray pattern as shown on the plans. Nozzles shall be listed in conformance with NFPA 13.

Flow switches shall be an integral, mechanical, non-coded, non-accumulative retard type. Flow switches shall have an alarm transmission delay time which is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. All flow switches shall come from a single manufacturer and series. Any required time delays for water surge shall be provided by the water flow switch. No delays shall be used by the programming of the software of the fire alarm control panel. Water flow switch shall conform to NFPA 72.

INSTALLATION

Welders and welding procedures shall be qualified in accordance with the requirements of ASME Section IX of the Boiler and Pressure Vessel Code.

Major piping assemblies shall be shop fabricated. Field welding will not be permitted.

Bedding and backfill for temporary supports shall be provided for pipe buried beneath roadway. Supports shall consist of masonry saddles or galvanized steel stanchions at minimum 10 feet on centers. All supports shall remain in place during and after the pour of lean concrete. Attention is directed to Section 73 "Concrete Curb & Sidewalk" of the Standard Specifications.

The Contractor shall coordinate and schedule installation with the concrete fill over the walkway and roadway surfaces covering the pipe. Precast and cast in place boxouts for valves and branch piping shall be placed as shown on the plans.

The Contractor shall verify the locations and establish the depth of all new and existing utilities at the points where connections are to be made to the water main and crossings are required for the fire protection mains. The profile of the standpipe mains shall follow the slope of the tunnel to allow drainage at the south end of the tunnel.

Where elevation of pipeline and ground surface is shown on the plans, pipeline shall be laid to the elevation shown. Elevation changes required to miss existing utilities shall be made only with the writted permission of the Engineer after all other avenues for resolution have been explored.

The buried wet standpipe piping shall be continuously sloped to the drainage points.

The Contractor shall perform trench excavation for pipe routed outside the tunnel to the depth as shown on the plans or specified in these special provisions. Excavations shall be made by open cut. Trenches shall be excavated to true and smooth bottom grades in accordance with the lines shown on the plans. The trench bottom shall provide uniform bearing and support for each length of pipe.

Bell holes shall be excavated to the extent necessary to permit installation and inspection of the joints. The banks of the trenches shall be kept as nearly vertical as soil conditions permit. Where required to control trench width and protect adjacent structures, the trench shall be sheeted and braced. Standard excavating equipment shall be adjusted so as to excavate the narrowest trench possible.

The Contractor shall not excavate below the depth specified.

Bedding material to the pipe shall be placed under the pipe and to a depth of at least 6 inches over the top of the pipe. The bedding material shall be rammed and tamped around the pipe by the use of shovels or other approved hand held tools, so as to provide firm and uniform support over the full length of all pipe, valves, and fittings.

Prior to backfilling trenches, all form lumber and debris shall be removed from the trench. Sheeting used by the Contractor shall be removed just ahead of the backfilling.

Backfill material shall conform to Section 19-3, "Structure Excavation and Backfill" of the Standard Specifications and shall be placed in maximum 6 inches lifts.

A minimum 3 inches sand cushion shall be placed between the buried fire protection lines and crossing water main or other pipelines or conduits encountered during construction unless otherwise directed by the Engineer.

Backfill shall be compacted to at least 95 percent of maximum density.

At locations where paved streets, roadway shoulders, driveways, or sidewalks will be constructed or reconstructed over the trench, the backfill shall be spread in layers (lifts), and be compacted by mechanical tampers. Each 6-inch layer shall be compacted with mechanical tampers to the density specified herein.

Piping shall be supported in conformance with the requirements specified in "Hangers and Supports" of these special provisions.

TESTING AND DISINFECTING

Piping equipment and instrumentation which will not safely withstand the test pressure shall be isolated and removed. All piping serving fixed and manual fire protection systems shall be flushed and hydrostatically tested in accordance with the requirements specified in NFPA 13 and NFPA 14.

The piping system shall be isolated, filled and pressure tested at 200 psi for 2 hours with no loss of pressure. The hydrostatic test pressure shall be measured at the low elevation point of the individual system or section being tested. If the tested system fails to meet the pressure test, the Contractor shall, at no additional cost to the State, locate and repair the defects and then retest the system. Upon successful completion of the test, the system shall be drained and the temporary caps and blind flanges required for the test shall be replaced to preclude foreign objects entering the piping or tested system before the next stage of construction or testing.

All systems shall be flushed after removal of all temporary testing equipment and installation of all permanent equipment.

The testing of the ductile iron buried pipe shall be conducted with all the thrust blocks in place and prior to the back filling of trench.

The operation of the fire protection system shall be tested in conformance with the requirements in NFPA 13 and 14.

PAYMENT

The contract lump sum price paid for tunnel fire protection system shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the work involved in furnishing and installing the tunnel fire protection system, complete in place, including excavation, backfill, thrust blocks, valve boxes and cover plates, miscellaneous piping, fire hose valves, fire department connections and testing, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

10-5.07 ROADWAY DRAINAGE SYSTEM

GENERAL

The roadway drainage system shall consist of furnishing, installing, and testing the roadway drainage piping, slot drains, utility duckbank drains, and appurtenances in the tunnel in conformance with the details shown on the plans and the requirements specified in these special provisions.

SUMMARY

The roadway drainage system shall include the following:

A. Slotted drainage system and all piping and accessories downstream, including manholes and junction boxes. The work shall include stainless steel slot drains, closed drains, access cover plates, and all piping inside and outside tunnel to connection to storm drainage system.
B. Utility ductbank drainage system and all piping and accessories.
C. Roadway drainage interceptors are not included in the roadway drainage system.

SUBMITTALS

The Contractor shall submit manufacturer's technical data for roadway drainage system components and accessories. In addition, brochures or other information describing the materials, construction methods, and the general characteristics of the roadway drainage system shall be included.

The Contractor shall submit manufacturer's technical data for each type of product in the roadway drainage system.

The Contractor shall submit working drawings in conformance with Section 5-1.02 "Plans and Working Drawings" of the Standard Specifications and these special provisions. The working drawings shall include the following:

A. Working drawings showing dimensions, details, anchorage details, reinforcement and the manner of installation.
B. A scalable (1:125 minimum) plan layout of the drainage system showing each slot drain joint, pipe joint and fitting by number. The layout shall include invert elevations at all intersections with manholes, vaults and interceptors.
C. Details of concrete junction boxes, including rebar details and access lid details.

PRODUCTS

The slot drain system shall be designed as a unit to continuously drain the roadway surface. It shall be configured to be encased in concrete and be provided with concrete embeds, leveling bars and form attachments as required to insure proper installation. The slot drain system shall have a continuous, single, horizontal slot, located at the low point in the top plate. Drain to be a single unit design with no removable parts. Unit to be provided in 10 feet continuous sections, flanged for field assembly, have a tear drop shape with semi-circular bottom section, and vertical throat. Dimensions shall be as shown on the plans. Slot drain shall incorporate spacer tabs welded across throat to maintain shape during concrete pour. Tabs shall be easily removable following final installation. Concrete anchor rods shall be welded to both top plate and throat to resist deformation from vehicle loading. The system shall comply with load class H-20. All components of slot drain system shall be Type 304L stainless steel and be supplied whole from a single manufacturer. Provide three, paddle-type, clean out devices for slot drain maintenance.

Ductile iron pipe for buried service shall be centrifugally cast in 18 feet or 20 feet nominal lengths conforming to AWWA C151. Pipe shall be seal coated and shall have standard thickness cement mortar lining conforming to AWWA C104. Pipe shall be pressure Class 350 psi pipe and shall be provided with push on joint ends.

Outside coating of pipe and fittings shall be asphaltic coated in accordance with AWWA C151, Section 51-9.

A. The exterior of the pipe and fittings shall have field applied polyethylene encasement in tube or sheet form conforming to the requirements of AWWA C105. The wrap material shall be minimum 0.005-inch thick high density, cross laminated polyethylene film.

Fittings for buried service for the push-on joint ductile iron pipe shall be ductile iron of Class 250 gray iron conforming to ANSI/AWWA C110 or C153. Joint components shall conform to the requirements for push-on joints in ANSI /AWWA C111. Fittings shall be seal coated and shall be standard thickness cement mortar lined conforming to AWWA C104. External coating and encasement shall be similar to that specified for the connecting pipe.

Flanged joint fittings conforming to AWWA C115 shall be allowed for use when connecting to junction boxes.

The Contractor shall furnish and install juction boxes as shown on the plans in conformance with "Concrete Structure" of these special provisions. The minimum strength of the concrete allowed for juction boxes is 4000 psi.

Cast iron pipe where shown on the plans shall be hub & plain end etc. Cast iron soil pipe with neoprene gaskets conforming to Cast Iron Soil Pipe Institute's Standard 301. Pipe, fittings and gaskets shall be of one manufacturer.

Floor drain shall be cast iron body and flashing collar, adjustable nickel bronze 6 inch strainer head with seepage openings and caulk or no-hub outlet. Floor drain shall be round or square as shown on the plans.

Cleanout to grade shall be cast iron ferrule type. Plug shall be countersunk brass or bronze with tapered threads.

Canal gate valve shall be non-rising stem type valve with adjustable side wedges. Valve cover, frame ring, adjustable wedges, arch, and handwheel shall be constructed of cast iron. Valve stem shall include a removable handwheel and be installed such that the top of the valve stem without the handwheel sits below the level of the valve box lid in which the valve is installed. Canal gate valve shall be UL Listed

INSTALLATION

The Contractor shall verify the locations and establish the depth of new and existing utilities at the points where crossings are required for the drainage lines. The Contractor shall coordinate with structural and civil for lines that are embedded in cut and cover structures. Drainage equipment shall be installed per manufacturer's installation instructions and as described herein.

Where elevation of pipeline and ground surface is shown on the plans, pipeline shall be laid to the elevation shown. Elevation changes to miss new or existing utilities shall not be made without the Engineer's approval.

The Contractor shall perform all trench excavation for pipe routed outside the tunnel of earthwork to the depth shown on the plans or specified in these special provisions. Excavations shall be made by open cut. Trenches shall be excavated to true and smooth bottom grades and in accordance with the lines approved by the Engineer. The trench bottom shall provide uniform bearing and support for each length of pipe.

Bell holes shall be excavated to the extent necessary to permit accurate work in making and inspecting the joints. The banks of the trenches shall be kept as nearly vertical as soil conditions permit. The trench shall be sheeted and braced to control trench width or to protect adjacent structures.

Over excavation below that depth shall be backfilled in conformance with Section, "Earthwork," of these special provisions.

Bedding material for pipe routed outside the tunnel meeting the requirements described in these special provisions shall be placed under the pipe and to a depth of at least 6 inch over the top of the pipe. The bedding material shall be rammed and tamped around the pipe by the use of shovels or other approved hand held tools, so as to provide firm and uniform support over the full length of all pipe, valves, and fittings without damage to the pipe and fittings.

Prior to backfilling trenches, all form lumber and debris shall be removed from the trench. Sheeting used by the Contractor shall be removed just ahead of the backfilling.

Backfill material shall be placed in maximum 6-inch lifts.

A minimum 3 inch sand cushion shall be placed between the buried fire protection lines and crossing water main or other pipelines and conduits encountered during installation.

Bedding and backfill conditions shall conform to Type 4 or Type 5 as described and detailed in Table 2 of ASTM A 746.

Backfill shall be compacted to at least 95 percent of maximum density.

Drainage piping shall be tested for water tightness in conformance with Section 61.1.02, "Performance Requirements for Culvert and Drainage Pipe Joints" of the Standard Specifications.

PAYMENT

The contract lump sum price paid for roadway drainage system shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the work involved in furnishing and installing the roadway drainage system complete in place, including testing as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

SECTION 11. (BLANK)

SECTION 12. SUBSTATION BUILDING WORK

SECTION 12-1. GENERAL REQUIREMENTS

12-1.01 SCOPE

This work includes the construction of the Presidio Viaduct Substation and the installation of required mechanical and electrical systems as shown on the plans and these Special Provisions.

Sections 10 through 95 of the Standard Specifications do not apply to the work in Section 12 except when specific reference is made thereto.

12-1.02 ABBREVIATIONS

Abbreviations:

AAMA	American Architectural Manufacturers' Association
ACI	American Concrete Institute
AGA	American Gas Association
AITC	American Institute of Timber Construction
AMCA	Air Movement and Control Association
APA	Engineered Wood Association
APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
BIA	Brick Industry Association
CBC	California Building Code
CEC	California Electrical Code
CMC	California Mechanical Code
CPC	California Plumbing Code
ESO	Electrical Safety Orders
FM	FM Global
FS	Federal Specification
GA	Gypsum Association
GANA	Glass Association of North America
ICC	International Code Council
ISO	International Organization for Standardization
LEED	Leadership in Energy and Environmental Design
NAAMM	National Association of Architectural Metal Manufacturers
NEC	National Electrical Code
NFPA	National Fire Protection Association or National Forests Products Association
PEI	Porcelain Enamel Institute
RIS	Redwood Inspection Service
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
TCNA	Tile Council of North America
TPI	Truss Plate Institute
WCLIB	West Coast Lumber Inspection Bureau (stamped WCLB)
WCLB	Grade stamp for WCLIB
WI	Woodwork Institute
WWPA	Western Wood Products' Association

12-1.03 COOPERATION

Comply with "Cooperation" in Section 10, "Constructions Details," of these special provisions.

State forces will be working within the project limits during this contract. Plan work to minimize interference with State forces.

Comply with all security policies of the State facility.

Submit requests for approval to the Engineer before interrupting any services for the purpose of making or breaking a connection. Include in the request the proposed time period necessary to complete the work. Allow the Engineer 5 days to review each request.

You may obtain electrical power and water from existing State electrical power and water outlets within the project limits free of charge for contract operations, provided that such utility services are in service and are not required by the State for other purposes. Outlets must not be modified.

Do not use State telephone facilities.

12-1.04 SUBMITTALS

Items to be submitted to the Engineer must be approved under Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications.

Items to be furnished to the Engineer do not require approval.

The Engineer may request submittals for materials or products where submittals have not been specified in these special provisions, or may request that you include additional information in specified submittals, as necessary to determine the quality or acceptability of such materials or products.

Submit the following items within 50 days of contract approval:

1. Working drawings
2. Material lists
3. Product and descriptive data
4. Samples
5. Other submittals

Submit at least 5 sets of each item. Two sets will be returned either approved for use or returned for correction and resubmittal.

Submit the Schedule of Values within 20 days of contract approval. Submit at least 2 sets.

Each item submitted must include a descriptive title, the name of the project, district, county, contract number, and must reference the applicable portion of the contract documents that it pertains to. Plans and detailed drawings must be not larger than 24" x 36."

The material lists must include the name of manufacturer, catalog number, size, capacity, finish, all pertinent ratings, and identification symbols used on the plans and in these special provisions for each unit.

Deliver submittals to Offices of Structure Design, Documents Unit.

Allow 20 days for approval or return for correction of each submittal or resubmittal. Should the Engineer fail to complete the review within the time specified and Engineer determines that your controlling operation is delayed or interfered with by delay in review, an extension of time commensurate with the delay in completion of the your work will be granted under Section 8-1.09, "Right of Way Delays," of the Standard Specifications.

Remove unapproved samples and samples not incorporated in the work from State property.

Furnish 3 copies of the following items to the Engineer at the job site:

1. Parts lists and service instructions packaged with or accompanying the equipment
2. Operating and maintenance instructions
3. Manufacturer's warranties
4. Qualification data

12-1.05 SCHEDULE OF VALUES

Divide the Schedule of Values into sections representing the cost of each separate building or structure. Do not include work that is not part of the building or structure in the building or structure cost. Include this work under a specific section as General Work.

List indirect costs and bond premiums as separate line items of work.

Identify the sections representing each building or structure as to the building or structure they represent and break them down to show the corresponding value of each craft, trade or other significant portion of the work. Provide a sub-total for each section.

The Schedule of Values must be approved by the Engineer before any partial payment estimate is prepared.

The sum of the items listed in the Schedule of Values must equal the contract lump sum price for building work. Do not list overhead and profit. Include bond premiums and other such items in the mobilization bid item for the entire project.

12-1.06 INSPECTION

Any work that will be covered or not visible in the completed work must be inspected and approved by the Engineer before progress of work conceals portions to be inspected. Notify the Engineer not less than 72 hours in advance of when such inspections are needed.

Provide adequate temporary lighting to allow the Engineer to inspect the project as each portion is completed.

12-1.07 UTILITY CONNECTION

Make all arrangements and obtain all permits and licenses required for the extension of and connection to each utility service applicable to this project. For extensions not performed or provided by the utility, provide all labor and materials necessary for such extensions and install any intermediate equipment required by the serving utilities.

The costs incurred by you for (1) utility permits, licenses, connection charges, and excess length charges, (2) the extensions of utilities beyond the limits shown on the plans, and (3) furnishing and installing any intermediate equipment required by the serving utilities, will be paid for as extra work under Section 4-1.03D of the Standard Specifications.

12-1.08 SANITARY FACILITIES

Do not clean tools or dispose of cleaning liquids in State sanitary facilities or sewers.

During toilet room renovation or other periods when State sanitary facilities are not operational, provide the following for State forces:

1. Wash facilities
2. Drinking water fixtures
3. At least two temporary toilet units

Provide separate temporary toilet units for your personnel.

Temporary toilet units must be 1) single occupant units of the chemical type, 2) properly vented, and 3) fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material.

Perform periodic flushing, waste removal, and cleaning of temporary toilet units. Maintain units in a clean and sanitary condition, including a supply of toilet tissue, toilet seat covers, and paper towels. Dispose of waste material off site in a lawful manner.

12-1.09 MEASUREMENT AND PAYMENT

The contract lump sum price paid for building work includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in performing the building work, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for any incidental materials and labor, not shown on the plans or specified that are necessary to complete the building work, are considered as included in the contract lump sum price paid for building work and no additional compensation will be allowed therefor.

12-1.10 PROJECT RECORD DRAWINGS

Prepare and maintain one set of project record drawings, using an unaltered set of original project plans, to clearly show all as-constructed information for the project.

As a minimum, project record drawings must include the following information:

1. Any plan clarifications or change orders
2. Locations of any underground utilities

3. Location, size, type, and manufacturer of all major products or components used in the work.

Prepare project record drawings as follows:

1. Place markings on the project record drawings using red ink or red pencil.
2. Do not eradicate or write over original figures.
3. Neatly line out superseded material.
4. Submit additional drawings if the required information cannot be clearly shown on the original set of project plans. The additional drawings must be not less than 11" x 17" in size. Label each sheet with the contract number.
5. Sign and date each sheet verifying that all as-built information shown on the drawings is correct.

Review the project record drawings monthly with the Engineer during the progress of the work to assure that all changes and other required information are being recorded.

Before completion of the work, request a review of the project record drawings to determine the completeness and adequacy of them. If the project record drawings are unacceptable, you must inspect, measure, and survey the project as necessary to record the required additional information.

Deliver the completed project record drawings to the Engineer before acceptance of the contract.

SECTION 12-2. SITEWORK

12-2.01 ROUGH GRADING

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of rough grading the site in accordance with the details shown on the plans and these special provisions.

Rough grading shall consist of excavation or removal of above grade material regardless of character and subsurface condition; filling of all holes, swales, embankments, and low points to the elevation shown on the plans or specified; and the preparation of basement material for the placing of other material thereon and the establishment of the grading plane.

Earthwork for building construction shall conform to the requirements specified under "Earthwork for Building Work" in this Section 12-2 of these special provisions.

PART 2 - PRODUCTS

Fill Material:

Material from the excavation that is suitable for the required compaction may be used for filling holes, swales and low points. Fill material shall be free of organic material. Rocks and lumps shall be well distributed with sufficient earth or other fine matrix material to produce a dense, compacted fill that is suitable for the construction and load support intended.

The Contractor shall furnish suitable borrow material to offset any material deficiencies developed from grading work.

PART 3 - EXECUTION

EXCAVATION

Care shall be exercised to avoid disturbing material below and beyond the limits of excavation. When excavation is carried beyond the limits shown on the plans or specified, such excavation shall be replaced in kind and compacted at the Contractor's expense.

Limits of the excavation shall allow for adequate working space for installing materials and as required for safety of personnel. Such working space excavation shall be replaced in kind and compacted at the Contractor's expense.

Excess and waste materials from the excavation shall become the property of the Contractor and be disposed of outside the highway right of way in accordance with the requirements in Section 7-1.13 of the Standard Specifications.

FILL

Subgrade Preparation: Preparation of subgrade material for placing other material thereon shall include fine grading, compaction, reworking as necessary, and preparation of cut, or fill upon which base materials, surfacing, or slabs are to be placed. The upper 8 inches of the subgrade shall have the same compaction as the fill to be placed over it.

Placing: When footings are to be constructed in fill, the fill shall be constructed to the grading plane required for the building construction prior to excavating for the footings. Fill shall be placed and compacted in layers. The loose thickness of each layer before compaction shall not exceed 6 inches.

Water shall be added to the fill material as needed for compaction.

COMPACTION

Relative compaction shall be determined in accordance with California Test 216 or 231. 22

Relative Compaction (95 percent):

In fill relative compaction of not less than 95 percent shall be obtained for a minimum depth of 2.5 feet below finished grade for the width of the paved areas plus 3 feet on each side thereof.

The prisim of fill directly underneath the building foundation and sloping downward at 1:1 shall be compacted to 95 percent.

Relative Compaction (90 percent): Relative compaction of not less than 90 percent shall be obtained in all fill except as specified above.

FIELD QUALITY CONTROL

Testing and Inspection: The State will conduct compaction tests during the earthwork operations.

12-2.02 EARTHWORK FOR BUILDING WORK

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of performing earthwork for building work in accordance with the details shown on the plans and these special provisions.

Earthwork for building work shall consist of structure excavation and structure backfill. Structure excavation shall include excavation for footings, foundations, walls, slabs, and trenches. Structure backfill shall include backfilling under slabs; backfilling under and around footings; backfilling for walls, backfilling for pipes and conduits; backfilling holes resulting from removal of existing facilities. In addition to structure excavation and structure backfill, earthwork for building work shall include any other earthwork, not mentioned, but necessary to complete the building work.

Attention is directed to the Materials Information Handout for information regarding foundation recommendations and reports that were prepared for use during the design of this project.

Attention is directed to the requirements of "Field Engineering" in Section 12-1, "General Requirements," of these special provisions.

QUALITY ASSURANCE

Samples: Samples of sand, pea gravel, or crushed stone, weighing not less than 25 pounds, shall be submitted to the Engineer at the jobsite for approval.

SITE CONDITIONS

Existing Underground Piping and Conduit: The location of existing underground piping and conduit is based on the best records available. Before beginning work, the Contractor shall accurately locate the piping and conduit involved in the work. If the location of the existing piping or conduit deviates from the location shown on the plans by more than 5 feet, or, if no elevations are indicated and the piping or conduit is more than 3 feet below grade, the cost of the additional excavation, backfill, piping or conduit, and removal and replacement of concrete, if any, will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications.

Existing Surfaced or Planted Areas:

Existing surfaced or planted areas that are removed, broken or damaged by the Contractor's operations shall be restored to their original condition except as otherwise shown on the plans or specified herein.

Restoration materials shall be equal to or better than the original materials. Surfacing shall be replaced to match the material thickness, grades, and finish of the adjacent surrounding surfaces.

PART 2 - PRODUCTS

BACKFILL MATERIALS

Structure Backfill: Structure and trench backfill shall be free of organic and other deleterious material and shall be suitable for the required compaction. Gravel without sand matrix shall not be used except as free draining granular material beneath slabs and footings.

Sand: Sand shall be clean, washed sand, free from clay or organic material graded such that 100 percent passes the 1/4-inch sieve, 90 percent to 100 percent passes the No. 4 sieve and not more than 5 percent passes the No. 200 sieve size.

Pea Gravel (Naturally Rounded):

Pea gravel (naturally rounded) shall be clean, washed, dry density of not less than 95 pounds per cubic foot, free from clay or organic material and shall conform to the following grading as determined by California Test 202:

Sieve or Screen Size	Percentage Passing
3/4"	100
1/2"	90-100
3/8"	40-70
No. 4	0-15
No. 8	0-3

Pea gravel shall conform to the following requirements:

Test	California Test No.	Test Requirements
Durability Index	229	35 Min.

Crushed Stone:

Crushed stone shall be clean, washed, dry density of not less than 95 pounds per cubic foot, crushed stone or crushed gravel with an angular particle size not less than 1/8 inch or more than 1/2 inch.

Sieve or Screen Size	Percentage Passing
1/2"	100
3/8"	85-100
No. 4	10-30
No. 8	0-3

Crushed stone shall conform to the following requirements:

Test	California Test No.	Test Requirements
Durability Index	229	35 Min.

PART 3 - EXECUTION

PREPARATION AND RESTORATION

Sawcutting: Prior to excavation or trenching, existing surfacing shall be removed to saw cut lines, or to existing wood dividers or expansion joints, if any. The saw cut shall be to a neat line and have a depth not less than one inch.

Restoration: Surfacing shall be replaced to match the thickness, grades and finish of the adjacent surrounding surfaces.

STRUCTURE EXCAVATION

Unless otherwise noted, all excavation for building work shall be classified as structure excavation.

Footing Excavation:

The bottom of excavation shall not be disturbed. The contractor shall excavate by hand to the final grade. The bottom of concrete footings shall be poured against undisturbed material. Unless otherwise noted, compaction of the bottom of footing excavation is not required unless the material is disturbed. The footing depths shown on the plans shall be changed to suit field conditions when directed by the Engineer. Solid rock at or near required depths shall not be disturbed. Unsuitable material shall be excavated down to firm bearing as directed by the Engineer. Work and materials required because of excavation in excess of the depths shown on the plans, when such excavation has been ordered by the Engineer, will be paid for as extra work as provided in Section 4-1.03D of the Standard Specifications.

Excavate to the elevations and dimensions within a tolerance of ±1/2 inch. Limits of the excavation shall allow for adequate working space for installing materials and as required for safety of personnel. Such working space excavation shall be replaced in kind and compacted at the Contractor's expense.

Overdepth excavation for footings shall be backfilled with concrete or such other material recommended by the Contractor and approved by the Engineer. Relative compaction shall be not less than 95 percent.

At locations and to the limits shown on the plans, material below the bottom of the foundation or footing shall be removed and replaced with select backfill in accordance with the placing and compacting requirements for backfill.

Excavation for Pipes and Conduits:

Pipes or conduits in the same trench shall have a minimum clear distance between pipes or conduits of 6 inches. Pipes or conduits shall have not less than 2½ feet of cover from top of pipes or conduits to finished grade unless otherwise shown on the plans or specified.

Trenching shall be of sufficient depth to permit placing a minimum depth of 4 inches of compacted sand under all pipes and conduits.

Excavation adjacent to trees shall be performed by hand methods where necessary to avoid injury to trees and roots. Roots 2 inches in diameter and larger shall be protected with heavy burlap. Roots smaller than 2 inches in diameter adjacent to trees shall be hand trimmed. Cuts through roots 1/2 inch in diameter and larger shall be sealed with tree trimmers' asphaltic emulsion. If trenches remain open more than 24 hours, the side of the trench adjacent to the tree shall be shaded with burlap and kept damp. Materials shall not be stockpiled within the drip line of trees.

Dewatering: Excavations shall be kept clear of standing water. Water shall be removed by pumping if necessary. Water removed from excavation shall be carried away from the building site and disposed of in a manner that will not harm State or adjacent property.

STRUCTURE BACKFILLING

Unless otherwise noted, all backfill for building work shall be classified as structure backfill. Backfill shall be placed and compacted in horizontal layers, not more than 6 inches thick prior to compaction, and to the lines and grades shown on the plans or to original ground.

Structure Backfill: After structures are in place and forms are removed, wood and other debris shall be removed from excavations before placing structure backfill.

Backfilling Pipes and Conduits:

Backfill placed under pipe and conduits shall be compacted sand, 4 inches minimum depth. Backfill material placed to a level 6 inches above tops of pipes and conduits shall be sand or fine earth and particles shall not exceed 1/2 inch in greatest dimension. For wrapped, coated, or plastic pipe or conduits, sand shall be used for backfill. Backfill material placed higher than 6 inches above tops of pipes or conduits shall consist of material free of stones or lumps exceeding 4 inches in greatest dimension except:

1. The top 12 inches of backfill under roads, walks or paving shall consist of aggregate base material.
2. The top 6 inches of backfill in planted areas shall consist of topsoil.

Unless otherwise shown on the plans, pipe under roads, with less than 2½ feet of cover over the top of pipe, shall be backfilled with concrete to a level 4 inches above the top of pipe. Concrete for backfill shall be commercial quality concrete containing not less than 564 pounds of cement per cubic yard.

COMPACTION

Relative compaction shall be determined in accordance with California Test 216 or 231.

Unless otherwise noted below, all backfill shall be compacted to a minimum relative compaction of 90 percent.

Unless approved in writing by the Engineer, compaction by jetting or ponding will not be permitted.

Compact Original Ground: Original ground surface under fill with surfacing of concrete and asphalt concrete shall be compacted to a relative compaction of not less than 95 percent for a minimum depth of 6 inches.

Subgrade Preparation:

Preparation of subgrade material for placing aggregate base, surfacing, or slabs thereon shall include fine grading, compaction, reworking as necessary. The upper 6 inches of the subgrade shall have the same compaction as the fill to be placed over it.

The prism of backfill directly underneath the building foundation and sloping downward at 1:1 shall be compacted to 95 percent.

Structure Backfill: Structure backfill shall be compacted to not less than 95 percent relative compaction.

Select Backfill:

Select backfill shall be compacted to not less than 95 percent relative compaction.

A relative compaction of not less than 95 percent shall be obtained for a minimum depth of 6 inches below the bottom of the excavation before placing select backfill.

Trench Backfill: Trench backfill placed beneath slabs or paved areas shall be compacted to a relative compaction of not less than 95 percent.

DISPOSAL

FIELD QUALITY CONTROL

Inspection: When the excavation is substantially completed to grade, the Contractor shall notify the Engineer. No concrete shall be placed until the foundation has been approved by the Engineer.

Testing: The State will conduct compaction tests during the backfilling and compacting operations.

12-2.03 AGGREGATE BASE

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of furnishing, spreading and compacting aggregate base in accordance with the details shown on the plans and these special provisions.

PART 2 - PRODUCTS

Aggregate base:

Aggregate base shall be commercial quality aggregates consisting of broken stone; crushed gravel; natural, clean, rough-surfaced gravel and sand; or a combination thereof.

Aggregate base shall conform to the following grading as determined by California Test 202:

Sieve or Screen Size	Percentage Passing
1"	100
3/4"	90 - 100
No. 4	35 - 60
No. 30	10 - 30
No. 200	2 - 9

Aggregate base shall also conform to the following quality requirements:

Tests	California Test No.	Test Requirements
Durability Index	229	35 Min.
Resistance (R-Value)	301	78 Min.
Sand Equivalent	217	22 Min.

PART 3 - EXECUTION

SPREADING AND COMPACTING

Spreading:

Aggregate base shall be placed and compacted to the lines and grades shown on the plans.

Spreading and compacting shall be performed by methods that will produce a uniform base, free from pockets of coarse or fine material.

Compaction: Relative compaction of each layer of compacted base material shall be not less than 95 percent, as determined by California Test 216 or 231.

12-2.04 FREE DRAINING GRANULAR MATERIAL

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of furnishing and placing free draining granular material beneath slabs in accordance with the details shown on the plans and these special provisions.

PART 2 - PRODUCTS

Free Draining Granular Material: Free draining granular material shall be clean, hard, durable, free-draining rock. The material gradation shall be such that all passes the one-inch screen, and not more than 10 percent passes the No. 4 sieve as determined by California Test 202. Granular material shall be free from organic material, clay balls or other deleterious substances.

PART 3 - EXECUTION

SPREADING AND CONSOLIDATING

Free draining granular material shall be placed, spread, and consolidated by tamping or vibrating.

SECTION 12-3. CONCRETE AND REINFORCEMENT

12-3.01 CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of constructing cast-in-place concrete facilities in accordance with the details shown on the plans and these special provisions.

SUBMITTALS

Product Data:

Manufacturer's descriptive data for admixtures, expansion joint material, vapor barrier, hardener, and sealer shall be submitted for approval.

Descriptive data shall be delivered to the Engineer at the jobsite.

QUALITY ASSURANCE

Certificates of Compliance:

Certificates of Compliance shall be furnished for cement, reinforcement, epoxy products, and admixtures in accordance with the requirements specified in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

PART 2 - PRODUCTS

CONCRETE MIXES

Concrete (Structural Work):

Commercial quality concrete shall be proportioned to provide a workable mix suitable for the intended use; shall have not less than 564 pounds of cement per cubic yard; 0 to 2-inch penetration, inclusive, as determined by California Test 533.

lifornia Test 504.

Concrete (Minor Work):

Commercial quality concrete for concrete curbs, sidewalks, driveways, gutter depressions, new door openings, and collars shall be proportioned to provide a workable mix suitable for the intended use; shall have not less than 470 pounds of cement per cubic yard; 0 to 2-inch penetration, inclusive, as determined by California Test 533.

CONCRETE MATERIALS

Cement: Cement shall conform to ASTM Designation: C 150, Types II, or III portland cement; or Type IP (MS) Modified cement. Type IP (MS) Modified shall conform to ASTM Designation: C 595 and shall be comprised of an intimate mixture of Type II Modified cement and not more than 20 percent of a pozzolanic material.

Aggregates:

Aggregates shall be free from deleterious coatings, clay balls and other extraneous materials.

Admixtures: Admixtures used in portland cement concrete shall be included on the Department's current list of approved admixtures, and shall conform to ASTM Designation: C 494, Types A, B, D, F or G for chemical admixtures; ASTM Designation: C 260 for air-entraining admixtures; and ASTM Designation: C 618 for mineral admixtures, except loss on ignition shall not exceed 4 percent. Properties of admixtures shall be uniform in each lot.

Coloring for Concrete: Coloring for portland cement concrete shall be chemically inert, fade resistant mineral oxide or synthetic type.

FORM MATERIALS

Forms for Exposed Finish Concrete:

Forms for exposed surfaces shall be plywood, metal or other panel type materials. Plywood shall be not less than 5/8 inch thick and without scars, dents, and delaminations. Forms shall be furnished in largest practical pieces to minimize number of joints.

Plywood shall conform to the requirements of U. S. Product Standard PS-1 for Exterior B-B (Concrete Form) Class I.

Forms for edges of slabs shall be nominal 2-inch solid stock lumber, plywood, or metal forms.

Forms for Unexposed Finish Concrete: Forms for unexposed finish concrete surfaces shall be plywood, lumber, metal or other acceptable material.

Forms for Cylindrical Columns or Supports: Forms for cylindrical columns shall be metal, fiberglass reinforced plastic, paper or fiber tubes. Paper or fiber tubes shall be constructed of laminated plies using water-resistant adhesive with wax-impregnated exterior for protection against weather or moisture.

Form Ties: Form ties shall be factory fabricated, removable or snapoff metal ties for use as necessary to prevent spreading of forms during concrete placement.

Form Oil: Form oil shall be commercial quality form oil which will permit the ready release of the forms and will not discolor the concrete.

REINFORCING MATERIALS

Bar Reinforcement: Bar reinforcement shall conform to ASTM Designation: A 615/A 615M, Grade 60 [420], or ASTM Designation: A 706/A 706M.

Welded Wire Fabric: Welded wire fabric shall conform to ASTM Designation: A 185.

Bar Supports: Bar supports for reinforcement shall be precast mortar blocks or ferrous metal chairs, spacers, metal hangers, supporting wires, and other approved devices of sufficient strength to resist crushing under applied loads.

EPOXY

Epoxy shall be furnished as 2 components which shall be mixed together at the site of the work.

Epoxy Resin Adhesive: Epoxy resin adhesive shall conform to State of California Specification No. 8040-21M-08 or other epoxy suitable for bonding new concrete to old.

Epoxy Mortars: Epoxy mortar and epoxy mortar surface treatment shall consist of a commercial quality, trowelable mixture consisting of epoxy and sand. Epoxy shall have a pull-off strength of not less than 1,000 psi and a 90-percent cure in 24 hours. Epoxy shall be of the type that requires no primer as a bonding agent.

Sand:

Sand for use in epoxy mortars shall be clean and shall have a moisture content of not more than 0.50-percent when tested in accordance with California Test 226.

Sand for epoxy mortar surface treatment shall be graded such that 100-percent passes the No. 100 sieve.

RELATED MATERIALS

Anchor Bolts, Nuts, and Washers:

Nonheaded anchor bolts shall conform to ASTM Designation: A 36/A 36M, with a minimum hook length of 6.2 diameters.

Headed anchor bolts shall conform to ASTM Designation: A 307.

Threaded rods shall conform to ASTM Designation: A 572.

Nuts shall conform to ASTM Designation: A 563, Grade A.

Washers for anchor bolts shall be commercial quality.

Exposed anchor bolts, nuts, and washers shall be hot dipped galvanized.

Expansion Joint Material: Expansion joint material shall be commercial quality asphalt impregnated pressed fiber sheets, ½-inch minimum thickness.

Vapor Barrier: Vapor barrier shall be commercial quality polyethylene sheets not less than 6 mils thick.

Bond Breaker: Bond breaker shall be Type I asphalt saturated organic felt or such other material approved by the Engineer.

Nonskid Abrasive Aggregate: Nonskid abrasive aggregate shall be commercial quality aluminum oxide, silicon carbide, or almandite garnet grit particles; screen size 12-30 or 14-36.

Type A Control Joints: Type A control joints shall be commercial quality, preformed, T-shaped plastic strips with detachable top flange.

Keyed Construction Joint Forms: Keyed construction joint forms shall be commercial quality, galvanized metal or plastic, factory fabricated construction joint forms. Forms shall produce a rabbeted key type joint.

Divider and Edger Strips: Divider and edger strips shall be foundation grade redwood.

Mortar: Mortar shall consist of one part cement to 2 parts clean sand and only enough water to permit placing and packing.

Curing Compound: Curing compound shall be a non-pigmented curing compound with fugitive dye conforming to the requirements of ASTM Designation: C 309, Type 1-D, Class A.

Concrete Hardener: Concrete hardener shall be commercial quality water borne penetrating type magnesium fluosilicate, zinc fluosilicate or combination thereof.

Splash Block: Splash blocks shall be precast concrete splash blocks with depressed runoff trough. Splash blocks shall be 12" x 24" x 3½" in size unless otherwise shown on the plans.

ADMIXTURES

Admixtures shall be used when specified or ordered by the Engineer and may be used at the Contractor's option to conserve cement or to facilitate any construction operation.

Calcium chloride shall not be used in any concrete.

Admixtures shall be combined with concrete materials by methods that produce uniform properties throughout the concrete.

If more than one admixture is used, said admixtures shall be compatible with each other so that the desirable effects of all admixtures will be realized.

Mineral admixtures may be used to replace up to 15 percent of Type II portland cement provided the weight of mineral admixture used is not less than the weight of cement replaced. Mineral admixtures shall not be used to replace Type IP (MS) Modified or Type III cements. Chemical admixtures may be used to reduce up to 5 percent of the portland cement except that the cement content shall not be less than 470 pounds per cubic yard. When both chemical and mineral admixtures are used with Type II cement, the weight of cement replaced by mineral admixture may be considered as cement in determining the resulting cement content.

Mineral admixtures will be required in the manufacture of concrete containing aggregates that are determined to be "deleterious" or "potentially deleterious" when tested in accordance with ASTM Designation: C 289. The use of mineral admixture in such concrete shall conform to the requirements in this section except that the use of set retarding admixtures will not be permitted.

When the use of a chemical admixture is specified or is ordered by the Engineer, the admixture shall be used at the rate specified or ordered. If no rate is specified or ordered, or if the Contractor uses a chemical admixture for his own convenience, the admixture shall be used at the dosage normally recommended by the admixture manufacturer.

When air-entrainment is specified or is ordered by the Engineer, the air-entraining admixture shall be used in amounts to produce concrete having the specified or ordered air content as determined by California Test 504. If the Contractor uses air-entrainment for his own convenience, the average air content shall not exceed 4 percent and no single test shall exceed 5½ percent.

Chemical admixtures and air-entraining admixtures shall be dispensed in liquid form. Dispensers shall have sufficient capacity to measure at one time the total quantity required for each batch. If more than one liquid admixture is used in the concrete, a separate measuring unit shall be provided for each liquid admixture and dispensing shall be such that the admixtures are not mixed at high concentrations. When air-entraining admixtures are used with other liquid admixtures, the air-entraining admixtures shall be the first to be incorporated into the mix. Unless liquid admixtures are added to premeasured water for the batch, they shall be discharged to flow into the stream of water so that the admixtures are well dispersed throughout the batch.

BAR REINFORCING STEEL

Bending:

Reinforcing steel bars shall accurately conform to the dimensions shown on the plans.

Bars shall be bent or straightened in a manner that will not crack or break the material. Bars with kinks or improper bends shall not be used.

Hooks, bends and splices shall conform to the provisions of the Building Code Requirements for Reinforced Concrete of the American Concrete Institute.

MIXING AND TRANSPORTING CONCRETE

When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be complete within 1½ hours, or before 250 revolutions of the drum or blades, whichever comes first, after the introduction of cement to the aggregates.

The temperature of mixed concrete, immediately before placing, shall be not less than 50°F nor more than 90°F.

Truck mixers or agitator shall be equipped with electrically or mechanically actuated revolution counters by which the number of revolutions of the drum or blades may readily be verified. The counters shall be of the continuous-registering type, which accurately register the number of revolutions and shall be mounted on the truck so that the Engineer may safely and conveniently inspect them from alongside the truck. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 86°F or above, a time less than 1½ hours may be required.

When non-agitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be complete within one hour after the introduction of cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 86°F, or above, the time between the introduction of cement to the aggregates and discharge shall not exceed 45 minutes.

Each load of concrete for the work shall be accompanied by a trip ticket, a copy of which shall be delivered to the Engineer at the jobsite. The trip ticket shall show volume of concrete, weight of cement and aggregates, quantity of each admixture, quantity of water including water added at the jobsite, time of day the concrete is batched, and revolution counter readings on transit mix trucks at the times the truck is charged and unloaded.

PART 3 - EXECUTION

PREPARATION

Existing Concrete Construction:

Where fresh concrete joins existing or previously placed concrete or masonry, the contact surfaces of the existing or previously placed material shall be roughened, cleaned, flushed with water and allowed to dry to a surface dry condition immediately prior to placing the fresh concrete. The roughened surface shall be no smoother than a wood trowelled surface. Cleaning of the contact surfaces shall remove laitance, curing compounds, debris, dirt and such other substances or materials which would prevent bonding of the fresh concrete.

Abrasive blast methods shall be used to clean horizontal construction joints to the extent that clean aggregate is exposed.

Exposed reinforcing steel located at the contact surfaces which is to be encased in the fresh concrete shall be cleaned to remove any substance or material that would prevent bonding of the fresh concrete.

Forms:

Forms shall be mortar tight, true to the dimensions, lines, and grades shown on the plans, securely fastened and supported, and of adequate rigidity to prevent distortion during placing of concrete.

Forms for exposed surfaces shall be constructed with triangular fillets not less than 3/4" x 3/4" attached so as to prevent mortar runs and to produce smooth straight chamfers at all sharp edges of the concrete.

Form fasteners shall be removable without chipping, spalling, heating or otherwise damaging the concrete surface. Form ties shall be removed to a depth of at least one inch below the surface of the concrete.

The inside surfaces of forms shall be cleaned of all dirt, mortar and foreign material. Forms shall be thoroughly coated with form oil prior to use.

Forms shall not be stripped until at least 40 hours after placing concrete, except soffit forms and supports shall not be released or removed until at least 10 days after placing concrete.

Anchorages and embedded items shall be placed and rigidly secured at their planned locations prior to placing concrete.

Reglets or embedded flashing shall be installed on concrete forms before the concrete is placed.

Redwood dividers shall have 16d galvanized nails partially driven into both vertical faces at 18 inches on center.

Vapor Barrier:

Vapor barrier shall be lapped 6 inches and securely taped at splices. Vapor barrier shall be protected with a 3-inch layer of clean uncompacted sand cover.

Unless otherwise shown on the plans, vapor barrier shall be placed under portions of the floor slab scheduled to receive finish flooring.

Placing Reinforcing Steel:

Reinforcing steel bars shall be accurately placed to the dimensions shown on the plans.

Bar reinforcement conforming to ASTM Designation: A 615/A 615M, Grade 60 [420], or A 706/A 706M shall be lapped at least 45 diameters.

Bars shall be firmly and securely held in position by means of wiring and approved bar supports. The spacing of supports and ties shall prevent displacement of the reinforcing or crushing of supports.

Tie wire shall be clear of concrete formwork and concrete surfaces.

All reinforcing steel shall be in place and inspected before concrete placement begins. Placing of bars on fresh layers of concrete will not be permitted.

Within areas where epoxy-coated reinforcement is required, tie wire and bar chairs or other metallic devices used to secure or support the reinforcement shall be plastic-coated or epoxy-coated to prevent corrosion of the devices or damage to the coated reinforcement.

Ground Bar: A continuous reinforcing steel bar shall be installed in the building foundation at the location indicated on the plans for the electrical ground bar. The use of epoxy coated reinforcing bar is not permitted. The end of the ground bar shall extend beyond the concrete surface and shall be protected from damage by construction operations.

PLACING CONCRETE

Concrete shall be placed and consolidated by means of internal vibrators to form dense, homogeneous concrete free of voids and rock pockets.

Forms and subgrade shall be thoroughly moistened with water immediately before placing concrete.

Concrete shall be placed as nearly as possible to its final location and the use of vibrators for extensive shifting of the concrete will not be permitted.

Concrete shall be deposited and consolidated in a continuous operation within limits of construction joints, until the placing of the panel or section is completed.

When concrete is to be placed in large areas requiring more than two pours, concrete shall be placed in alternate long strips between construction joints and the final slab infilled.

Vibrators used to consolidate concrete containing epoxy-coated bar reinforcement shall have a resilient covering to prevent damage to such reinforcement.

FINISHING CONCRETE SURFACES

Finishing Unformed Surfaces:

Slabs shall be placed full thickness to finish elevation and leveled to screeds by use of long straightedges. The screeds shall be set to grade at approximately 6-foot centers. After leveling, screeds shall be removed and the surface shall be floated with wooden floats.

Type A control joint strips shall be inserted into the floated concrete so that the bottom of the top flange is flush with the finish elevation. Strips shall be standard manufactured lengths and shall be placed on an approximate straight line. The top flange of the strips shall be removed after the concrete has set and cured.

The floated surface shall be trowelled with steel trowels. Troweling shall form a dense, smooth and true finish. Walkways, pedestrian ramps, stairs and outdoor slabs for pedestrian traffic shall be given a non-slip broom finish unless a different finish is called for on the plans or in these special provisions.

The application of cement dust coat will not be permitted.

Steel trowel finish and broom finish will not be required for slabs to receive exposed aggregate finish nor for slabs to be covered with ceramic tile.

Concrete floor surfaces to receive ceramic tile shall be floated to grade and then, before final set of the concrete, the floated surfaces shall be roughened with stiff bristled brushes or rakes.

Finished surfaces of floor slabs shall not deviate more than 1/8 inch from the lower edge of a 10-foot long straight edge.

Finishing Formed Surfaces:

Formed concrete surfaces shall be finished by filling holes or depressions in the surface, repairing all rock pockets, and removing fins. All surfaces of formed concrete exposed to view shall have stains and discolorations removed, unsightly bulges removed, and all areas which do not exhibit the required smooth, even surface of uniform texture and appearance shall be sanded with power sanders or other approved abrasive means until smooth, even surfaces of uniform texture and appearance are obtained.

Cement mortar, patching and finishing materials used to finish exposed surfaces of concrete shall closely match the color of surrounding surfaces.

Nonskid Abrasive Aggregate Finish: Where shown on the plans, walkways shall receive a nonskid abrasive aggregate (grit) finish. The grit shall be applied uniformly at the rate of not less than 0.3 pound per square foot and tamped into the floated concrete surface while the concrete is plastic. The grit shall be buried about 0.7 diameter of each particle into the concrete.

CURING CONCRETE

Freshly placed concrete shall be protected from premature drying and excessive cold or hot temperatures.

Initial curing of floor slabs shall start as soon as free water has disappeared from the concrete surface. The concrete shall be kept continuously wet by application of water for not less than 7 days after the concrete has been placed.

Cotton mats, rugs, carpets, or sand blankets may be used as a curing medium to retain the moisture during the curing period. Curing materials that will stain or discolor concrete shall not be used on surfaces exposed to view.

Prior to placing the curing medium, the entire surface of the concrete shall be kept damp by applying water with a nozzle that so atomizes the flow that a mist and not a spray is formed, until the surface of the concrete is covered with the curing medium. At the expiration of the curing period, the concrete surfaces shall be cleared of all curing mediums.

Concrete surfaces, other than floor slabs, shall be kept moist for a period of at least 5 days by leaving the forms in place or by covering the exposed surfaces using moist rugs, cotton mats or other curing materials approved by the Engineer.

Concrete curbs, sidewalks, collars, and gutter depressions may be cured with a curing compound.

PROTECTING CONCRETE

Concrete shall not be placed on frozen or frost covered surfaces.

Concrete shall be protected from damage due to rain, freezing or inclement weather, and shall be maintained at a temperature of not less than 40°F for 72 hours. When required by the Engineer, the Contractor shall provide a written outline of his proposed methods of protecting concrete.

Vehicles, equipment, or concentrated loads weighing more than 300 pounds individually and material stockpiles weighing more than 50 pounds per square foot will not be permitted on the concrete within 10 calendar days after placing.

SPECIAL TREATMENTS

Concrete Hardener:

Chemical concrete hardener shall be applied to the floor surfaces shown on the plans, prior to the application of concrete sealer. Surfaces shall be clean and dry before the application of hardener.

The solution shall be applied in accordance with the manufacturer's instructions.

After the hardener has dried, the surface shall be mopped with water to remove encrusted salts.

Concrete Sealer: Concrete sealer shall be applied to the concrete surfaces designated on the plans in accordance with the manufacturer's instructions for heavy duty use. The sealer shall be applied to dry concrete surfaces.

Epoxy Resin Adhesive: Epoxy resin adhesive shall be applied to concrete surfaces shown on the plans. Epoxy resin adhesive shall be mixed and applied in accordance with the manufacturer's recommendations.

Epoxy Mortars:

Epoxy for use as a binder in epoxy mortars shall be thoroughly mixed together before the aggregate is added, and unless otherwise specified, the mix proportions shall consist of one part binder to approximately 4 parts of aggregate, by volume.

All surfaces against which epoxy mortars are to be applied shall be free of rust, paint, grease, asphalt, and loose or deleterious material.

12-3.02 DRILL AND BOND DOWELS

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of drilling holes in existing concrete and installing and bonding bar reinforcing steel dowels into such drilled holes in existing concrete in accordance with the details shown on the plans and these special provisions.

PART 2 - PRODUCTS

Bonding Material: The bonding material shall be magnesium phosphate concrete, either single component (water activated) or dual component (with a prepackaged liquid activator), as approved by the Engineer.

Dowels: Dowels shall be bar reinforcing steel, as specified under "Cast-In-Place Concrete" in Section 12-3, "Concrete and Reinforcement," of these special provisions.

PART 3 - EXECUTION

Installation:

The holes shall be drilled by methods that will not shatter or damage the concrete adjacent to the holes. The diameter of drilled holes shall be 1/2 inch larger than the nominal diameter of the dowels unless otherwise shown on the plans.

Immediately prior to placing the dowels, the holes shall be cleaned of dust and other deleterious materials, and the holes shall be dry.

Sufficient bonding material shall be placed in the hole so that no voids remain after the dowels are inserted.

Dowels which fail to bond or are damaged before new concrete is placed shall be removed and replaced.

Magnesium phosphate concrete shall be formulated for minimum initial set time of 15 minutes and minimum final set time of 25 minutes at 70°F. The materials, prior to use, shall be stored in a cool, dry environment.

Mix water used with water activated material shall be free from oil and impurities and contain not more than 2,000 parts per million as Cl nor more than 1,500 parts per million of sulfate as SO_4.

The quantity of water for single component type or liquid activator for dual component type to be blended with the dry component, shall be within the limits recommended by the manufacturer and shall be the least amount required to produce a pourable batter.

Magnesium phosphate concrete shall not be mixed in containers or worked with tools containing zinc, cadmium, aluminum, or copper metals.

The surface of any dowel coated with zinc or cadmium shall be coated with a colored lacquer before installation of the dowel. The lacquer shall be allowed to dry thoroughly before embedment of said dowels.

SECTION 12-4. (BLANK)

SECTION 12-5. (BLANK)

SECTION 12-6. (BLANK)

SECTION 12-7. THERMAL AND MOISTURE PROTECTION

12-7.01 BITUMINOUS WATERPROOFING

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of furnishing and applying a bituminous waterproofing membrane in accordance with the details shown on the plans and these special provisions.

Bituminous waterproofing membrane shall consist of a coating of primer, a bonded, continuous membrane composed of 2 layers of asphalt saturated glass fabric and 3 moppings of waterproofing asphalt.

SUBMITTALS

Product Data: Manufacturer's descriptive data, installation instructions and recommendations for each waterproofing material shall be submitted for approval.

QUALITY ASSURANCE

The Contractor shall obtain primary materials from a single manufacturer. Secondary materials shall be only as recommended by the primary manufacturer.

Labels: Materials shall be furnished which have factory applied labels affixed to each container or roll of material certifying compliance with ASTM standards specified.

PART 2 - PRODUCTS

Asphalt Primer: Asphalt primer shall be cut-back type conforming to ASTM Designation: D 41.

Waterproofing Asphalt: Waterproofing asphalt shall conform to ASTM Designation: D 449, Type I, suitable for vertical surfaces below grade.

Glass Fiber Fabric: Glass fiber fabric shall conform to ASTM Designation: D 1668, Type I, for woven glass fabric treated with asphalt and weighs about 1.5 pounds per 100 square feet.

Plastic Cement: Plastic cement shall be suitable for use with bituminous materials.

Protection Board: Protection board shall be organic fiberboard treated for resistance to fungus and insects, asphalt impregnated and asphalt coated on both faces; ½ inch thick unless otherwise noted.

PART 3 - EXECUTION

PREPARATION

Protection: Liquid or mastic compounds shall not be permitted to enter or clog drains and conductors. Spillage or migration onto other surfaces of work shall be prevented by masking or otherwise protect adjoining work.

Surface Preparation: All concrete surfaces which are to be waterproofed shall be reasonably smooth and free from holes and projections which might puncture the membrane. The surface shall be dry and thoroughly cleaned of dust and loose materials.

The primer shall be applied to the surface and allowed to dry before applying asphalt.

INSTALLATION

Installation shall comply with manufacturer’s instructions, except where more stringent requirements are shown or specified, and except where proper conditions require extra precautions or provisions to ensure satisfactory performance of work.

Application:

No primer or asphalt shall be applied in wet weather, nor when the temperature is below 65°F. Heating shall be in accordance with the manufacturer's instructions.

Multiply-courses of bitumen and felts or fabrics shall be installed in individual courses, unless manufacturer recommends shingle-fashion courses. Courses shall be laid in direction or directions recommended.

Membrane shall be extended as flashing at edges, openings and projections, so as to complete waterproof enclosure as required for leakproof installation.

Protection Board: Protection board shall be set into last course of asphalt before it cools.

12-7.02 WATER REPELLENT COATING

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of furnishing and applying water repellent coating to concrete or masonry surfaces in accordance with the details shown on the plans and these special provisions.

The water repellent coating shall be applied to all exterior concrete or masonry surfaces and exposed aggregate surfaces as shown on the plans.

SUBMITTALS

Product Data: Manufacturer's descriptive data, application instructions and general recommendations for water repellents shall be submitted for approval.

QUALITY ASSURANCE

Codes and Standards: Water repellent coatings shall comply with all rules and regulations concerning air pollution in the State of California.

Certificates of Compliance: Certificates of Compliance shall be furnished with each shipment of water repellent coating materials in accordance with Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

PART 2 - PRODUCTS

Water Repellent Coating: Water repellent coating shall be clear, colorless, water-based sealer. Water repellent coating shall be Hydrozo Inc., Clear Double 7; Euclid Chemical Co., Architectural Seal VOX; Tamms Industries Co., Chemstop; or equal.

PART 3 - EXECUTION

Preparation: All surfaces to receive water repellent coating shall be dry and cleaned by removing contaminants that block pores of the surface. Cleaning methods shall be as recommended by the water repellent manufacturer.

Application:

The water repellent solution shall be applied in accordance with the manufacturer's printed instructions

The time period between applications of water repellent coating shall be not less than 24 hours.

Protection: Surfaces of other materials surrounding or near the surfaces to receive the water repellent coating shall be protected from overspray or spillage from the waterproofing operation. Water repellent coating applied to surfaces not intended to be waterproofed shall be removed and the surfaces restored to their original condition.

12-7.03 THROUGH-PENETRATION FIRESTOPPING

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of furnishing and installing firestopping materials at penetrations in fire-rated walls, floors, and ceilings in accordance with the details shown on the plans and these special provisions.

SUBMITTALS

Product Data:

A list of materials, manufacturer's descriptive data, and location schedule shall be submitted for approval.

Descriptive data shall include trade names, manufacturers' names, complete information on the materials to be applied, California State Fire Marshal Listing, the material thickness for the required fire resistance ratings, and the manufacturer's printed instructions for installation. Manufacturer's assembly shall be California State Fire Marshal approved.

QUALITY ASSURANCE

Certificates of Compliance: Certificates of Compliance shall be furnished with each shipment of firestopping materials in accordance with Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

DELIVERY, STORAGE AND HANDLING

Delivery: Materials to be applied shall be delivered in original unopened packages. Packages shall be identified by the manufacturer's label and shall bear proper labels for fire resistance classification.

Storage: Materials shall be stored above ground, under cover, and in a dry location until ready for use. Packages which have been exposed to moisture before use shall be discarded.

PART 2 - PRODUCTS

Fire-rated Caulk: Fire-rated caulk shall conform to ASTM Designation: E 814 and shall be rated for use in 2 and 3-hour fire-rated assemblies. Fire-rated caulk shall be 3M Brand, Fire Barrier Caulk; Dow Corning, Fire Stop Sealant; Standard Oil, Fyre Putty; or equal.

Wrap Strip: Wrap strip shall be nominal ¼-inch thick intumescent elastomeric material in 2-inch wide strips, faced one side with aluminum foil, and rated for use in 1-hour and 2-hour fire-rated systems.

Packing Material: Packing material shall be polyethylene backer rod or nominal one-inch thickness of tightly packed ceramic (alumina silica) fiber blanket, mineral-wool batt or glass fiber insulation material.

Fire-rated Mortar: Fire-rated mortar shall be non-asbestos, 47 to 57 pounds per cubic foot air dried density portland cement fly ash through-penetration firestopping mortar. Fire-rated mortar shall conform to ASTM Designation: E 814 and shall be rated for use in 3-hour fire-rated systems at 3-inch minimum thickness.

Fire Safing Insulation: Fire safing insulation shall be inorganic 3.5 pounds per cubic foot minimum density, non-combustible fiber insulation conforming to Federal Specifications HH-1-521F, when tested in accordance with ASTM Designation: E 119 and ASTM Designation: E 136 for 3 hour fire resistance.

PART 3 -EXECUTION

Installation: Firestopping materials shall be installed to conform to the requirements of the California State Fire Marshal Listing and the manufacturer's recommendations.

12-7.04 JOINT SEALANT

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of preparing and placing a joint sealant in accordance with the details shown on the plans and these special provisions.

The sealed joint shall consist of tempered hardboard, expanded polystyrene and a pourable joint seal.

SUBMITTALS

Product Data: Manufacturer's descriptive data, specifications and installation instructions shall be submitted to the Engineer at the jobsite for approval.

PART 2 - PRODUCTS

Tempered Hardboard: Tempered hardboard shall be 1/8-inch minimum thickness, commercial quality suitable for the use intended. Other facing materials may be used provided they furnish equivalent protection.

Expanded Polystyrene: Expanded polystyrene shall be commercially available polystyrene board.

Polyethylene Foam: Polyethylene foam shall be commercial quality, with a continuous, impervious, glazed top surface, suitable for retaining the liquid sealant in the joint while hardening.

Primer: Primer shall be as recommended by the sealant manufacturer.

Joint Sealant: Joint sealant shall be a commercial quality, 2 component polyurethane sealant, which shall be self-levelling and withstand up to 25 percent movement.

PART 3 - EXECUTION

PREPARATION

Forming:

Groove for joint seal shall be formed to a uniform width and depth and to the alignment shown on the plans or as ordered by the Engineer. The completed groove shall have a top width within 1/8 inch of the width shown on the plans and the bottom width shall not vary from the top width by more than 1/16 inch.

At least 24 hours prior to installing the joint seal, the Contractor shall repair all spalls, fractures, breaks, or voids in the concrete surfaces of the joint groove.

The lip of the joint shall be beveled by grinding as shown on the plans.

Cleaning:

Prior to sealing joints, expanded polystyrene, hardboard, concrete spillage and all foreign material shall be removed from the deck to the bottom of the formed joint.

Prior to placing the joint seal, the joint shall be cleaned by a method which shall include abrasive blast cleaning and then be cleaned with a high pressure air jets to remove all residue and foreign material.

INSTALLATION

Materials:

No material shall be used which has skinned over or which has settled in the container to the extent that it cannot be easily redispersed by hand stirring to form a smooth uniform product.

Each container of material shall be clearly labeled or each delivery of material in the tanks of 2-component equipment shall be accompanied with a ticket showing designation (Component A or B), the manufacturer's name, lot or batch number, date of manufacture, date of packaging, and date, if any, beyond which the sealant shall not be used.

Primer: A primer shall be applied to the sides of the groove and all exposed vertical surfaces in the joint prior to placing the sealant. Primer shall be dry at the time of placing the sealant. Contaminated primer shall be removed and replaced.

Joint Sealant: The 2-component sealant shall be mixed and placed in the groove in accordance with manufacturer's instructions. Unmixed liquid components which have been exposed to the atmosphere for more than 24 hours, shall not be used.

12-7.05 SEALANTS AND CAULKING

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of furnishing and applying sealants and caulking which are required for this project, but not specified elsewhere, in accordance with the details shown on the plans and these special provisions.

Related Work: Pourable polyurethane joint sealant shall conform to the requirements under "Joint Sealant" elsewhere in this Section 12-7.

QUALITY ASSURANCE

Certificates of Compliance: Certificates of compliance shall be furnished for the sealants and caulking in accordance with the requirements specified in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

SUBMITTALS

Product Data: Manufacturer's descriptive data and installation instructions for all sealants shall be submitted for approval.

Samples: Color samples of all sealants shall be submitted for approval. Unless otherwise shown on the plans, colors will be selected by the Engineer from the manufacturer's standard colors.

PART 2 - PRODUCTS

MATERIALS

All sealants, primers and accessories shall be non-staining to adjacent exposed surfaces. Products having similar applications and usage shall be of the same type and same manufacturer. Gun consistency compound shall be used unless otherwise required by the job conditions.

Acrylic Sealant: Acrylic sealant shall be one compound, solvent release acrylic sealant.

Butyl Sealant: Butyl sealant shall be one component, skinning type.

Silicone Sealant: Silicone sealant shall be one component, low modulus building sealant. Sealant shall be tack-free in one hour, shall not sag or flow, shall be ozone resistant and capable of 100 percent extension without failure.

Joint Sealant: Joint sealant shall be a two-part, non sag polysulfide base, synthetic rubber sealant formulated from liquid polysulfide polymer.

Backer Rod: Backer rod shall be round, open or closed cell polyurethane. Backer rod shall be sized such that it must be compressed between 25 percent and 75 percent of its uncompressed diameter during installation in the joint.

Neoprene: Neoprene shall conform to the requirements of ASTM Designation: C 542.

PART 3 - EXECUTION

APPLICATION

Unless otherwise shown on the plans, sealants shall be applied in accordance with the manufacturer's instructions.

Silicone sealants shall not be used in locations where painting is required.

Butyl sealants shall not be used in exterior applications, and acrylic sealants shall not be used in interior applications.

Sealants shall be applied in a continuous operation for the full length of the joint. Immediately following the application of the sealant, the sealant shall be tooled smooth using a tool similar to that used to produce concave masonry joints. Following tooling, the sealant shall remain undisturbed for not less than 48 hours.

SECTION 12-8. DOORS AND WINDOWS

12-8.01 HINGED DOORS

PART 1 – GENERAL

Scope: This work shall consist of furnishing and installing hinged doors and frames in accordance with the details shown on the plans and these special provisions.

SUBMITTALS

Manufacturer's descriptive data, installation instructions for fire rated assemblies and a door schedule shall be submitted for approval. The door schedule shall include a description of the type, location and size of each door and frame.

PART 2 - PRODUCTS

Metal Door:

Metal door shall be flush, seamless steel door factory prepared and reinforced to receive hardware and having cold rolled stretcher leveled sheet steel face sheets not less than 0.048 inch thick (18-gage). Face sheets shall be bonded with thermosetting adhesive to rigid board honeycomb or precured foam core; or face sheets shall be welded to all parts of an assembled grid of cold formed pressed metal stiffeners and framing members located around edges, ends, openings and at all locations necessary to prevent buckling of face sheets. Seams shall be tack welded, filled and ground smooth. Bottom edge and internal stiffeners of grid type core shall have moisture vents. Welds on exposed surfaces shall be ground smooth.

Where fire rated doors are required, doors shall be listed and labeled for the fire rating shown on the plans.

Active leaf of double door shall have a full height astragal of 1/8-inch flat bar or folded sheet strip, not less than 0.060 inch thick (16-gage), welded on the outside of the active leaf.

Door shall be cleaned and treated by the bonderized process or approved phosphatizing process and then given one factory application of metal protective rust inhibitive primer. Primer shall not contain lead type pigments.

Pressed Metal Frame:

Pressed metal frame shall be not less than 0.060-inch thick (16-gage) sheet steel with integral stop, mitered corners, face welded and ground smooth corners. Frames shall be reinforced for all hardware and shall be cleaned and treated by the bonderized process or an approved phosphatizing process and then given one factory application of metal protective rust inhibitive primer. Primer shall not contain lead type pigments.

Frames for fire rated doors shall be listed for the same rating shown on the plans for fire rated doors.

Sealants: Sealants shall be ultraviolet and ozone resistant, gun grade polysulfide or polyurethane, multicomponent, Federal Specification: TT-S-227.

PART 3 - EXECUTION

INSTALLATION

Doors and frames shall be installed rigidly, securely, plumb and true and in such a manner that the doors operate freely without rubbing or binding. Clearance between frame and door shall be not more than 1/8 inch. The exterior frame shall be sealed weathertight.

Pressed metal frames shall be secured with clips and anchors as shown on the plans.

Fire rated assemblies shall be installed according to the manufacturer's recommendations.

Fire rated assemblies shall include doors, door frames, automatic smoke-actuated closers, self-closing mechanisms, panic hardware, wire glass, and fire rated louvers. Assemblies shall be approved by the California State Fire Marshal.

Painting: Except for the primer application specified herein, doors and frames shall be cleaned, prepared and painted in accordance with the requirements specified under "Painting" in Section 12-9, "Finishes," of these special provisions.

12-8.02 FINISH HARDWARE

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of furnishing and installing hardware items for doors in accordance with the details shown on the plans and these special provisions.

Hardware for special doors and frames, if required, shall be as specified under "Hinged Doors" in Section 12-8 "Doors and Windows," of these special provisions.

Hardware assemblies shall comply with the fire code and the disabled accessibility requirements indicated on the plans and specified in these special provisions.

SUBMITTALS

Manufacturer's technical information and catalog cuts for each item of door hardware and a door hardware schedule shall be submitted for approval prior to installation.

Manufacturer's catalog cuts shall include catalog numbers, material, grade, type, size, function, design, quality and finish of hardware.

The door hardware schedule shall indicate the location and size of door opening, the door and frame material, and the size, style, finish and quantity of the hardware components required.

FINISHES

Hardware shall be provided with standard US 26D metal plated finish.

KEYING INSTRUCTIONS

New facilities shall have a building master key system established.

Locks shall have cylinders with figure eight interchangeable cores with six pin barrels. Permanent cores and keys shall be delivered to the Engineer for final installation at completion of project.

The Contractor shall also provide figure eight interchangeable cores for use during construction which shall remain the property of the State.

Key bows shall be stamped "State of California" and "Do Not Duplicate."

PART 2 - PRODUCTS

GENERAL

Door hardware equal in material, grade, type, size, function, design, quality and manufacture to that specified herein may be submitted for approval.

Butt Hinges:

Butt hinges shall be steel, 1 1/2-pair per door unless otherwise specified or shown on the plans. Nonremovable pins shall be provided at outswing exterior doors. Hinge size shall be 4½" x 4½" unless otherwise noted.

Standard weight hinges shall be:

Hager	BB 1279
McKinney	TB 2714
Stanley	BB 179
or equal.	

Heavy weight hinges shall be:

Hager	BB 1168
McKinney	T4B 37869
Stanley	BB 168
or equal.	

Mortise Locksets, Latchsets and Privacy Sets:

Mortise locksets, latchsets and privacy sets shall be steel case with 1¼" x 8" face plate and 2¾-inch backset. Door and frame preparation for mortise locksets, latchset and privacy sets shall conform to ANSI A115.1.

Lever operated lockset shall be:

Best	35H 6FW 15H
Falcon	LM521 DG
Schlage	L9453R x 06
or equal.	

Lever operated latchset:

Best	35H 0N 15H
Falcon	LM101 DG
Schlage	L9010 x 06
or equal.	

Flush Bolts:

Flush bolts shall be installed at the top and bottom of the inactive leaf of pairs of doors. Provide automatic bolts on UL rated pairs of doors.

Flush bolts for automatic operation shall be:

Door Control	840
Glynn Johnson	FB7
H.B. Ives	559
or equal.	

Coordinators:

Coordinators shall be installed at pairs of UL rated doors and at pairs of doors having panic devices.

Coordinators shall be:

Door Control	600
Glynn Johnson	GJCOR
H.B. Ives	936
or equal.	

Door Closers:

Parallel arms for closers shall be installed at outswing exterior doors. Closers shall have sprayed finish to match other hardware on door.

Door closers shall be:

LCN	4040
Norton	3501-BF
Dorma	7800
or equal.	

Panic Devices:

Rim type panic devices shall be installed at single doors and on the active leaf of pairs of doors, unless indicated otherwise. A vertical rod device shall be provided for the inactive leaf of pairs of doors. Dogging devices shall be omitted at UL rated door openings.

Panic devices with outside key operation shall be:

Corbin	3727
Monarch	XX-R-T
Von Duprin	88TP
or equal.	

Wall or Door Mounted Door Stop:

Wall or door mounted door stop shall have a 3¾-inch projection and 3-point anchoring.

Wall or door mounted door stop shall be:

Builders Brass	W96
Quality	38
Trimco	1236-1/4-2
or equal.	

Wall Mounted Door Stop and Holder:

Wall mounted door stop and holder shall be:

Builders Brass	W141X
Quality	36/136
Trimco	1207
or equal.	

Automatic Door Bottom:

Automatic door bottom shall be heavy duty, full mortise.

Bottom shall be:

Pemko	434 AR
Zero	360
or equal.	

Thresholds, Rain Drips, Door Sweeps and Door Shoes:

Thresholds, rain drips, door sweeps and door shoes shall conform to the sizes and configurations shown on plans. Thresholds at door openings with accessibility requirements shall not exceed ½ inch in height.

Threshold, rain drip, door sweep and door shoe manufacturers shall be Pemko, Reese, Zero, or equal.

Threshold Bedding Sealant: Threshold bedding sealant shall conform to Federal Specification: SS-C-153.

Weatherstrip and Draft Stop:

Weatherstrip and draft stop shall conform to the sizes and shapes shown on plans. Assemblies shall be UL listed and shall be provided where shown on the plans or as specified in these special provisions.

Weatherstrip and draft stop manufacturers shall be Pemko, Reese, Zero, or equal.

Door Signs and Name Plates: Door signs and name plates shall be as specified under "Signs" in Section 12-10, "Specialties," of these special provisions.

PART 3 - EXECUTION

Doors and Frames: Doors and frames shall be set square and plumb and be properly prepared before the installation of hardware.

INSTALLATION

Hardware items shall be accurately fitted, securely applied, and adjusted and lubricated in accordance with the manufacturer's instructions. Installation shall provide proper operation without bind or excessive play.

Hinges shall be installed at equal spacing with the center of the end hinges not more than 9 5/8 inches from the top and bottom of the door. Locksets, and panic exit mechanisms shall be 40 5/16 inches from the finished floor.

Thresholds shall be set in a continuous bed of sealant material.

Door controls shall be set so that the effort required to operate doors with closers shall not exceed 5 pounds maximum for exterior doors and interior doors. The effort required to operate fire doors may be increased above the values shown for exterior and interior doors but shall not exceed 15 pounds maximum.

Door stops located on concrete surfaces shall be fastened rigidly and securely in place with expansion anchoring devices. Door stops mounted elsewhere shall be securely attached with wood screws or expansion devices as required.

Backing shall be provided in wall framing at wall bumper locations.

The location and inscriptions for door signs and name plates shall be as shown on the plans.

Hardware, except hinges, shall be removed from surfaces to be painted before painting.

Upon completion of installation and adjustment, the Contractor shall deliver to the Engineer all dogging keys, closer valve keys, lock spanner wrenches, and other factory furnished installation aids, instructions and maintenance guides.

DOOR HARDWARE GROUPS AND SCHEDULE

Hardware groups specified herein shall correspond to those shown on the plans:

GROUP 1

6 1/2-pair butt hinges
1 each Lever Operated Lock Set
1 each Door Closer
1 each Panic Device with Outside Key Operation
1 each Door Mounted Door Stop
1 each Threshold, Rain Drip, Door Sweep and Shoe
1 each Weatherstrip and Draft Stop

GROUP 2

6 1/2-pair butt hinges
1 each Lever Operated Lock Set
1 each Door Closer
1 each Panic Device with Outside Key Operation
1 each Door Coordinators
1 each Automatic Flush Bolt
1 each Astaragal
1 each Door Mounted Door Stop
1 each Threshold, Rain Drip, Door Sweep and Shoe
1 each Weatherstrip and Draft Stop

GROUP 3

3 1/2-pair butt hinges
1 each Lever Operated Lock Set
1 each Door Closer
1 each Panic Device with Outside Key Operation
1 each Door Mounted Door Stop
1 each Threshold

SECTION 12-9. FINISHES

12-9.01 PAINTING

PART 1 - GENERAL

Scope: This work shall consist of preparing surfaces to receive coatings, and furnishing and applying coatings, in conformance with the schedules and details shown on the plans and these special provisions.

The coatings specified in this section are in addition to any factory finishes, shop priming, or surface treatment specified elsewhere in these special provisions.

DEFINITIONS

Detergent Wash: Removal of dirt and water-soluble chemicals by scrubbing with a solution of detergent and water, and removal of all solution and residues with clean water.

Hand Cleaning: Removal of dirt, loose rust, mill scale, excess base material, filler, aluminum oxide, chalking paint, peeling paint, or paint that is not firmly bonded to the surfaces by using hand or powered wire brushes, hand scraping tools, power grinders, or sandpaper and removal of all loose particles and dust prior to coating.

Mildew Wash: Removal of mildew by scrubbing with a solution of detergent, hypochlorite-type household bleach, and warm water, and removal of all solution and residues with clean water.

Abrasive Blasting:

Removal of loosely adhering paint, dirt, rust, mill scale, efflorescence, weak concrete, or laitance, shall be by the use of airborne abrasives. Loose particles, dust, and abrasives shall be removed by blasting with clean, oil-free air.

Abrasives shall be limited to mineral grit, steel grit, or steel shot, and shall be graded to produce the surface profile recommended in the manufacturer's data sheet.

Steam Cleaning: Removal of oil, grease, dirt, or other foreign matter by using steam generated by commercial steam cleaning equipment, from a solution of water and steam cleaning compounds, and removal of all residues and cleaning compounds with clean water.

TSP Wash: Removal of oil, grease, dirt, paint gloss, and other foreign matter by scrubbing with a solution of trisodium phosphate and warm water, and removal of all solution and residues with clean water.

Water Blasting: Removal of dirt, loose scale, chalking, or peeling paint by low-pressure water cleaning. Water blasting shall be performed in conformance with the requirements in SSPC-SP12 and shall produce a surface cleanliness meeting the requirements of SSPC-SP12-WJ4. Equipment used shall have a minimum flow rate of 1.5 GPM. If a detergent solution is used, it shall be biodegradable and shall be removed from all surfaces with clean water.

Protection:

The Contractor shall provide protective devices, such as tarps, screens or covers, as necessary to prevent damage to the work and to other property or persons from all cleaning and painting operations.

Paint or paint stains on surfaces not designated to be painted shall be removed by the Contractor at the Contractor's expense and the original surface shall be restored.

SUBMITTALS

Manufacturer's descriptive data, a materials list, and color samples shall be submitted for approval.

Product descriptive data shall include product description, manufacturer's recommendations for product mixing, thinning, tinting, handling, site environmental requirements, product application, and drying time.

Materials list shall include manufacturer's name, trade name, and product numbers for each type coating to be applied.

Color samples shall be manufacturer's color cards, approximately 2" x 3", for each color of coating shown on the plans. Color samples for stains shall be submitted on wood of the same species, color, and texture as the wood to receive the stain.

QUALITY ASSURANCE

Certificates of Compliance: Certificates of Compliance shall be furnished when products are required to conform with the requirements of The Society for Protective Coatings (SSPC) in conformance with the requirements specified in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

REGULATORY REQUIREMENTS

Coatings and applications shall conform to the rules for control of Volatile Organic Compound (VOC) emissions adopted by the air quality control district in the air basin in which the coatings are applied.

SITE ENVIRONMENTAL REQUIREMENTS

Coatings shall be applied in conformance with the environmental constraints specified in the manufacturer's printed instructions. These conditions shall be maintained until the coating has cured and is ready for recoat.

Continuous ventilation shall be provided during application of the coatings.

Adequate lighting, as determined by the Engineer, shall be provided while surfaces are being prepared for coatings and during coating applications.

DELIVERY, STORAGE, AND HANDLING

Products shall be delivered to the site in sealed, labeled containers and stored in a well-ventilated area at an ambient air temperature of not less than 45°F. Container labeling shall include manufacturer's name, type of coating, trade name, color designation, drying time, and instructions for tinting, mixing, and thinning.

MAINTENANCE STOCK

Upon completion of coating work, a full one-gallon container of each type and color of finish coat and stain used shall be delivered to the location at the project site designated by the Engineer. Containers shall be tightly sealed and labeled with color, texture, and room locations where used, in addition to the manufacturer's standard product label.

PART 2 - PRODUCTS

Products for each coating system shall be from a single manufacturer and shall conform to the requirements in the Detailed Performance Standards of the Master Painters Institute (MPI). Each product shall be shown on the MPI Approved Products List unless otherwise specified in these special provisions.

PART 3 - EXECUTION

INSPECTION

Coatings shall not be applied until surface preparation has been approved by the Engineer. The Contractor shall notify the Engineer at least 3 working days prior to the application of coatings.

SURFACE PREPARATION

Surfaces scheduled to be coated shall be prepared in conformance with the coating manufacturer's printed instructions unless otherwise specified in these special provisions.

Hardware, cover plates, light fixture trim, and similar items shall be removed prior to preparing surfaces for coating. Following the application of the finish coating, the removed items shall be reinstalled in their original locations.

Steel and Other Ferrous Metals: Surface shall be cleaned in conformance with the requirements in SSPC-SP 1. Surface profile shall be as required for the coating system specified.

Aluminum and Other Non-ferrous Metals: Surface shall be cleaned in conformance with the requirements in SSPC-SP 1.

Gypsum Board: Holes, cracks, and other surface imperfections shall be filled with joint compound or suitable filler prior to application of coatings. Taped joints and filled areas shall be hand sanded to remove excess joint compound and filler.

Concrete and Concrete Masonry Unit: New material shall be cleaned and prepared in conformance with the requirements in SSPC-SP 13. Cracks and voids shall be filled with cement mortar patching material. Concrete shall be cured until the surface moisture is below the level specified in the coating manufacturer's printed instructions.

Previously Coated Surfaces:

Dirt, oil, grease, or other surface contaminants shall be removed by water blasting, steam cleaning, or TSP wash. Minor surface imperfections shall be filled as required for new work. Mildew shall be removed by mildew wash. Chalking paint shall be removed by hand cleaning. The surfaces of existing hard or glossy coatings shall be abraded to dull the finish by hand cleaning or light abrasive blasting. Abrasive blasting shall not be used on wood or non-ferrous metal surfaces.

Chipped, peeling, blistered, or loose coatings shall be removed by hand cleaning, water blasting, or abrasive blasting. Bare areas shall be pretreated and primed as required for new work.

APPLICATION

Coatings shall be applied in conformance with the printed instructions and at the application rates recommended by the manufacturer to achieve the dry film thickness stated in the coating technical data sheet.

Mixing, thinning and tinting shall conform to the manufacturer's printed instructions. After thinning, the coating shall conform to the regulatory requirements in these special provisions.

Coatings shall be applied only when surfaces are dry and properly prepared.

Cleaning and painting shall be scheduled so that dust and other contaminants from the cleaning process will not fall on wet, newly coated surfaces.

Materials required to be coated shall have coatings applied to all exposed surfaces, including the tops and bottoms of wood and metal doors, the insides of cabinets, and other surfaces not normally visible from eye level.

Surface Finish Application:

Each coat shall be applied to a uniform finish. Finished surfaces shall be free of surface deviations and imperfections such as skips, cloudiness, spotting, holidays, laps, brush marks, runs, sags, curtains, ropiness, improper cutting in, overspray, drips, ridges, waves, and variations in color and texture.

Each application of a multiple application finish system shall closely resemble the final color coat, except each application shall provide enough contrast in shade to distinguish the separate applications.

Work Required Between Applications:

Each application of material shall be cured in conformance with the coating manufacturer's printed instructions before applying the succeeding coating.

Stain blocking primer shall be spot applied whenever bleeding substances are visible through the previous application of a coating.

Timing of Applications: The first application of the coating system shall be during the same work shift that the final surface preparation was performed. Additional coats shall be applied as soon as the required drying time of the preceding coat, specified in the coating manufacturer's printed instructions, has been met.

Application Methods:

Coatings shall be applied by brush, roller or spray. Rollers shall be of a type which do not leave a stippled texture in the paint film. Extension handles for rollers shall not be greater than 6 feet in length.

If spray methods are used, surface deviations and imperfections such as overspray, thickness deviations, lap marks, and orange peel shall be considered as evidence the work is unsatisfactory and the Contractor shall apply the remainder of the coating by brush or roller, as approved by the Engineer.

Patches in Previously Coated Surfaces: Where patches are made on surfaces of previously coated walls or ceilings, the entire surface to corners on every side of the patch shall be coated with a minimum of one application of the finish coat.

Finishing Mechanical and Electrical Components:

Shop primed mechanical and electrical components shall be finish coated in conformance with the coating system specified for the substrate material. Louvers, grilles, covers, and access panels on mechanical and electrical components shall be removed and coated separately.

Interior surfaces of air ducts which are visible through grilles or louvers shall be coated with one application of flat black enamel, to limit of the sight line.

Conduit, piping, and other mechanical and electrical components visible in the finished work shall be painted.

Both sides and all surfaces, including edges and back of wood mounting panels for electrical and telephone equipment shall be finish coated before installing equipment.

CLEANING

Upon completion of all operations, the coated surfaces shall be thoroughly cleaned of dust, dirt, grease, or other unsightly materials or substances.

Surfaces marred or damaged as a result of the Contractor's operations shall be repaired, at his expense, to match the condition of the surfaces prior to the beginning of the Contractor's operations.

COATING SYSTEM

The surfaces to be coated shall be as shown on the plans and as specified in these special provisions. When a coating system is not shown or specified for a surface to be finish coated, the coating system to be used shall be as specified below for the substrate material. The number of applications specified for each coating system listed herein is a minimum. Additional coats shall be applied if necessary to obtain a uniform color, texture, appearance, or required dry film thickness.

SYSTEM _1_ - ALUMINUM AND OTHER NON-FERROUS METALS

2 Finish Coats:

Flat: Latex, exterior, MPI Gloss Level 1, MPI List Number 10
Eggshell-like: Light Industrial coating, Water Based, Exterior, MPI Gloss Level 3, MPI List Number 161
Semi-Gloss: Light Industrial coating, Water Based, Exterior, MPI Gloss Level 5, MPI List Number 163
Gloss: Light Industrial coating, Water Based, Exterior, MPI Gloss Level 6, MPI List Number 164

SYSTEM _2_ - STEEL AND OTHER FERROUS METALS, HIGHLY CORROSIVE ENVIRONMENT

2 Prime Coats:

Coating meeting the requirements of SSPC-Paint 29

2 Finish Coats:

Flat: Latex, Exterior, MPI Gloss Level 1, MPI List Number 10
Eggshell-like: Light Industrial coating, Water Based, Exterior, MPI Gloss Level 3, MPI List Number 161
Semi-Gloss: Light Industrial coating, Water Based, Exterior, MPI Gloss Level 5, MPI List Number 163
Gloss: Light Industrial coating, Water Based, Exterior, MPI Gloss Level 6, MPI List Number 164

COLOR SCHEDULE

Colors shall be as shown on the plans.

SECTION 12-10. SPECIALTIES

12-10.01 LOUVERS

PART 1 - GENERAL

Scope: This work consists of furnishing and installing louvers in accordance with the details shown on the plans and these special provisions.

SUBMITTALS

Manufacturer's descriptive data and installation instructions shall be submitted for approval.

PART 2 - PRODUCTS

Louvers:

Louvers shall be factory fabricated units of extruded aluminum alloy not less than 0.081 inch thick (12-gage) or galvanized steel sheet not less than 0.064 inch thick (16-gage) with standard "Z" type blades, and removable bronze 16 x 16 mesh insect screens mounted on the inside of the units.

Louvers shall have integral caulking strips and retaining beads.

The finish on louvers shall be baked on primer and fluorocarbon polymeric resin.

The finish on louvers shall be anodized with the color as shown on the plans.

PART 3 - EXECUTION

INSTALLATION

Louvers shall be installed in accordance with the manufacturer's instructions. The completed louver installation shall be weather tight.

PAINTING

Louvers shall be cleaned, prepared and painted in accordance with the requirements specified under "Painting" in Section 12-9, "Finishes," of these special provisions.

12-10.02 SIGNS

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of furnishing and installing signs in accordance with the details shown on the plans and these special provisions.

SUBMITTALS

Product Data: Manufacturer's descriptive data for sign materials, graphics, and fastening hardware shall be submitted for approval.

Manufacturer's standard color palette for acrylic signs shall be submitted. The Engineer will select background and character colors from the standard color palette.

QUALITY ASSURANCE

Regulatory Requirements: Identification, directional, informational, exit, and accessibility signs and symbols shall conform to the requirements in Identification symbols, 24 CA Code of Regs Pt 2 § 1115B.6, and Signs and identification, § 1117B.5.

Certificate of Compliance: The Contractor shall furnish the Engineer a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for the sheet aluminum.

PART 2 - PRODUCTS

Sign Colors: The color white shall conform to FED-STD-595, Color No. 17886. The color blue shall conform to FED-STD-595, Color No. 15090. The color black shall conform to FED-STD-595, Color No. 17038.

Signs:

Signs shall be scratch resistant, non-static, fire retardant, washable acrylic laminate with a non-glare surface, not less than 1/8-inch thick.

International symbol of accessibility entrance sign may be a pressure sensitive decal.

Symbols: Symbols shall be scratch resistant, non-static, fire retardant, washable acrylic. Symbol colors shall be in contrast to door color.

Self-Luminous Sign (Exit):

Self-luminous sign shall be internally illuminated, self-luminous exit sign powered by permanent integral tritium gas source. Sign shall be listed by the California State Fire Marshal.

Sign housing shall be ABS molding. Faceplate shall be acrylic.

Fastening Hardware and Material: Fastening hardware and material shall be as recommended by the sign manufacturer. Fasteners shall be noncorrosive.

PART 3 - EXECUTION

INSTALLATION

Signs and symbols shall be fastened or secured to clean, finished surfaces in accordance with the sign manufacturer's instructions. Signs shall be installed at a location and height as shown on the plans.

Metal signs shall be attached securely with galvanized or cadmium plated fasteners.

12-10.03 FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

SUMMARY

Scope: This work shall consist of furnishing and installing fire extinguishers with cabinets or mounting brackets in accordance with the details shown on the plans and these special provisions.

REFERENCES

Fire Extinguishers shall conform to the requirements in California Code of Regulations, Title 19 Division 1, Chapter 3, "Portable Fire Extinguishers," NFPA 502, "Standard for Road Tunnels, Bridges, and Other Limited Access Highways," 2008 Edition, and NFPA 10, "Standard for Portable Fire Extinguishers," 2005 Edition.

SUBMITTALS

Product Data: Manufacturer's descriptive product data and installation instructions shall be submitted for approval.

QUALITY ASSURANCE

Codes and Standards: Fire extinguishers shall be Underwriters Laboratories or Factory Mutual Laboratories approved for the type, rating and classification of extinguisher specified.

PART 2 - PRODUCTS

MANUFACTURER'S

Acceptable Manufacturers: Subject to contract compliance, manufacturers shall be J. L. Industries; Larsen's Manufacturing; Potter-Roemer; or equal.

COMPONENTS

Fire Extinguisher: Fire extinguisher shall be fully charged, multi-purpose dry chemical type, with charge indicator, hose and nozzle, and attached service record tag. Fire extinguisher shall be of the capacity and type rating shown on the plans.

Mounting Bracket: Mounting bracket shall be the manufacturer's standard painted, surface mounted type.

PART 3 - EXECUTION

INSTALLATION

Fire extinguishers shall be installed in locations and at mounting heights shown on the plans, or if not shown, at a height of 48 inches from the finished floor to the top of the fire extinguisher.

Fire extinguisher mounting brackets and cabinets shall be attached to structure, square and plumb, in accordance with the manufacturer's recommendations.

IDENTIFICATION

Bracket-mounted: Extinguishers shall be identified with red letter decals spelling "FIRE EXTINGUISHER" applied to wall surface. Letter size, style and location as selected by the Engineer.

SERVICING

Fire extinguishers shall be serviced, charged, and tagged not more than 5 days prior to contract acceptance.

SECTION 12-11. (BLANK)

SECTION 12-12. (BLANK)

SECTION 12-13. (BLANK)

SECTION 12-14. (BLANK)

SECTION 12-15. MECHANICAL

12-15.01 MECHANICAL WORK

PART 1 - GENERAL

Scope: This work shall consist of performing mechanical work in accordance with the details shown on the plans and these special provisions.

Mechanical work shall include furnishing all labor, materials, equipment and services required for providing heating, ventilating, air conditioning, and plumbing distribution systems.

Earthwork, foundations, sheet metal, painting, electrical, and such other work incidental and necessary to the proper installation and operation of the mechanical work shall be in accordance with the requirements specified for similar type work elsewhere in these special provisions.

System layouts are generally diagrammatic and location of equipment is approximate. Exact routing of pipes, ducts, etc., and location of equipment is to be governed by structural conditions and obstructions. Equipment requiring maintenance and inspection is to be readily accessible. The Contractor shall be responsible for sizing, detailing, and routing ancillary items such as maintenance pad, equipment anchoring details, and pipe routing.

Mechanical materials and methods, mechanical identification, hangers and supports, and seismic requirements shall conform to Section 10-5, "Tunnel Mechanical," of these special provisions and the requirements specified herein.

SUBMITTALS

Product Data:

A list of materials and equipment to be installed, manufacturer's descriptive data, and such other data as may be requested by the Engineer shall be submitted for approval.

Manufacturer's descriptive data shall include complete description, performance data and installation instructions for the materials and equipment specified herein. Control and wiring diagrams, rough-in dimensions for plumbing fixtures, and component layout shall be included where applicable.

Manufacturer's descriptive data shall be submitted for the following:

The Contractor's ancillary items.

CLOSEOUT SUBMITTALS

Operation and Maintenance Manuals:

Prior to the completion of the contract, 3 identified copies of the operation and maintenance instructions with parts lists for the equipment specified herein shall be delivered to the Engineer at the jobsite. The instructions and parts lists shall be indexed and bound in a manual form and shall be complete and adequate for the equipment installed. Inadequate or incomplete material shall be returned. The Contractor shall resubmit adequate and complete manuals at no expense to the State. Each piece of mechanical equipment shall include a copy of the stamped approved submittal as part of its section.

QUALITY ASSURANCE

Codes and Standards: Mechanical work, including equipment, materials and installation, shall conform to the CBC,CMC, and to the California Code of Regulations, Title 8, Chapter 4, Division of Industrial Safety (DIS).

WARRANTY

Warranties and Guarantees: Manufacturer's warranties and guarantees for materials or equipment used in the work shall be delivered to the Engineer at the jobsite prior to acceptance of the contract.

SYSTEM IDENTIFICATION

Piping, Ducts, Valves and Equipment:

Identification of piping, ducts, valves and equipment shall be as shown on the plans or these special provisions:

Equipment: All equipment shall be identified with a plastic laminated, engraved nameplate, which bears the unit mark number as indicated on the drawings (for example, AC-4). Provide ½-inch high lettering, white on black background. Nameplates shall be permanently secured to the unit.

PART 2 – PRODUCTS (Not applicable)

PART 3 – EXECUTION (Not applicable)

12-15.02 HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT AND SYSTEMS

PART 1 - GENERAL

Scope: This work shall consist of furnishing, installing and testing heating, ventilating and air conditioning (HVAC) equipment and systems in accordance with the details shown on the plans and these special provisions.
The performance rating and electric service of the HVAC equipment shall be as shown on the plans.

Temperature Controls: Thermostats, relays, timer switches, and other sensor type control devices required for this work shall be furnished and installed by the supplier of the heating, ventilating and air conditioning equipment. All temperature control wiring shall be furnished and installed in accordance with the requirements specified in Section 12-16, "Electrical," of these special provisions.

Codes and Standards:

Equipment and systems shall conform to California State Energy Commission Regulations and, where applicable, shall be American Refrigeration Institute (ARI), American Gas Association (AGA), Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), and Air Movement and Control Association (AMCA) approved for performance ratings and application shown on the plans.

Any appliance for which there is a California standard established in the Appliance Efficiency Standards may be installed only if the manufacturer has certified to the Commission, as specified in those regulations, that the appliance complies with the applicable standards for that appliance. Space conditioning equipment may be installed only if the manufacturer has certified that the equipment meets or exceeds all applicable efficiency requirements listed in the Energy Efficiency Standards.

PART 2 - PRODUCTS

HEATING AND COOLING UNITS

Split system air conditioner shall include a cased evaporator coil, a remote outdoor condensing unit and economizer. Indoor evaporator coil shall be a factory assembled unit. Unit shall be provided with a refrigerant metering device and corrosion-resistant condensate drain pan with drain connections. The wetted coil air friction shall not exceed 0.3-inch water column.

Refrigerant lines and condensate drain piping shall be as specified elsewhere in these special provisions.

Outdoor condensing unit shall be same manufacturer as indoor unit; air cooled, factory assembled, charged and tested, and wired for single point power and control connections. Unit shall be enclosed in a weatherproof acoustically lined cabinet with access panels and a baked-on enamel finish. The compressor shall be the hermetically sealed type, and shall be provided with quick start components, pressure relief valve, high and low pressure switches, liquid-line filter-dryer, crankcase heater, short cycling protection, and service valves.

Economizer: Economizer shall be modulating type assembly consisting of 2 dampers and motor(s) with linkage, designed for full range modulation of the outdoor and return air dampers. Dampers shall be temperature controlled and a barometric damper sized to relief a minimum of 100 percent of the rated liters per minute shall be provided. Wiring for the economizer shall be compatible with the furnace/air conditioner installed and shall provide for automatic compressor lockout and minimum position damper control to provide the minimum outside air as shown on the plans.

FANS AND VENTILATORS

Fan (Wall Mounted): Fan shall be wall mounted, AMCA certified and shall be equipped with grille, metal housing, backdraft damper, centrifugal fan wheel and bird screen. Fan motor and fan assembly shall be isolated from base with rubber vibration isolators. Fan shall be completely weatherproof and shall have a disconnect means under the hood and fan motor shall have integral thermal overload protection. Wall fan shall be Jenn-Air; Carnes; EWDA; Penn; or equal.

Variable Frequency Drive (VFD) shall be designed to convert incoming power to a DC voltage and then to adjustable frequency AC by use of a 3 phase inverter. The inverter shall be a voltage source design producing a pulse-width-modulated type output. Inverters shall be designed to operate at design voltage, NEMA B, open drip-proof (1.1S SF) TTEFC (1.15 SF), squirrel-cage high efficiency inverter duty induction motors over the range of 10 - 100 percent of base speed without derating or requiring any motor modifications. Inverters shall be capable of delivering nameplate horsepower exclusive of service factor without the need for mandatory thermostats or feedback tachometers. The VFD shall vary both the AC voltage and frequency simultaneously to operate the motor at required speeds. Standard volts per Hertz control and sensorless vector control shall be installed on each drive and shall be selectable based on the application needs. Current source inverters will not be acceptable. Inverters shall be sized to match the KVA and inrush characteristics of the motors actually provided. The Contractor shall be responsible for matching the controller to the load (variable torque or constant torque) as well as the speed and current of the actual motor being controlled.

HVAC CONTROLS

Unit Thermostat: Unit thermostat shall be low voltage type, single set point range internally adjustable from 40°F to 80°F, and provided with a blank cover.

AUXILIARY HVAC COMPONENTS

Unless specified herein, all components shall be sized and have the characteristics as shown on the plans.

Rigid Ductwork: Rigid ductwork shall be galvanized steel sheet metal conforming to the latest edition of the SMACNA "Low Velocity Duct Construction Standards." Galvanized steel shall be cleaned by washing with mineral spirit solvent sufficient to remove any oil, grease or other materials foreign to the galvanized coating.

Spiral Duct: Spiral duct shall be prefabricated type.

Duct Supports: Duct supports shall be hot-dip galvanized steel.

Flexible Ductwork: Flexible ductwork shall be UL 181, Class 1 air duct rated and shall meet the requirements of NFPA 90-A. Duct shall have steel helix wire, flexible insulation, minimum thermal resistance of R-8, and flame resistant vapor barrier. Inner and outer surfaces shall be non-metallic. Outer surface shall be Copolymer or Mylar, factory applied.

Flexible Connection: Flexible connection shall be prefabricated type and shall be commercial quality flexible glass fabric coated on both sides with neoprene or hypalon.

Duct Supply Register: Supply and install cooling only Thermally powered variable air volume (VAV) thermostat self contained diffusers where indicated on the project drawings. All control components, including the thermal mechanism, shall be removable from below the ceiling without the use of any tools. Instructions for the diffuser shall be on the inside of the panel.

The VAV diffusers shall have a manually adjusted temperature setpoint adjustment with an indicator that moves along a 68 /20 to 78 /26 temperature scale. The initial setpoint shall be factory set at 72 /22.

The manufacturer shall warrant that the VAV diffuser shall be free from defects in materials and workmanship for a period of ten years from date of installation. External wiring or pneumatics shall not be allowed.

Registers shall be steel with oven baked-on enamel bone white finish or extruded aluminum; Accutherm TK-C, Rickard type 4 VCD, or equivalent

Wall Return Register: Wall return register shall be single deflecting type, with horizontal adjustable louvers, steel with oven baked-on enamel bone white finish or extruded aluminum, flanged frame with sponge or felt gasket; Hart and Cooley, T70; Air Mate, 200-HO; or equal.

Air Filter (for HVAC Units): Air filter shall be permanent metal viscous impingement type, constructed of aluminum or galvanized steel, 2-inch minimum thickness and be approved for Class 2 use. Filter shall have a minimum efficiency rating of 50 percent as determined when tested in accordance with ASHRAE Test Standard 52. Filter shall be mounted in 16-gage galvanized steel holding frames. Two cans of recharging adhesive shall be provided with the filter and shall be nearly odorless, have a high flash point, rapid wetting characteristics, dye tracer and be water soluble. Filter shall be Airspan, Type AF, Eco-Air Products, Inc., Type HIA; Snyder General, Type AAF; or approved equal.

Refrigerant and Condensate Drain Piping: Refrigerant and condensate drain piping shall be rigid, Type L copper tubing with brazed solder fittings. The suction line shall be insulated, with vapor barrier and shall be weatherproofed for exterior installation. Factory sealed tubing shall not be used.

Louvers: To avoid water penetration (as defined per AMCA), velocity shall be below 650 fpm. Louvers shall conform to Section "Louvers" of these special provisions.

Combination Louver/Damper: Combination louver/damper shall be set at .05 inWg. Finish shall conform to Section "Louvers" of these special provisions.

PART 3 - EXECUTION

INSTALLATION

Condensate Drains: Air conditioning units and heat pumps shall be provided with condensate drain trap and piping. Outdoor piping shall extend to the nearest roof drain, gutter or as shown on the plans. Air gap shall be installed where required by code. Interior condensate drain piping shall be insulated with foam insulation.

Mounting Heights: Thermostats and time switches shall be installed as shown on the plans.

Each thermostat shall be insulated from the outside walls, and shall be provided with an aluminum radiation shield above the thermostat.

Ducts and Vents:

Ductwork within the building shall be installed to clear lighting fixtures, doors, windows and other obstructions. Ductwork shall preserve head room and shall keep openings and passageways clear whether shown on plans or not.

Ductwork shall be installed and braced according to the latest edition of the SMACNA "HVAC Duct Construction Standards."

Slopes in sides at transitions shall be approximately one to five. The ductwork system shall not contain abrupt changes or offsets of any kind unless otherwise shown on the plans.

Where ducts pass through walls, floors or ceilings, galvanized sheet metal or steel angle collars shall be installed around the ducts.

Duct sections shall be connected by beaded sleeve-type couplings using joint sealer as recommended by the duct manufacturer. Duct sections shall be mechanically fastened with pop rivets or sheet metal screws and sealed with mastic or insulated, reinforced silver tape.

Flexible connections shall be provided at both inlet and outlet of fan coil and ventilating units.

Sheet metal plenums shall be adequately braced and supported from the floor or structure with structural steel angles to prevent sagging, flexing and vibration.

All standing seams and transverse joints of supply, return and exhaust ducts and seams around plenums, fan and coil housings shall be sealed with sealant and taped.

Duct Penetrations in Fire Rated Assemblies: Where ductwork passes through fire rated wall, floor or ceiling assemblies, the penetration shall be protected in accordance with the requirements specified under "Through-Penetration Firestopping" in Section 12-7, "Thermal and Moisture Protection," of these special provisions.

AMENDMENTS TO THE STANDARD SPECIFICATIONS

DATED MAY 2006

AMENDMENTS ISSUE DATE: 10-08-09

SECTION 0 GLOBAL REVISIONS
(Issued 06-05-09)

Global revisions are changes to contract documents not specific to a section of the Standard Specifications. In each contract document at each occurrence, interpret the following terms as shown:

Term	Interpretation	Conditions
AC	HMA	1. Where AC means asphalt concrete 2. Except where existing AC is described
Asphalt concrete	Hot mix asphalt	Except where existing asphalt concrete is described
Class 1 concrete	Concrete containing not less than 675 pounds of cementitious material per cubic yard	--
Class 2 concrete	Concrete containing not less than 590 pounds of cementitious material per cubic yard	--
Class 3 concrete	Concrete containing not less than 505 pounds of cementitious material per cubic yard	--
Class 4 concrete	Concrete containing not less than 420 pounds of cementitious material per cubic yard	--
Clause providing an option to use either a class concrete or minor concrete	Use minor concrete	--
Clause referring to a delay as a right-of-way delay	Delay under Section 8-1.09, "Delays"	--
Contact joint	Construction joint	--
Controlling operation	Controlling activity	--
Engineer's Estimate	Verified Bid Item List	--
Engineering fabrics	Geosynthetics	--
Notice to Contractors	Notice to Bidders	--
Partial payments	Progress payments	Except in Section 9-1.07D, "Mobilization"
PCC pavement	Concrete pavement	Except where existing PCC pavement is described
Portland cement concrete pavement	Concrete pavement	Except where existing portland cement concrete pavement is described
Project information	Supplemental project information	Except in "Contract Project Information Signs"
Reference to a working day or non–working day under Section 8-1.06, "Time of Completion"	Working day as defined in Section 1-4.02, "Glossary"	--
Section 9-1.015	Section 9-1.01C	--
Section 86, "Signal, Lighting and Electrical Systems"	Section 86, "Electrical Systems"	--
Section 86-2.07, "Traffic Pull Boxes"	Section 86-2.06, "Pull Boxes"	

Section 86-2.08, "Conductors"	Section 86-2.08, "Conductors and Cables"	--
Section 86-5.01A(5), "Installation Details"	Section 86-5.01A(4), "Installation Details"	--
Section 86-6.05, "Sign Lighting Fixtures—Mercury"	Section 86-6.05, "Induction Sign Lighting Fixtures"	--
Time extension due to an unanticipated event not caused by either party or an issue involving a third party under Section 8-1.07, "Liquidated Damages"	Non–working day	--
Time extension due to an act of the Engineer or of the Department not contemplated by the contract	Time adjustment under Section 8-1.09B, "Time Adjustments"	--
Weakened plane joint	Contraction joint	--

^^

SECTION 1 DEFINITIONS AND TERMS
(Issued 07-31-09)

Replace Section 1 with:

SECTION 1 GENERAL
1-1 GENERAL

1-1.01 GENERAL

Section 1 includes general rules of interpretation.

The Department is gradually standardizing the style and language of the specifications. The new style and language includes:

1. Use of:

    1.1. Imperative mood
    1.2. Introductory modifiers
    1.3. Conditional clauses

2. Elimination of:

    2.1. Language variations
    2.2. Definitions for industry-standard terms
    2.3. Redundant specifications
    2.4. Needless cross-references

The use of this new style does not change the meaning of a specification not yet using this style.

Sections 1 through 9 include general specifications applicable to every contract unless specified as applicable under certain conditions.

Sections 10 through 15 include specifications for general construction applicable to every contract unless specified as applicable under certain conditions.

The specifications are written to the Bidder before award and the Contractor after. Before award, interpret sentences written in the imperative mood as starting with "The Bidder must" and interpret "you" as "the Bidder" and "your" as "the Bidder's." After award, interpret sentences written in the imperative mood as starting with "The Contractor must" and interpret "you" as "the Contractor" and "your" as "the Contractor's."

Omission of "a," "an," and "the" is intentional. These articles have been omitted in some specifications for streamlining purposes.

Unless an object or activity is specified to be less than the total, the quantity or amount is all of the object or activity.

A plural term includes the singular.

All items in a list apply unless the items are specified as choices.

Headings are included for the purposes of organization and referencing. Inclusion of a heading with no related content, "Reserved," or "Not Used" does not indicate that no specification exists for that subject; applicable specifications may be covered in a general or referenced specification.

1-2 REFERENCES

1-2.01 REFERENCES

Where Standard Specifications refer to the special provisions to describe the work, interpret the reference as a reference to the Bid Item List, the special provisions, or both.

Interpret a reference to a section of the Standard Specifications as a reference to the Standard Specifications as revised by any amendment, special provision, or both.

A reference within parentheses to a law or regulation is included in the contract for convenience only and is not a comprehensive listing of related laws and regulations. Lack of a reference does not indicate no related laws or regulations exist.

Where the version of a referenced document is not specified, use the current version in effect on the date of Notice to Bidders.

A reference to a subsection includes the section's general specifications of which the subsection is a part.

A code not specified as a Federal code is a California code.

1-3 ABBREVIATIONS AND MEASUREMENT UNITS

1-3.01 ABBREVIATIONS

Abbreviations

Abbreviation	Meaning
AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMA	archaeological monitoring area
ANSI	American National Standards Institute
APHA	American Public Health Association
API	American Petroleum Institute
AREMA	American Railway Engineering and Maintenance-of-Way Association
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gage
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
CIH	Certified Industrial Hygienist
DBE	Disadvantaged Business Enterprise
DVBE	Disabled Veteran Business Enterprise
EIA	Electronic Industries Alliance
ESA	environmentally sensitive area
ETL	Electrical Testing Laboratories
FHWA	Federal Highway Administration
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers
NEC	National Electrical Code
NETA	National Electrical Testing Association, Inc.
NEMA	National Electrical Manufacturers Association
PLAC	permit, license, agreement, certification, or any combination of these
RFI	request for information
SSPC	The Society for Protective Coatings
TIA	time impact analysis
UL	Underwriters' Laboratories Inc.

1-3.02 MEASUREMENT UNITS

Measurement Units

Symbols as used in the specifications	Symbols as used in the Bid Item List	Meaning
A	—	amperes
	ACRE	acre
	CF	cubic foot
	CY	cubic yard
--	EA	each
g	--	gram
ksi	--	kips per square inch
	GAL	gallon
h	H	hour
	LB	pound
--	LS	lump sum
	LF	linear foot
	LNMI	lane mile
	MFBM	thousand foot board measure
	MI	mile
	MSYD	thousand station yard
Ω	--	ohm
pcf	--	pounds per cubic foot
s	--	second
	STA	100 feet
	SQFT	square foot
	SQYD	square yard
	TAB	tablet
ton	TON	2,000 pounds
V	--	volt
W	--	watt
--	WDAY	working day

1-4 DEFINITIONS

1-4.01 GENERAL

Interpret terms as defined in the contract documents. A construction-industry term not defined in the contract documents has the meaning defined in Means Illustrated Construction Dictionary, Condensed Version, Second Edition.

1-4.02 GLOSSARY

aerially deposited lead: Lead primarily from vehicle emissions deposited within unpaved areas or formerly unpaved areas.

archaeological monitoring area: Area within, near, or straddling the project limits where access is allowed, but work is subject to archaeological monitoring.

archaeological resources: Remains of past human activity, including historic and prehistoric material (e.g., tools and tool fragments, hearth and food remains, structural remains, and human remains).

acceptance: Formal written acceptance by the Director of an entire contract that has been completed in all respects in accordance with the plans and specifications and any modifications to them previously approved.

base: Layer of specified material of planned thickness placed immediately below the pavement or surfacing.

basement material: Material in excavation or embankments underlying the lowest layer of subbase, base, pavement, surfacing, or other specified layer to be placed.

bid item: Specific work unit for which the bidder provides a price.

Bid Item List: List of bid items and the associated quantities.

Bid Item List, verified: Bid Item List with verified prices. The Contract Proposal of Low Bidder at the Department's Web site is the verified Bid Item List.

bridge: Structure, with a bridge number, that carries a utility facility, or railroad, highway, pedestrian or other traffic, over a water course or over or under or around any obstruction.

building-construction contract: Contract that has "building construction" on the cover of the Notice to Bidders and Special Provisions.

business day: Day on the calendar except Saturday or holiday.

California Manual on Uniform Traffic Control Devices: The California Manual on Uniform Traffic Control Devices for Streets and Highways (California MUTCD) is issued by the Department of Transportation and is the Federal Highway Administration's MUTCD 2003 Edition, as amended for use in California.

Certified Industrial Hygienist: Industrial hygienist certified in comprehensive practice by the American Board of Industrial Hygiene.

conduit: Pipe or tube in which smaller pipes, tubes, or electrical conductors are inserted or are to be inserted.

contract: Written and executed contract between the Department and the Contractor.

contract bonds: Security for the payment of workers and suppliers furnishing materials, labor, and services and for guaranteeing the Contractor's work performance.

contract item: Bid item.

Contractor: Person or business or its legal representative entering into a contract with the Department for performance of the work.

culvert: Structure, other than a bridge, that provides an opening under a roadway for drainage or other purposes.

day: 24 consecutive hours running from midnight to midnight; calendar day.

deduction: Amount of money permanently taken from progress payment and final payment. Deductions are not retentions under Pub Cont Code § 7107.

Department: Department of Transportation as defined in St & Hwy Code § 20 and authorized in St & Hwy Code § 90; its authorized representatives.

detour: Temporary route for traffic around a closed road part. A passageway through a job site is not a detour.

Director: Department's Director.

Disabled Veteran Business Enterprise: Business certified as a DVBE by the Office of Small Business and DVBE Services, Department of General Services.

divided highway: Highway with separated traveled ways for traffic, generally in opposite directions.

Engineer: Department's Chief Engineer acting either directly or through properly authorized agents; the agents acting within the scope of the particular duties delegated to them.

environmentally sensitive area: Area within, near, or straddling the project limits where access is prohibited or limited to protect environmental resources.

Federal-aid contract: Contract that has a Federal-aid project number on the cover of the Notice to Bidders and Special Provisions.

fixed costs: Labor, material, or equipment cost directly incurred by the Contractor as a result of performing or supplying a particular bid item that remains constant regardless of the item's quantity.

frontage road: Local street or road auxiliary to and located generally on the side of an arterial highway for service to abutting property and adjacent areas and for control of access.

grading plane: Basement material surface on which the lowest layer of subbase, base, pavement, surfacing, or other specified layer is placed.

highway: Whole right of way or area that is reserved for and secured for use in constructing the roadway and its appurtenances.

holiday:

1. Every Sunday
2. January 1st, New Year's Day
3. 3rd Monday in January, Birthday of Martin Luther King, Jr.
4. February 12th, Lincoln's Birthday
5. 3rd Monday in February, Washington's Birthday
6. March 31st, Cesar Chavez Day
7. Last Monday in May, Memorial Day
8. July 4th, Independence Day
9. 1st Monday in September, Labor Day
10. 2nd Monday in October, Columbus Day
11. November 11th, Veterans Day
12. 4th Thursday in November, Thanksgiving Day
13. Day after Thanksgiving Day
14. December 25th, Christmas Day

If January 1st, February 12th, March 31st, July 4th, November 11th, or December 25th falls on a Sunday, the Monday following is a holiday. If November 11th falls on a Saturday, the preceding Friday is a holiday. Interpret "legal holiday" as "holiday."

idle equipment: Equipment:
1. On the job site at the start of a delay
2. Idled because of the delay
3. Not operated during the delay

informal-bid contract: Contract that has "Informal Bid Authorized by Pub Cont Code §10122" on the cover of the Notice to Bidders and Special Provisions.

Information Handout: Supplemental project information furnished to bidders as a handout.

laboratory: Laboratory authorized by the Department to test materials.

liquidated damages: Amount prescribed in the specifications, pursuant to the authority of Pub Cont Code § 10226, to be paid to the State or to be deducted for each day's delay in completing the whole or any specified portion of the work beyond the time allowed in the specifications.

listed species: Any species listed as threatened or endangered under (1) Federal Endangered Species Act of 1973, 16 USC §1531 et seq., (2) California Endangered Species Act, Fish & Game Code §§ 2050–2115.5, (3) or both.

material shortage: Shortage of raw or produced material that is area-wide and caused by an unusual market condition, except if any of the following occurs:

1. Shortage relates to a produced, nonstandard material
2. Supplier's and the Contractor's priority for filling an order differs
3. Event outside the U.S. for a material produced outside the U.S.

median: Portion of a divided highway separating the traveled ways for traffic in opposite directions including inside shoulders.

mobilization: Preparatory work that must be performed or costs incurred before starting work on the various items on the job site (Pub Cont Code § 10104).

Notice to Bidders: Document that provides a general work description, bidder and bid specifications, and the time and location the Department receives bids.

paleontological resources: Fossils and the deposits they are found in. Fossils are evidence of ancient life preserved in sediments and rock. Examples of paleontological resources are remains of (1) animals, (2) animal tracks, (3) plants, and (4) other organisms. Archaeological resources are not paleontological and fossils found within an archaeological resource are generally considered archaeological resources, not paleontological resources.

pavement: Uppermost layer of material placed on the traveled way or shoulders. This term is used interchangeably with surfacing.

permitted biological activities: Monitoring, surveying, or other practices that require a take permit and project specific permission from U.S. Fish and Wildlife Service or NOAA Fisheries or a take permit or Memorandum of Understanding with Department of Fish and Game.

plans: Official project plans and Standard Plans, profiles, typical cross sections, working drawings and supplemental drawings, or reproductions thereof, approved by the Engineer, which show the location, character, dimensions and details of the work to be performed. These documents are to be considered as a part of the plans.

In the above definition, the following terms are defined as follows:

Standard Plans: Standard Plans issued by the Department.

project plans: Specific details and dimensions peculiar to the work supplemented by the Standard Plans insofar as the same may apply.

protective radius: Minimum distance between construction activities and regulated species.

regulated species: Any species protected by one or any combination of the following:

1. Federal Endangered Species Act of 1973, 16 USC §1531 et seq.
2. California Endangered Species Act, Fish & Game Code §§2050–2115.5
3. Fish & Game Code §§1600–1616
4. National Environmental Policy Act, 42 USC §4321 et seq.
5. California Environmental Quality Act, Pub Res Code § 21000 et.seq.
6. Other law or regulation that governs activities that affect species or their habitats.

roadbed: Area between the intersection of the upper surface of the roadway and the side slopes or curb lines. The roadbed rises in elevation as each increment or layer of subbase, base, surfacing or pavement is placed. Where the medians are so wide as to include areas of undisturbed land, a divided highway is considered as including 2 separate roadbeds.

roadway: Highway portion included between the outside lines of sidewalks, or curbs, slopes, ditches, channels, waterways, and including all the appertaining structures, and other features necessary to proper drainage and protection.

routine biological activities: Biological monitoring, surveying, or other activity that does not require a take permit from the U.S. Fish and Wildlife Service or NOAA Fisheries or a take permit or Memorandum of Understanding with Department of Fish and Game.

service-approved biologist: Biologist whose activities must be approved by a state or federal agency as provided in PLACs.

shoulder: Roadway portion contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

small tool: Tool or piece of equipment not listed in Labor Surcharge and Equipment Rental Rates that has a replacement value of $500 or less.

special provisions: Specific clauses setting forth conditions or requirements peculiar to the work and supplementary to these Standard Specifications. The Department's publication titled "Labor Surcharge And Equipment Rental Rates" is part of the special provisions.

specifications: Directions, provisions, and requirements contained in these Standard Specifications, Amendments to the Standard Specifications, and the special provisions. Where the term "these specifications" or "these Standard Specifications" is used in this book, it means the provisions set forth in this book.

State: State of California, including its agencies, departments, or divisions, whose conduct or action is related to the work.

Structure Design: Offices of Structure Design of the Department.

subbase: Layer of specified material of planned thickness between a base and the basement material.

subgrade: Roadbed portion on which pavement, surfacing, base, subbase, or a layer of any other material is placed.

substructure: Bridge portions below the bridge seats, tops of piers, haunches of rigid frames, or below the spring lines of arches. Backwalls and parapets of abutments and wingwalls of bridges are portions of the substructure.

superstructure: Bridge portion except the bridge substructure.

supplemental project information: Information relevant to the project, specified as supplemental project information, and made available to bidders.

surfacing: Uppermost layer of material placed on the traveled way, or shoulders. This term is used interchangeably with pavement.

take: Legal definition regarding harm to listed species as defined in 16 USC §1532 and Fish & Game Code § 86.

take permit: Permit granted by the US Fish and Wildlife Service or by the NOAA Fisheries that allows take of federal listed species under 16 USC §1539 or by the Department of Fish & Game that allows take of state listed species under to Fish & Game Code § 2081.

traffic lane: Portion of a traveled way for the movement of a single line of vehicles.

traveled way: Portion of the roadway for the movement of vehicles, exclusive of shoulders.

total bid: Sum of the item totals as verified by the Department; original contract price.

withhold: Money temporarily or permanently taken from progress payment. Withholds are not retentions under Pub Cont Code § 7107.

work: All the work specified, indicated, shown or contemplated in the contract to construct the improvement, including all alterations, amendments, or extensions to it made by contract change order or other written orders of the Engineer.

working day: Time measure unit for work progress. A working day is any day except:

1. Saturdays and holidays
2. A day when you cannot perform work on the controlling activity for at least 50 percent of the day with at least 50 percent of the normal labor and equipment due to any of the following:

    2.1. Adverse weather-related conditions that cause you to dismiss the crew
    2.2. Maintaining traffic under the contract
    2.3. The Engineer's direction to suspend the controlling activities for reasons unrelated to your performance
    2.4. An unanticipated event not caused by either party such as:

        2.4.1. Act of God (Pub Cont Code § 7105)
        2.4.2. Act of a public enemy
        2.4.3. Epidemic
        2.4.4. Fire
        2.4.5. Flood
        2.4.6. Governor-declared state of emergency
        2.4.7. Landslide
        2.4.8. Quarantine restriction

2.5. An issue involving a third-party, including:

2.5.1. Industry or area-wide labor strike
2.5.2. Material shortage
2.5.3. Freight embargo
2.5.4. Jurisdictional requirement of a law enforcement agency
2.5.5. Workforce labor dispute of a utility or non-highway facility owner resulting in a utility or non-highway facility reconstruction not described and not solely for the Contractor's convenience

1-5 DISTRICTS

District Composition and Office Addresses

District	Counties	Location Address	Mailing Address
1	Del Norte (DN), Humboldt (Hum), Lake (Lak), Mendocino (Men)	1656 UNION ST EUREKA, CA	PO BOX 3700 EUREKA CA 95502
2	Lassen (Las), Modoc (Mod), Plumas (Plu), Shasta (Sha), Siskiyou (Sis), Tehama (Teh), Trinity (Tri)	1657 RIVERSIDE DR REDDING, CA	PO BOX 496073 REDDING CA 96049-6073
3	Butte (But), Colusa (Col), El Dorado (ED), Glenn (Gle), Nevada (Nev), Placer (Pla), Sacramento (Sac), Sierra (Sie), Sutter (Sut), Yolo (Yol), Yuba (Yub)	703 B ST MARYSVILLE, CA	PO BOX 911 MARYSVILLE CA 95901
4	Alameda (Ala), Contra Costa (CC), Marin (Mrn), Napa (Nap), San Francisco (SF), San Mateo (SM), Santa Clara (SCl), Solano (Sol), Sonoma (Son)	111 GRAND AVE OAKLAND, CA	PO BOX 23660 OAKLAND CA 94623-0660
5	Monterey (Mon), San Benito (SBt), San Luis Obispo (SLO), Santa Barbara (SB), Santa Cruz (SCr)	50 HIGUERA ST SAN LUIS OBISPO, CA	50 HIGUERA ST SAN LUIS OBISPO CA 93401-5415
6	Fresno (Fre), Kern (Ker), Kings (Kin), Madera (Mad), Tulare (Tul)	1352 W. OLIVE AVE FRESNO, CA	PO BOX 12616 FRESNO CA 93728-2616
7	Los Angeles (LA), Ventura (Ven)	100 S. MAIN ST LOS ANGELES	100 S MAIN ST LOS ANGELES CA 90012
8	Riverside (Riv), San Bernardino (SBd)	464 W 4TH ST SAN BERNARDINO, CA	464 W 4TH ST SAN BERNARDINO CA 92401-1400
9	Inyo (Iny), Mono (Mno)	500 S MAIN ST BISHOP, CA	500 S MAIN ST BISHOP CA 93514-3423
10	Alpine (Alp), Amador (Ama), Calaveras (Cal), Mariposa (Mpa), Merced (Mer), San Joaquin (SJ), Stanislaus (Sta), Tuolumne (Tuo)	1976 E CHARTER WAY STOCKTON, CA	PO BOX 2048 STOCKTON CA 95201
11	Imperial (Imp), San Diego (SD)	4050 TAYLOR ST SAN DIEGO, CA	4050 TAYLOR ST SAN DIEGO CA 92110-2737
12	Orange (Ora)	3347 MICHELSON DR STE 100 IRVINE, CA	3347 MICHELSON DR STE 100 IRVINE CA 92612-0661

A project with work in District 1, 2, or 3 is a North Region project. For Districts 1, 2, and 3, interpret each reference to the district office as the North Region office. The North Region office address is the District 3 address.

1-6 WEB SITES, ADDRESSES, AND TELEPHONE NUMBERS

Web Sites, Addresses, and Telephone Numbers

Agency, Department Unit, or Reference	Web Site	Address	Telephone No.
Bid Document Unit		MSC 26 BID DOCUMENT UNIT DEPARTMENT OF TRANSPORTATION 1120 N ST RM 200 SACRAMENTO CA 95814-5605	
Department	www.dot.ca.gov		
Department of General Services, Office of Small Business and DVBE Services	www.pd.dgs.ca.gov/smbus/default.htm	OFFICE OF SMALL BUSINESS AND DVBE SERVICES DEPARTMENT OF GENERAL SERVICES 707 3RD ST WEST SACRAMENTO CA 95605-2811	(800) 559-5529 (916) 375-4940
Department of Industrial Relations	www.dir.ca.gov		
Department of Industrial Relations, Division of Apprenticeship Standards		455 GOLDEN GATE AVENUE SAN FRANCISCO, CA 94102	
Office Engineer		MSC 43 OFFICE ENGINEER DEPARTMENT OF TRANSPORTATION 1727 30TH ST SACRAMENTO CA 95816-7005	
Office Engineer–Verified Bid Results	http://www.dot.ca.gov/hq/esc/oe/awards/bidsum_html/6week_list.html.		
Offices of Structure Design, Documents Unit		MSC 9-4/4I DOCUMENTS UNIT OFFICES OF STRUCTURE DESIGN DEPARTMENT OF TRANSPORTATION 1801 30TH ST SACRAMENTO CA 95816-7006	(916) 227-0716
Publication Distribution Unit		PUBLICATION UNIT DEPARTMENT OF TRANSPORTATION 1900 ROYAL OAKS DRIVE SACRAMENTO CA 95815-3800	
Transportation Laboratory		MATERIALS AND ENGINEERING TESTING SERVICES AND GEOTECHNICAL SERVICES DEPARTMENT OF TRANSPORTATION 5900 FOLSOM BLVD SACRAMENTO CA 95819-4612	(916) 227-7000
Department's Pre-Qualified Products List	http://www.dot.ca.gov/hq/esc/approved_products_list		

^^

SECTION 2 PROPOSAL REQUIREMENTS AND CONDITIONS
(Issued 10-08-09)

Replace Section 2 with:
SECTION 2 BIDDING

2-1.01 GENERAL

Section 2, "Bidding," includes specifications related to bid eligibility and the bidding process.

2-1.02 BID INELIGIBILITY

A firm that has provided architectural or engineering services to the Department for this contract before bid submittal for this contract is prohibited from any of the following:

1. Submit a bid
2. Subcontract for a part of the work
3. Supply materials

2-1.03 BID DOCUMENTS

2-1.03A General

Standard Specifications and Standard Plans may be viewed at the Department's Web site and may be purchased at the Publication Distribution Unit.

Special provisions, Amendments to the Standard Specifications, and project plans may be viewed at:

1. Department's Web site
2. District office of the district in which the work is located
3. Districts 4 and 12 offices
4. Bid Document Unit

For an informal-bid contract, special provisions, Amendments to the Standard Specifications, and project plans may be viewed at:

1. Department's Web site
2. Bid Document Unit

Bid books, special provisions, Amendments to the Standard Specifications, and project plans may be obtained at the Bid Document Unit. To expedite orders, you may obtain these documents by faxing an order to (916) 654-7028. Fax orders must include credit card charge number, card expiration date, and authorizing signature.

2-1.03B Supplemental Project Information

Logs of test borings attached to the project plans are supplemental project information. The Department makes other supplemental information available as specified in the special provisions.

If an Information Handout is available, you may view it at:

http://www.dot.ca.gov/hq/esc/oe/weekly_ads/index.php

If rock cores are available for inspection, you may view them by sending a request to Coreroom@dot.ca.gov. If other supplemental project information is available for inspection, you may view it by phoning in a request. Make your request at least 7 days before viewing. Include in your request:

1. District-County-Route
2. Contract number
3. Viewing date
4. Contact information, including telephone number.

For rock cores, also include the bridge number in your request.
If bridge as-built drawings are available:

1. For a project in District 1 through 6 or 10, you may request them from the Office of Structure Maintenance and Investigations, fax (916) 227-8357
2. For a project in District 7, 8, 9, 11, or 12, you may request them from the Office of Structure Maintenance and Investigations, fax (916) 227-8357, and are available at the Office of Structure Maintenance and Investigations, Los Angeles, CA, telephone (213) 897-0877

As-built drawings may not show existing dimensions and conditions. Where new construction dimensions are dependent on existing bridge dimensions, verify the field dimensions and adjust dimensions of the work to fit existing conditions.

2-1.04–2-1.10 RESERVED

2-1.11 JOB SITE AND DOCUMENT EXAMINATION

Examine the job site and bid documents.
Bid submission is your acknowledgment that you have examined the job site and bid documents and are satisfied with:

1. General and local conditions to be encountered
2. Character, quality, and scope of work to be performed
3. Quantities of materials to be furnished
4. Character, quality, and quantity of surface and subsurface materials or obstacles
5. Requirements of the contract

2-1.12 BID DOCUMENT COMPLETION

2-1.12A General

Complete forms in the Bid book.
On the Subcontractor List you may either submit the percentage of each bid item subcontracted with your bid or fax the percentage to (916) 227-6282 within 24 hours after bid opening.
Except for the percentage of each bid item subcontracted, do not fax submittals.

2-1.12B Bid Item List and Bid Comparison

Submit a bid based on the work item quantities the Department shows in the Bid Item List.
For a lump sum based bid, the Department compares bids based on the total price.
For a unit price based bid, the Department compares bids based on the sum of the item totals.
For a cost plus time based bid, the Department compares bids based on the sum of the item totals and the total bid for time. If your bid for time exceeds the number of working days described in the Notice to Bidders, your bid is nonresponsive.

2-1.12C Subcontractor List

In the Subcontractor List, list each subcontractor to perform work in an amount in excess of 1/2 of 1 percent of the total bid or $10,000, whichever is greater (Pub Cont Code § 4100 et seq.)
The Subcontractor List must show the name, address, and work portions to be performed by each subcontractor listed. Show work portion by bid item number, description, and percentage of each bid item subcontracted.

2-1.13 BIDDER'S SECURITY

Submit your bid with one of the following forms of bidder's security equal to at least 10 percent of the bid:

1. Cash
2. Cashier's check
3. Certified check
4. Bidder's bond signed by a surety insurer who is licensed in California

Make checks and bonds payable to the Department of Transportation.
If using a bidder's bond, you may use the form in the Bid book. If you do not use the form in the Bid book, use a form containing the same information.

2-1.14 BID SUBMITTAL

Submit your bid:

1. Under sealed cover
2. Marked as a bid
3. Identifying the contract number and the bid opening date

If an agent other than the authorized corporation officer or a partnership member signs the bid, file a Power of Attorney with the Department either before opening bids or with the bid. Otherwise, the bid may be nonresponsive.

2-1.15 BID WITHDRAWAL

An authorized agent may withdraw a bid before the bid opening date and time by submitting a written bid withdrawal request at the location where the bid was submitted. Withdrawing a bid does not prevent you from submitting a new bid.

After the bid opening time, you cannot withdraw a bid.

2-1.16 BID OPENING

The Department publicly opens and reads bids at the time and place described in the Notice to Bidders.

2-1.17 BID REJECTION

The Department may reject:

1. All bids
2. A nonresponsive bid

2-1.18 BID RELIEF

The Department may grant bid relief under Pub Cont Code § 5100 et seq. Submit any request for bid relief to the Office Engineer. For Relief of Bid Request form, go to:

http://www.dot.ca.gov/hq/esc/oe/contractor_info/relief.pdf

2-1.19 SUBMITTAL FAILURE HISTORY

The Department considers a bidder's past failure to submit documents required after bid opening in determining a bidder's responsibility.

2-1.20 BID RIGGING

Section 2-1.20, "Bid Rigging," applies to a Federal-aid contract.

The U.S. Department of Transportation (DOT) provides a toll-free hotline to report bid rigging activities. Use the hotline to report bid rigging, bidder collusion, and other fraudulent activities. The hotline number is (800) 424-9071. The service is available Monday through Friday between 11:00 a.m. and 8:00 p.m. and is confidential and anonymous. The hotline is part of the DOT's effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the DOT Inspector General.

^^

SECTION 3 AWARD AND EXECUTION OF CONTRACT

(Issued 07-31-09)

Replace Section 3 with:

SECTION 3 CONTRACT AWARD AND EXECUTION

3-1.01 SCOPE

Section 3, "Contract Award and Execution," includes specifications related to contract award and execution.

3-1.02 CONTRACT AWARD

Submit any bid protest to the Office Engineer.

If the Department awards the contract, the award is made to the lowest responsible bidder within the number of days shown in the following table:

Contract Award Period

Days (after bid opening)	Project Estimated Cost shown in the Notice to Bidders
30	< $200 million
60	≥ $200 million

The Department may extend the specified award period if the bidder agrees.

3-1.03 CONTRACT BONDS (PUB CONT CODE §§ 10221 AND 10222)

The successful bidder must furnish 2 bonds:

1. Payment bond to secure the claim payments of laborers, workers, mechanics, or materialmen providing goods, labor, or services under the contract. This bond must be equal to at least 100 percent of the total bid.
2. Performance bond to guarantee the faithful performance of the contract. This bond must be equal to at least 50 percent of the total bid.

The Department furnishes the successful bidder with bond forms.

3-1.04 CONTRACTOR LICENSE

For a Federal-aid contract, the Contractor must be properly licensed as a contractor (Pub Cont Code § 10164) from contract award through contract acceptance.

For a non-Federal-aid contract:

1. The Contractor must be properly licensed as a contractor from bid opening through contract acceptance (Bus & Prof Code § 7028.15)
2. Joint venture bidders must obtain a joint venture license before contract award (Bus & Prof Code § 7029.1)

3-1.05 INSURANCE POLICIES

The successful bidder must submit:

1. Copy of its commercial general liability policy and its excess policy or binder until such time as a policy is available, including the declarations page, applicable endorsements, riders, and other modifications in effect at the time of contract execution. Standard ISO form No. CG 0001 or similar exclusions are allowed if not inconsistent with Section 7-1.12, "Indemnification and Insurance." Allowance of additional exclusions is at the discretion of the Department.
2. Certificate of insurance showing all other required coverages. Certificates of insurance, as evidence of required insurance for the auto liability and any other required policy, shall set forth deductible amounts applicable to each policy and all exclusions that are added by endorsement to each policy. The evidence of insurance shall provide that no cancellation, lapse, or reduction of coverage will occur without 10 days prior written notice to the Department.
3. A declaration under the penalty of perjury by a CPA certifying the accountant has applied GAAP guidelines confirming the successful bidder has sufficient funds and resources to cover any self-insured retentions if the self-insured retention is $50,000 or higher.

If the successful bidder uses any form of self-insurance for workers compensation in lieu of an insurance policy, it shall submit a certificate of consent to self-insure under Labor Code § 3700.

3-1.06 RESERVED

3-1.07 PAYEE DATA RECORD

Complete and sign the Payee Data Record form included in the contract documents.

3-1.08 RESERVED

3-1.09 CONTRACT EXECUTION

The successful bidder must sign the contract.

Deliver to the Office Engineer:

1. Signed Contract form
2. Contract bonds
3. Documents identified in Section 3-1.05, "Insurance Policies"
4. Payee data record

For an informal-bid contract, the Office Engineer must receive these documents before the 5th business day after the bidder receives the contract. For all other contracts, the Office Engineer must receive these documents before the 10th business day after the bidder receives the contract.

The bidder's security may be forfeited for failure to execute the contract within the time specified (Pub Cont Code §§ 10181, 10182, and 10183).

The following is a copy of the Contract form:

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION

CONTRACT

DES-OE-0103A (NEW 3/2008)

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
CONTRACT NO. _____

This contract is entered into between the State of California's Department of Transportation and the Contractor named below:

_____

CONTRACTOR'S NAME

The parties agree to comply with the terms of the following exhibits that are by this reference made a part of this contract.

Exhibit A - Bid book dated _____

Exhibit B - Notice to Bidders and Special Provisions dated _____

Exhibit C - Project Plans approved _____

Exhibit D - Standard Specifications dated _____

Exhibit E - Standard Plans dated _____

Exhibit F - Addenda

Exhibits A, B, C, and F are those exhibits identified with the same contract number as this contract.

This contract has been executed by the following parties:

CONTRACTOR

CONTRACTOR'S NAME *(if other than an individual, state whether a corporation, partnership, etc.)*

BY *(Authorized Signature)*	DATE SIGNED *(Do not type)*

PRINTED NAME AND TITLE OF PERSON SIGNING

FEDERAL EMPLOYER IDENTIFICATION NUMBER

DEPARTMENT OF TRANSPORTATION

BY *(Authorized Signature)*	DATE SIGNED *(Do not type)*

PRINTED NAME AND TITLE OF PERSON SIGNING

ADA Notice For individuals with sensory disabilities, this document is available in alternate formats. For information call (916) 654-6410 or TDD (916) 654-3880 or write Records and Forms Management, 1120 N Street, MS-89, Sacramento, CA 95814.

3-1.10 BIDDERS' SECURITIES

The Department keeps the securities of the 1st, 2nd, and 3rd low bidders until the contract has been executed. The other bidders' securities, other than bidders' bonds, are returned upon determination of the 1st, 2nd, and 3rd low bidders, and their bidders' bonds are of no further effect (Pub Cont Code § 10184).

^^

SECTION 4 SCOPE OF WORK
(Issued 06-05-09)

Add to Section 4-1.01:

Nothing in the specifications voids the Contractor's public safety responsibilities.

Add:

4-1.015 PROJECT DESCRIPTION

Construct the work described in the special provisions and on project plans and by the bid items. The special provisions, project plans, and bid item descriptions set forth the specifications that apply.

Replace Section 4-1.03 with:

4-1.03 CHANGES

4-1.03A General

The Department may make changes within the scope of work and add extra work. The Engineer describes the changes and extra work, the payment basis, and any time adjustment in a Contract Change Order.

A Contract Change Order is approved when the Department signs the Contract Change Order.

Submit detailed cost data for a payment adjustment for:

1. Request for a payment adjustment for a bid item
2. Payment adjustment resulting from a change of more than 25 percent in the bid item's quantity if requested

If ordered, start the work before receipt of an approved Contract Change Order.

You may protest a Contract Change Order.

4-1.03B Increased or Decreased Quantities

The Department adjusts payment for changed quantities and eliminated items under Section 9-1.05, "Changed Quantity Payment Adjustments."

4-1.03C Changes in Character of Work

The Department adjusts payment for an item if:

1. An ordered plan or specification change materially changes the character of a work item from that on which the bid price was based
2. The unit cost of the changed item differs when compared to the unit cost of that item under the original plans and specifications
3. No approved Contract Change Order addresses the payment

The Department adjusts the payment under Section 9-1.06, "Work-Character Changes."

4-1.03D Extra Work

The Department classes new and unforeseen work as extra work if the Engineer determines that the work is not covered by any of the various items for which there is a bid price or by combinations of those items. If portions of this work are covered by some of the various items for which there is a bid price or combinations of those items, the remaining portion of the work will be classed as extra work. Extra work also includes work specifically designated as extra work in the plans or specifications.

Add:

4-1.035 VALUE ENGINEERING

4-1.035A General

Reserved

4-1.035B Value Engineering Change Proposal

You may submit a VECP to reduce any of the following:

1. Total cost of construction
2. Construction activity duration
3. Traffic congestion

Before preparing a VECP, meet with the Engineer to discuss:

1. Proposal concept
2. Permit issues
3. Impact on other projects
4. Project impacts, including traffic, schedule, and later stages
5. Peer reviews
6. Overall proposal merits
7. Review times required by the Department and other agencies

The VECP must not impair the project's essential functions or characteristics, such as:

1. Service life
2. Operation economy
3. Maintenance ease
4. Desired appearance
5. Design and safety

The VECP must include:

1. Description of the contract specifications and drawing details for performing the work and the proposed changes.
2. Itemization of contract specifications and drawing details that would be changed.
3. Detailed cost estimate for performing the work under the existing contract and under the proposed change. Determine the estimates under Section 9-1.03, "Force Account Payment."
4. Deadline for the Engineer to decide on the changes.
5. Bid items affected and resulting quantity changes.

The Department is not required to consider a VECP. If a VECP is similar to a change in the plans or specifications being considered by the Department at the time the proposal is submitted or if the proposal is based on or similar to drawings or specifications adopted by the Department before Contract award, the Department does not accept the VECP and may make these changes without VECP payments.

Until the Department approves a change order incorporating the VECP or parts of it, continue to perform the work under the contract. If the Department does not approve a change order before the deadline stated in the VECP or other date you subsequently stated in writing, the VECP is rejected. The Department does not adjust time or payment for a rejected VECP.

The Department decides whether to accept a VECP and the estimated net construction-cost savings from adopting the VECP or parts of it.

The Department may require you to accept a share of the investigation cost as a condition of reviewing a VECP. After written acceptance, the Department considers the VECP and deducts the agreed cost.

If the Department accepts the VECP or parts of it, the Department issues a change order that:

1. Incorporates changes in the contract necessary to implement the VECP or the parts adopted
2. Includes the Department's acceptance conditions
3. States the estimated net construction-cost savings resulting from the VECP
4. Obligates the Department to pay you 50 percent of the estimated net savings

In determining the estimated net construction-cost savings, the Department excludes your VECP preparation cost and the Department's VECP investigation cost, including parts paid by you.

If a VECP providing for a reduction in working days is accepted by the Department, 50 percent of the reduction is deducted from contract time.

If a VECP providing for a reduction in traffic congestion or avoiding traffic congestion is accepted by the Department, the Department pays 60 percent of the estimated net savings in construction costs attributable to the VECP. Submit detailed traffic handling comparisons between the existing contract and the proposed change, including estimates of the traffic volumes and congestion.

The Department may apply an accepted VECP for general use on other contracts.

If an accepted VECP is adopted for general use, the Department pays only the contractor who first submitted the VECP and only to the contracts awarded to that contractor before the submission of the accepted VECP.

If the Department does not adopt a general-use VECP, an identical or similar submitted proposal is eligible for acceptance.

4-1.035C Value Analysis Workshop

Section 4-1.035C, "Value Analysis Workshop," applies to a non-building-work contract with a total bid of over $5 million.

You may request a value analysis workshop by submitting a request after contract approval.

The Department offers a value analysis workshop to:

1. Identify value enhancing opportunities
2. Consider changes to the contract that will reduce the total cost of construction, construction activity duration, or traffic congestion without impairing the essential functions specified for a VECP in Section 4-1.035B, "Value Engineering Change Proposal."

If the request is authorized, you and the Engineer:

1. Schedule a value analysis workshop
2. Select a facilitator and workshop site
3. Agree to other workshop administrative details

The workshop must be conducted under the methods described in the Department's Value Analysis Team Guide available at:

http://www.dot.ca.gov/hq/oppd/value/

The facilitator must be a certified value specialist as recognized by the Society of American Value Engineers.

The Department reimburses you for 1/2 of the workshop cost. The workshop cost is the sum of the workshop-facilitator cost and the workshop-site cost. The Department determines the workshop cost based on the facilitator and workshop-site invoice prices minus any available or offered discounts. The Department does not pay you for any other associated costs.

^^

SECTION 5 CONTROL OF WORK
(Issued 07-31-09)

Add:

5-1.005 GENERAL

Failure to comply with any specification part is a waiver of your right to an adjustment of time and payment related to that part.

After contract approval, submit documents and direct questions to the Engineer. Orders, approvals, authorizations, and requests to the Contractor are by the Engineer.

The Engineer furnishes the following in writing:

1. Approvals
2. Authorizations
3. Certifications
4. Decisions
5. Notifications
6. Orders
7. Responses

The Contractor must furnish the following in writing:

1. Assignments
2. Notifications
3. Proposals
4. Reports
5. Requests, including RFIs, sequentially numbered
6. Subcontracts
7. Test results

The Department rejects a form if it has any error or any omission.

Convert foreign language documents to English.

Use contract administration forms available at the Department's Web site.

If the last day for submitting a document falls on a Saturday or holiday, it may be submitted on the next business day with the same effect as if it had been submitted on the day specified.

Add to 5-1.01:

Failure to enforce a contract provision does not waive enforcement of any contract provision.

Add:

5-1.011 PROTESTS

You may protest an Engineer's decision by submitting an RFI under Section 5-1.145, "Requests for Information."

Add:

5-1.012 PARTNERING

5-1.012A General

The Department strives to work cooperatively with all contractors; partnering is our way of doing business. The Department encourages project partnering among the project team, made up of significant contributors from the Department and the Contractor, and their invited stakeholders.

For a project with a total bid greater than $1 million, professionally facilitated project partnering is encouraged.

For a project with a total bid greater than $10 million, professionally facilitated project partnering is required.

In implementing project partnering, you and the Engineer manage the contract by:

1. Using early and regular communication with involved parties
2. Establishing and maintaining a relationship of shared trust, equity, and commitment
3. Identifying, quantifying, and supporting attainment of mutual goals
4. Developing strategies for using risk management concepts
5. Implementing timely communication and decision making
6. Resolving potential problems at the lowest possible level to avoid negative impacts
7. Holding periodic partnering meetings and workshops as appropriate to maintain partnering relationships and benefits throughout the life of the project
8. Establishing periodic joint evaluations of the partnering process and attainment of mutual goals

Partnering does not void any contract part.

The Department's "Field Guide to Partnering on Caltrans Construction Projects" current at the time of bid is available to the project team as reference. This guide provides structure, context, and clarity to the partnering process requirements. This guide is available at the Department's Partnering Program website:

http://www.dot.ca.gov/hq/construc/partnering.html

In implementing project partnering, the project team must:

1. Create a partnering charter that includes:

    1.1. Mutual goals, including core project goals and may also include project-specific goals and mutually supported individual goals.
    1.2. Partnering maintenance and close-out plan.
    1.3. Dispute resolution plan that includes a dispute resolution ladder and may also include use of facilitated dispute resolution sessions.
    1.4. Team commitment statement and signatures.

2. Participate in monthly partnering evaluation surveys to measure progress on mutual goals and may also measure short-term key issues as they arise.
3. Evaluate the partnering facilitator on Forms CEM-5501 and CEM-5502. The Engineer provides the evaluation forms to the project team and collects the results. The Department makes evaluation results available upon request. Facilitator evaluations must be completed:

    3.1. At the end of the initial partnering workshop on Form CEM-5501.
    3.2. At the end of the project close-out partnering workshop on Form CEM-5502.

4. Conduct a project close-out partnering workshop.
5. Document lessons learned before contract acceptance.

5-1.012B Partnering Facilitator, Workshops, and Monthly Evaluation Surveys

The Engineer sends you a written invitation to enter into a partnering relationship after contract approval. Respond within 15 days to accept the invitation and request the initial and additional partnering workshops. After the Engineer receives the request, you and the Engineer cooperatively:

1. Select a partnering facilitator that offers the service of a monthly partnering evaluation survey with a 5-point rating and agrees to follow the Department's "Partnering Facilitator Standards and Expectations" available at the Department's Partnering Program website
2. Schedule initial partnering workshop
3. Determine initial workshop site and duration
4. Agree to other workshop administrative details

Additional partnering workshops and sessions are encouraged throughout the life of the project as determined necessary by you and the Engineer, recommended quarterly.

5-1.012C Training in Partnering Skills Development

For a project with a total bid of $25 million or greater, training in partnering skills development is required.
For a project with a total bid between $10 million and $25 million, training in partnering skills is optional.

You and the Engineer cooperatively schedule the training session and select a professional trainer, training site, and 1 to 4 topics from the following list to be covered in the training:

1. Active Listening
2. Building Teams
3. Change Management
4. Communication
5. Conflict Resolution
6. Cultural Diversity
7. Dealing with Difficult People
8. Decision Making
9. Effective Escalation Ladders
10. Emotional Intelligence
11. Empathy
12. Ethics
13. Facilitation Skills
14. Leadership
15. Partnering Process and Concepts
16. Project Management
17. Project Organization
18. Problem Solving
19. Running Effective Meetings
20. Time Management
21. Win-Win Negotiation

Before the initial partnering workshop, the trainer conducts a 1-day training session in partnering skills development for the Contractor's and the Engineer's representatives. This training session must be a separate session from the initial partnering workshop and must be conducted locally. The training session must be consistent with the partnering principles under the Department's "Field Guide to Partnering on Caltrans Construction Projects."

Send at least 2 representatives to the training session. One of these must be your assigned representative as specified in Section 5-1.06, "Superintendence," of the Standard Specifications.

5-1.012D Payment

The Department pays you for:

1. 1/2 of partnering workshops and sessions based on facilitator and workshop site cost
2. 1/2 of monthly partnering evaluation survey service cost
3. Partnering skills development trainer and training site cost

The Department determines the costs based on invoice prices minus any available or offered discounts. The Department does not pay markups on these costs.

The Department does not pay for wages, travel expenses, or other costs associated with the partnering workshops and sessions, monthly partnering evaluation surveys, and training in partnering skills development.

Add:

5-1.015 RECORDS

5-1.015A General

Reserved

5-1.015B Record Retention

Retain project records from bid preparation through:

1. Final payment
2. Resolution of claims, if any

For at least 3 years after the later of these, retain cost records, including records of:

1. Bid preparation
2. Overhead
3. Payrolls
4. Payments to suppliers and subcontractors
5. Cost accounting

Maintain the records in an organized way in the original format, electronic and hard copy, conducive to professional review and audit.

5-1.015C Record Inspection, Copying, and Auditing

Make your records available for inspection, copying, and auditing by State representatives for the same time frame specified under Section 5-1.015B, "Record Retention." The records of subcontractors and suppliers must be made available for inspection, copying, and auditing by State representatives for the same period. Before contract acceptance, the State representative notifies the Contractor, subcontractor, or supplier 5 business days before inspection, copying, or auditing.

If an audit is to start more than 30 days after contract acceptance, the State representative notifies the Contractor, subcontractor, or supplier when the audit is to start.

5-1.015D Cost Accounting Records

Maintain cost accounting records for the project distinguishing between the following work cost categories:

1. Work performed based on bid item prices
2. Work performed by change order other than extra work. Distinguish this work by:

    2.1. Bid item prices
    2.2. Force account
    2.3. Agreed price

3. Extra work. Distinguish extra work by:

    3.1. Bid item prices
    3.2. Force account
    3.3. Agreed price
    3.4. Specialist billing

4. Work performed under potential claim records
5. Overhead
6. Subcontractors, suppliers, owner-operators, and professional services

Cost accounting records must include:

1. Final cost code lists and definitions
2. Itemization of the materials used and corresponding vendor's invoice copies
3. Direct cost of labor
4. Equipment rental charges
5. Workers' certified payrolls
6. Equipment:

    6.1. Size
    6.2. Type
    6.3. Identification number
    6.4. Hours operated

5-1.015E Extra Work Bills

Maintain separate records for costs of work performed by change order.

Submit extra work bills using the Department's Internet extra work billing system.

The Contractor submitting and the Engineer approving an extra work bill using the Internet force account work billing system is the same as each party signing the bill.

The Department provides billing system:

1. Training within 30 days of your written request
2. Accounts and user identification to your assigned representatives after a representative has received training

Each representative must maintain a unique password.

Replace Section 5-1.04 with:

5-1.04 CONTRACT COMPONENTS

A component in one contract part applies as if appearing in each. The parts are complementary and describe and provide for a complete work.

If a discrepancy exists:

1. The governing ranking of contract parts in descending order is:

    1.1. Special provisions
    1.2. Project plans
    1.3. Revised Standard Plans
    1.4. Standard Plans
    1.5. Amendments to the Standard Specifications
    1.6. Standard Specifications
    1.7. Supplemental project information

2. Written numbers and notes on a drawing govern over graphics
3. A detail drawing governs over a general drawing
4. A detail specification governs over a general specification
5. A specification in a section governs over a specification referenced by that section

If a discrepancy is found or confusion arises, request correction or clarification.

Add:

5-1.055 SUBCONTRACTING

5-1.055A General

No subcontract releases you from the contract or relieves you of your responsibility for a subcontractor's work.

If you violate Pub Cont Code § 4100 et seq., the Department may exercise the remedies provided under Pub Cont Code § 4110. The Department may refer the violation to the Contractors State License Board as provided under Pub Cont Code § 4111.

Except for a building-construction non-federal-aid contract, perform work equaling at least 30 percent of the value of the original total bid with your employees and with equipment owned or rented by you, with or without operators.

Each subcontract must comply with the contract.

Each subcontractor must have an active and valid State contractor's license with a classification appropriate for the work to be performed (Bus & Prof Code, § 7000 et seq.).

Submit copies of subcontracts upon request.

Before subcontracted work starts, submit a Subcontracting Request form.

Do not use a debarred contractor; a current list of debarred contractors is available at the Department of Industrial Relations' Web site.

Upon request, immediately remove and not again use a subcontractor who fails to prosecute the work satisfactorily.

Replace Section 5-1.07 with:

5-1.07 LINES AND GRADES

The Engineer places stakes and marks under Chapter 12, "Construction Surveys," of the Department's Surveys Manual.

Submit your request for Department-furnished stakes:

1. On a Request for Construction Stakes form. Ensure:

    1.1. Requested staking area is ready for stakes
    1.2. You use the stakes in a reasonable time

2. A reasonable time before starting an activity using the stakes

Establish priorities for stakes and note priorities on the request.

Preserve stakes and marks placed by the Engineer. If the stakes or marks are destroyed, the Engineer replaces them at the Engineer's earliest convenience and deducts the cost.

Replace Section 5-1.10 with:

5-1.10 EQUIPMENT

Clearly stencil or stamp at a clearly visible location on each piece of equipment except hand tools an identifying number and:

1. On compacting equipment, its make, model number, and empty gross weight that is either the producer's rated weight or the scale weight
2. On meters and on the load-receiving element and indicators of each scale, the make, model, serial number, and producer's rated capacity

Submit a list:

1. Describing each piece of equipment
2. Showing its identifying number

Upon request, submit producer's information that designates portable vehicle scale capacities.

For proportioning materials, use measuring devices, material plant controllers, and undersupports complying with Section 9-1.01B, "Weighing Equipment and Procedures."

Measuring devices must be tested and approved under California Test 109 in the Department's presence by any of the following:

1. County Sealer of Weights and Measures
2. Scale Service Agency
3. Division of Measurement Standards Official

The indicator over-travel must be at least 1/3 of the loading travel. The indicators must be enclosed against moisture and dust.

Group measuring system dials such that the smallest increment for each indicator can be read from the location at which proportioning is controlled.

Replace Section 5-1.116 with:

5-1.116 DIFFERING SITE CONDITIONS (23 CFR 635.109)

5-1.116A Contractor's Notification

Promptly notify the Engineer if you find either of the following:

1. Physical conditions differing materially from either of the following:

    1.1. Contract documents
    1.2. Job site examination

2. Physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract

Include details explaining the information you relied on and the material differences you discovered.

If you fail to notify the Engineer promptly, you waive the differing site condition claim for the period between your discovery of the differing site condition and your notification to the Engineer.

If you disturb the site after discovery and before the Engineer's investigation, you waive the differing site condition claim.

5-1.116B Engineer's Investigation and Decision

Upon your notification, the Engineer investigates job site conditions and:

1. Notifies you whether to resume affected work
2. Decides whether the condition differs materially and is cause for an adjustment of time, payment, or both

You may protest the Engineer's decision.

Replace Section 5-1.14 with:

5-1.14 COST REDUCTION INCENTIVE

Comply with Section 4-1.035B, "Value Engineering Change Proposal."

Add:

5-1.145 REQUESTS FOR INFORMATION

Submit an RFI upon recognition of any event or question of fact arising under the Contract.

The Engineer responds to the RFI within 5 business days. Proceed with the work unless otherwise ordered. You may protest the Engineer's response by:

1. Submitting an Initial Potential Claim Record within 5 business days after receipt of the Engineer's response
2. Complying with Section 5-1.146, "Potential Claims and Dispute Resolution"

Add:

5-1.146 POTENTIAL CLAIMS AND DISPUTE RESOLUTION

5-1.146A General

Minimize and mitigate impacts of potentially claimed work or event.

For each potential claim, assign an identification number determined by chronological sequencing and the 1st date of the potential claim.

Use the identification number for each potential claim on the:

1. Initial Potential Claim Record
2. Supplemental Potential Claim Record
3. Full and Final Potential Claim Record

Failure to comply with this procedure is:

1. Waiver of the potential claim and a waiver of the right to a corresponding claim for the disputed work in the administrative claim procedure
2. Bar to arbitration (Pub Cont Code § 10240.2)

5-1.146B Initial Potential Claim Record

Submit an Initial Potential Claim Record within 5 business days of the Engineer's response to the RFI. The Initial Potential Claim Record establishes the claim nature and circumstances. The claim nature and circumstances must remain consistent.

The Engineer responds within 5 business days of the date of the Initial Potential Claim Record. Proceed with the potentially claimed work unless ordered.

Within 20 days of a request, provide access to the project records determined necessary by the Engineer to evaluate the potential claim.

5-1.146C Supplemental Potential Claim Record

Within 15 days of submitting the Initial Potential Claim Record, submit a Supplemental Potential Claim Record including:

1. Complete nature and circumstances causing the potential claim or event
2. Contract specifications supporting the basis of a claim
3. Estimated claim cost and an itemized breakdown of individual costs stating how the estimate was determined
4. TIA

The Engineer evaluates the Supplemental Potential Claim Record and furnishes you a response within 20 days of submittal. If the estimated cost or effect on the scheduled completion date changes, update the Supplemental Potential Claim Record information as soon as the change is recognized and submit this information.

5-1.146D Full and Final Potential Claim Record

Notify the Engineer within 10 days of the completion date of the potentially claimed work. The Engineer approves this completion date or notifies you of a revised date.

Within 30 days of the completion of the potentially claimed work, submit a Full and Final Potential Claim Record including:

1. A detailed factual account of the events causing the potential claim, including:

    1.1. Necessary dates
    1.2. Locations
    1.3. Work items affected by the potential claim

2. The Contract documents supporting the potential claim and a statement of the reasons these parts support entitlement
3. If a payment adjustment is requested, an itemized cost breakdown. Segregate costs into the following categories:

    3.1. Labor, including:

        3.1.1. Individuals
        3.1.2. Classifications
        3.1.3. Regular and overtime hours worked
        3.1.4. Dates worked

    3.2. Materials, including:

        3.2.1. Invoices
        3.2.2. Purchase orders
        3.2.3. Location of materials either stored or incorporated into the work
        3.2.4. Dates materials were transported to the job site or incorporated into the work

    3.3. Equipment, including:

        3.3.1. Detailed descriptions, including make, model, and serial number
        3.3.2. Hours of use
        3.3.3. Dates of use
        3.3.4. Equipment rates at the rental rate listed in Labor Surcharge and Equipment Rental Rates in effect when the affected work related to the claim was performed

4. If a time adjustment is requested:

    4.1. Dates for the requested time.
    4.2. Reasons for a time adjustment.
    4.3. Contract documentation supporting the requested time adjustment.
    4.4. TIA. The TIA must demonstrate entitlement to a time adjustment.

5. Identification and copies of your documents and copies of communications supporting the potential claim, including certified payrolls, bills, cancelled checks, job cost reports, payment records, and rental agreements
6. Relevant information, references, and arguments that support the potential claim

The Department does not consider a Full and Final Potential Claim Record that does not have the same nature, circumstances, and basis of claim as those specified on the Initial Potential Claim Record and Supplemental Potential Claim Record.

The Engineer evaluates the information presented in the Full and Final Potential Claim Record and furnishes you a response within 30 days of its receipt unless the Full and Final Potential Claim Record is submitted after Contract acceptance; in which case, a response may not be furnished. The Engineer's receipt of the Full and Final Potential Claim Record must be evidenced by postal return receipt or the Engineer's written receipt if delivered by hand.

5-1.146E Dispute Resolution

Comply with Section 5-1.15, "Dispute Resolution."

Add:

5-1.15 DISPUTE RESOLUTION

5-1.15A General

Section 5-1.15, "Dispute Resolution," applies to a contract with 100 or more working days.

The dispute resolution process is not a substitute for filing an RFI and complying with the requirements of Section 5-1.146, "Potential Claims and Dispute Resolution."

5-1.15B Dispute Resolution Advisor

Section 5-1.15B, "Dispute Resolution Advisor," applies to a contract with a total bid from $3 million to $10 million.

A dispute resolution advisor, hereinafter referred to as "DRA," is chosen by the Department and the Contractor to assist in the resolution of disputes.

The DRA shall be established by the Department and the Contractor within 30 days of contract approval.

The Department and the Contractor shall each propose 3 potential DRA candidates. Each potential candidate shall provide the Department and the Contractor with their disclosure statement. The disclosure statement shall include a resume of the potential candidate's experience and a declaration statement describing past, present, anticipated, and planned relationships with all parties involved in this contract.

The Department and the Contractor shall select one of the 6 nominees to be the DRA. If the Department and the Contractor cannot agree on one candidate, the Department and the Contractor shall each choose one of the 3 nominated by the other. The final selection of the DRA will be decided by a coin toss between the two candidates.

The Department and the Contractor shall complete and adhere to the Dispute Resolution Advisor Agreement. No DRA meeting shall take place until the Dispute Resolution Advisor Agreement has been signed by all parties, unless all parties agree to sign it at the first meeting.

If DRA needs outside technical services, technical services shall be preapproved by both the Department and the Contractor.

DRA recommendations are nonbinding.

The Contractor shall not use the DRA for disputes between subcontractors or suppliers that have no grounds for a lawsuit against the Department.

DRA replacement is selected in the same manner as the original selection. The appointment of a replacement DRA will begin promptly upon determination of the need for replacement. The Dispute Resolution Advisor Agreement shall be amended to reflect the change of the DRA.

Failure of the Contractor to participate in selecting DRA will result in the withhold of 25 percent of the estimated value of all work performed during each estimate period that the Contractor fails to comply. DRA withholds will be released for payment on the next monthly progress payment following the date that the Contractor has provided assistance in choosing the DRA and no interest will be due the Contractor.

The State and the Contractor shall bear the costs and expenses of the DRA equally.

The DRA shall be compensated at an agreed rate of $1,500 per day for time spent per meeting either at the start of the project or for a dispute. A member serving on more than one State DRA or Dispute Resolution Board, regardless the number of meetings per day shall not be paid more than the agreed rate per day. The agreed rate shall be considered full compensation for on-site time, travel expenses, transportation, lodging, time for travel, and incidentals for each day or portion thereof that the DRA is at an authorized DRA meeting.

No additional compensation will be made for time spent by the DRA to review and research activities outside the official DRA meetings unless that time, such as time spent evaluating and preparing recommendations on specific issues presented to the DRA, has been specifically agreed to in advance by the State and Contractor. Time away from the project that has been specifically agreed to in advance by the Department and the Contractor will be compensated at an agreed rate of $150 per hour. The agreed amount of $150 per hour shall include all incidentals including expenses for telephone, fax, and computer services.

The State will provide conference facilities for DRA meetings at no cost to the Contractor.

The Contractor shall make direct payments to the DRA for participation in authorized meetings and approved hourly rate charges from invoices submitted.

The State will reimburse the Contractor for the State's share of the costs.

There will be no markups applied to expenses associated with the DRA, either by the DRA or by the Contractor when requesting payment of the State's share of DRA expenses. Regardless of the DRA recommendation, neither party will be entitled to reimbursement of DRA costs from the other party.

The Contractor shall submit extra work bills and include invoices with original supporting documents for reimbursement of the State's share.

The cost of technical services will be borne equally by the State and Contractor. There will be no markups for these costs.

A copy of the "Dispute Resolution Advisor Agreement" to be executed by the Contractor, State and the DRA is as follows:

Form CEM 6206 Rev (04-06-07)

DISPUTE RESOLUTION ADVISOR AGREEMENT

_____
(Contract Identification)

Contract No. _____

THIS DISPUTE RESOLUTION ADVISOR AGREEMENT, hereinafter called "AGREEMENT", made and entered into this _____ day of _____, _____, between the State of California, acting through the California Department of Transportation and the Director of Transportation, hereinafter called the "STATE," _____ hereinafter called the "CONTRACTOR," and _____, the Dispute Resolution Advisor, hereinafter called the "DRA."

WITNESSETH, that

WHEREAS, the STATE and the CONTRACTOR, hereinafter called the "parties," are now engaged in the construction on the State Highway project referenced above; and

WHEREAS, the Standard Specifications for the above referenced contract provides for the establishment and operation of the DRA to assist in resolving disputes; and

WHEREAS, the DRA is composed of one person, chosen by the CONTRACTOR and the STATE;

NOW THEREFORE, in consideration of the terms, conditions, covenants, and performance contained herein, or attached and incorporated and made a part hereof, the STATE, the CONTRACTOR, and the DRA hereto agree as follows:

SECTION I DESCRIPTION OF WORK

To assist in the timely resolution of disputes between the parties, the contract provides for the establishment and the operation of the DRA. The DRA is to fairly and impartially consider disputes placed before it and provide recommendations for resolution of these disputes to the parties. The DRA shall provide recommendations based on the facts related to the dispute, the contract and applicable laws and regulations. The DRA shall perform the services necessary to participate in the DRA's actions as designated in Section III, Scope of Work.

SECTION II DRA QUALIFICATIONS

The DRA shall be knowledgeable in the type of construction and contract documents anticipated by the contract and shall have completed training through the Dispute Review Board Foundation. In addition, it is desirable for the DRA to have served on several State Dispute Resolution Boards (DRB).

No DRA shall have prior direct involvement in this contract. No DRA shall have a financial interest in this contract or parties thereto, including but not limited to the CONTRACTOR, subcontractors, suppliers, consultants, and legal and business services, within a period 6 months prior to award and during this contract. Exceptions to above are compensation for services on this or other DRAs and DRBs or retirement payments or pensions received from a party that are not tied to, dependent on or affected by the net worth of the party.

The DRA shall fully disclose all direct or indirect professional or personal relationships with all key members of the contract.

SECTION III SCOPE OF WORK

The Scope of Work of the DRA includes, but is not limited to, the following:

A. PROCEDURES

The DRA shall meet with the parties at the start of the project to establish procedures that will govern the conduct of its business and reporting procedures in conformance with the requirements of the contract and the terms of this AGREEMENT. The DRA established procedures shall only be implemented upon approval by the parties. Subsequent meetings shall be held only to hear disputes between the parties.

The DRA shall not meet with, or discuss contract issues with individual parties.

The State shall provide the DRA with the contract and all written correspondence regarding the dispute between the parties and, if available, the Contractor's supplemental potential claim record, and the Engineer's response to the supplemental potential claim record.

The parties shall not call the DRA who served on this contract as a witness in arbitration proceedings, which may arise from this contract.

The DRA shall have no claim against the STATE or the CONTRACTOR, or both, from claimed harm arising out of the parties' evaluations of the DRA's opinions.

B. DISPUTE MEETING

The term "dispute meeting" as used in this subsection shall refer to both the informal and traditional dispute meeting processes, unless otherwise noted.

If the CONTRACTOR requests a dispute meeting with the DRA, the Contractor must simultaneously notify the STATE. Upon being notified of the need for a dispute meeting, the DRA shall review and consider the dispute. The DRA shall determine the time and location of the dispute meeting with due consideration for the needs and preferences of the parties, while recognizing the importance of a speedy resolution to the dispute.

Dispute meetings shall be conducted at any location that would be convenient and provide required facilities and access to necessary documentation.

Only the STATE's Area Construction Engineer, Resident Engineer, and Structure Representative and the CONTRACTOR's or subcontractor's, Superintendent or Project Manager may present information at a dispute meeting. There shall be no participation of persons who are not directly involved in the contract or who do not have direct knowledge of the dispute. The exception to this is technical services, as described below:

> The DRA, with approval of the parties, may obtain technical services necessary to adequately review the disputes presented, including audit, geotechnical, schedule analysis and other services. The parties' technical staff may supply those services as appropriate. The cost of technical services, as agreed to by the parties, shall be borne equally by the two parties as specified in an approved contract change order. The CONTRACTOR shall not be entitled to markups for the payments made for these services.

At the dispute meeting the DRA may ask questions, seek clarification, and request further clarification of data presented by either of the parties as may be necessary to assist in making a fully informed recommendation. However, the DRA shall refrain from expressing opinions on the merits of statements on matters under dispute during the parties' presentations. Each party will be given ample time to fully present its position, make rebuttals, provide relevant documents, and respond to DRA questions and requests.

There shall be no testimony under oath or cross-examination, during DRA dispute meetings. There shall be no reporting of the procedures by a shorthand reporter or by electronic means. Documents and verbal statements shall be received by the DRA in conformance with the rules and regulations established at the first meeting between the DRA and parties. These established rules and regulations need not comply with prescribed legal laws of evidence.

Failure to attend a dispute meeting by either of the parties shall be conclusively considered by the DRA as indication that the non-attending party considers all written documents and correspondence submitted as their entire and complete argument. The claimant shall discuss the dispute, followed by the other party. Each party shall then be allowed one or more rebuttals at the meeting until all aspects of the dispute are thoroughly covered.

1. TRADITIONAL DISPUTE MEETING:

The following procedure shall be used for the traditional dispute meeting:

a. Within 5 days after receiving the STATE's written response to the CONTRACTOR's supplemental potential claim record, the CONTRACTOR shall refer the dispute to the DRA, if the CONTRACTOR wishes to further pursue the dispute. The CONTRACTOR shall make the referral in writing to the DRA, simultaneously copied to the STATE. The written dispute referral shall describe the disputed matter in individual discrete segments, so that it will be clear to both parties and the DRA what discrete elements of the dispute have been resolved, and which remain unresolved, and shall include an estimate of the cost of the affected work and impacts, if any, on project completion.

b. The parties shall each be afforded an opportunity to be present and to be heard by the DRA, and to offer evidence. Either party furnishing written evidence or documentation to the DRA must furnish copies of such information to the other party a minimum of 10 days prior to the date the DRA is scheduled to convene the meeting for the dispute. Either party shall produce such additional evidence as the DRA may deem necessary to reach an understanding and a determination of the dispute. The party furnishing additional evidence shall furnish copies of such additional evidence to the other party at the same time the evidence is provided to the DRA. The DRA shall not consider evidence not furnished in conformance with the terms specified herein.

c. Upon receipt by the DRA of a written referral of a dispute, the DRA shall convene to review and consider the dispute. The dispute meeting shall be held no later than 25 days after receipt of the written referral unless otherwise agreed to by all parties.
d. The DRA shall furnish a written report to both parties. The DRA may request clarifying information of either party within 5 days after the DRA dispute meeting. Requested information shall be submitted to the DRA within 5 days of the DRA request. The DRA shall complete its report and submit it to the parties within 10 days of the DRA dispute meeting, except that time extensions may be granted at the request of the DRA with the written concurrence of both parties. The report shall summarize the facts considered, the contract language, law or regulation viewed by the DRA as pertinent to the dispute, and the DRA's interpretation and philosophy in arriving at its conclusions and recommendations and, if appropriate, recommends guidelines for determining compensation. The DRA's written opinion shall stand on its own, without attachments or appendices.
e. Within 10 days after receiving the DRA's report, both parties shall respond to the DRA in writing signifying that the dispute is either resolved or remains unresolved. Failure to provide the written response within the time specified, or a written rejection of the DRA's recommendation or response to a request for reconsideration presented in the report by either party, shall conclusively indicate that the party(s) failing to respond accepts the DRA recommendation. Immediately after responses have been received from both parties, the DRA shall provide copies of both responses to the parties simultaneously. Either party may request clarification of elements of the DRA's report from the DRA prior to responding to the report. The DRA shall consider any clarification request only if submitted within 5 days of receipt of the DRA's report, and if submitted simultaneously in writing to both the DRA and the other party. Each party may submit only one request for clarification for any individual DRA report. The DRA shall respond, in writing, to requests for clarification within 5 days of receipt of such requests.
f. Either party may seek a reconsideration of the DRA's recommendation. The DRA shall only grant reconsideration based upon submission of new evidence and if the request is submitted within the 10 day time limit specified for response to the DRA's written report. Each party may submit only one request for reconsideration regarding an individual DRA recommendation.
g. If the parties are able to settle their dispute with the aid of the DRA's report, the STATE and CONTRACTOR shall promptly accept and implement the settlement of the parties. If the parties cannot agree on compensation within 30 days of the acceptance by both parties of the settlement, either party may request the DRA to make a recommendation regarding compensation.

2. INFORMAL DISPUTE MEETING

An informal dispute meeting shall be convened, only if, the parties and the DRA agree that this dispute resolution process is appropriate to settle the dispute.
The following procedure shall be used for the informal dispute meeting:

a. The parties shall furnish the DRA with one copy of pertinent documents requested by the DRA that are or may become necessary for the DRA to perform its function. The party furnishing documents shall furnish such documents to the other party at the same time the document is provided to the DRA.
b. After the dispute meeting has concluded, the DRA shall deliberate in private the same day, until a response to the parties is reached or as otherwise agreed to by the parties.
c. The DRA then verbally delivers its recommendation with findings to the parties.
d. After the recommendation is presented, the parties may ask for clarifications.
e. Occasionally the DRA, on complex issues, may be unable to formulate a recommendation based on the information given at a dispute meeting. However, the DRA may provide the parties with advice on strengths and weaknesses of their prospective positions, in the hope of the parties reaching settlement.
f. If the parties are able to settle their dispute with the aid of the DRA's opinion, the STATE and CONTRACTOR shall promptly accept and implement the settlement of the parties.
g. The DRA will not be bound by its oral recommendation in the event that a dispute is later heard by the DRA in a traditional dispute meeting.

Unless the dispute is settled, use of the informal dispute meeting does not relieve the parties of their responsibilities under Section 5-1.15B, "Dispute Resolution Advisor," of the Standard Specifications or Subsection, "Traditional Dispute Meeting," of this AGREEMENT. There will be no extension of time allowed for the process to permit the use of the informal dispute meeting, unless otherwise agreed to by the parties.

SECTION IV TIME FOR BEGINNING AND COMPLETION

Once established, the DRA shall be in operation until the day the Director accepts the contract. The DRA shall not begin work under the terms of this AGREEMENT until authorized in writing by the STATE or as agreed to by the parties.

SECTION V PAYMENT

The DRA shall be compensated at an agreed rate of $1,500 per day for time spent per meeting, either at the start of the project or for a dispute. A member serving on more than one State DRA or DRB, regardless the number of meetings per day, shall not be paid more than the agreed rate per day. The agreed rate shall be considered full compensation for onsite time, travel expenses, transportation, lodging, time for travel and incidentals for each day, or portion thereof that the DRA is at an authorized DRA meeting. No additional compensation will be made for time spent by the DRA to review and research activities outside the official DRA meetings unless that time, (such as time spent evaluating and preparing recommendations on specific issues presented to the DRA), has been specifically agreed to in advance by the parties. Time away from the project, which has been specifically agreed to in advance by the parties, will be compensated at an agreed rate of $150 per hour. The agreed amount of $150 per hour shall include all incidentals including expenses for telephone, fax, and computer services. The State will provide administrative services such as conference facilities to the DRA.

A. PAYMENT PROCESSING

The CONTRACTOR shall make direct payments to the DRA for their participation in authorized meetings and approved hourly rate charges, from invoices submitted by the DRA, and technical services.

The DRA may submit invoices to the CONTRACTOR for partial payment for work performed and services rendered for their participation in authorized meetings not more often than once per month during the progress of the work. The invoices shall be in a format approved by the parties and accompanied by a general description of activities performed during that billing period. Payment for hourly fees, at the agreed rate, shall not be paid to the DRA until the amount and extent of those fees are approved by the STATE and CONTRACTOR.

B. INSPECTION OF COSTS RECORDS

The DRA and the CONTRACTOR shall keep available for inspection by representatives of the STATE and the United States, for a period of 3 years after final payment, the cost records and accounts pertaining to this AGREEMENT. If any litigation, claim, or audit arising out of, in connection with, or related to this contract is initiated before the expiration of the 3-year period, the cost records and accounts shall be retained until such litigation, claim, or audit involving the records is completed.

SECTION VI ASSIGNMENT OF TASKS OF WORK

The DRA shall not assign the work of this AGREEMENT.

SECTION VII TERMINATION OF DRA

The DRA may resign after providing not less than 15 days written notice of the resignation to the STATE and CONTRACTOR. The DRA may be terminated, by either party, for failing to fully comply at all times with all required employment or financial disclosure conditions of DRA membership in conformance with the terms of the contract and this AGREEMENT. Each party shall document the need for replacement and substantiate the replacement request in writing to the other party and the DRA.

SECTION VIII LEGAL RELATIONS

The parties hereto mutually understand and agree that the DRA in the performance of duties is acting in the capacity of an independent agent and not as an employee of either party.

No party to this AGREEMENT shall bear a greater responsibility for damages or personal injury than is normally provided by Federal or State of California Law.

Notwithstanding the provisions of this contract that require the CONTRACTOR to indemnify and hold harmless the STATE, the parties shall jointly indemnify and hold harmless the DRA from and against all claims, damages, losses, and expenses, including but not limited to attorney's fees, arising out of and resulting from the findings and recommendations of the DRA.

SECTION IX CONFIDENTIALITY

The parties hereto mutually understand and agree that all documents and records provided by the parties in reference to issues brought before the DRA, which documents and records are marked "Confidential - for use by the DRA only," shall be kept in confidence and used only for the purpose of resolution of subject disputes, and for assisting in development of DRA findings and recommendations; that such documents and records will not be utilized or revealed to others, except to officials of the parties who are authorized to act on the subject disputes, for any purposes, during the life of this AGREEMENT. Upon termination of this AGREEMENT, said confidential documents and records, and all copies thereof, shall be returned to the parties who furnished them to the DRA. However, the parties understand that such documents may be subsequently discoverable and admissible in court or arbitration proceedings unless a protective order has been obtained by the party seeking further confidentiality.

SECTION X DISPUTES

Disputes between the parties arising out of the work or other terms of this AGREEMENT that cannot be resolved by negotiation and mutual concurrence between the parties or through the administrative process provided in the contract shall be resolved by arbitration as provided in Section 9-1.10, "Arbitration," of the Standard Specifications. Disputes between the DRA and the parties that cannot be resolved by negotiation and mutual concurrence shall be resolved in the appropriate forum.

SECTION XI VENUE, APPLICABLE LAW, AND PERSONAL JURISDICTION

In the event that any party, including the DRA, deems it necessary to institute arbitration proceedings to enforce any right or obligation under this AGREEMENT, the parties hereto agree that such action shall be initiated in the Office of Administrative Hearings of the State of California. The parties hereto agree that all questions shall be resolved by arbitration by application of California law and that the parties to such arbitration shall have the right of appeal from such decisions to the Superior Court in conformance with the laws of the State of California. Venue for the arbitration shall be Sacramento or any other location as agreed to by the parties.

SECTION XII FEDERAL REVIEW AND REQUIREMENTS

On Federal-Aid contracts, the Federal Highway Administration shall have the right to review the work of the DRA in progress, except for private meetings or deliberations of the DRA.

Other Federal requirements in this agreement shall only apply to Federal-Aid contracts.

SECTION XIII CERTIFICATION OF CONTRACTOR, DRA, AND STATE

IN WITNESS WHEREOF, the parties hereto have executed this AGREEMENT as of the day and year first above written.

DRA

By: _____

Title: _____

CONTRACTOR	CALIFORNIA DEPARTMENT OF TRANSPORTATION
By: _____	By: _____
Title: _____	Title: _____

5-1.15C Dispute Resolution Board

Section 5-1.15C, "Dispute Resolution Board," applies to a contract with a total bid of over $10 million.

The Dispute Resolution Board, hereinafter referred to as "DRB," is a three member board established by the Department and Contractor to assist in the resolution of disputes.

The DRB shall be established by the Department and the Contractor within 45 days after contract approval.

The DRB shall consist of one member selected by the Department and approved by the Contractor, one member selected by the Contractor and approved by the Department, and a third member selected by the first 2 members and approved by both the Department and the Contractor.

The Department and Contractor shall provide the other written notification for approval of the name of their DRB nominee along with the nominee's disclosure statement.

Disclosure statements shall include a resume of the nominee's experience and a declaration statement describing past, present, anticipated, and planned relationships with all parties involved in this contract. Objections to nominees shall be based on a specific breach or violation of nominee responsibilities or on nominee qualifications. The Department or the Contractor may, on a one-time basis, object to the other's nominee without specifying a reason and this person shall not be selected for the DRB. Another person shall then be nominated within 15 days.

The 2 DRB members shall proceed with the selection of the third DRB member immediately after receiving written notification from the Department of their selection. The 2 DRB members shall provide their recommendation simultaneously to the parties within 15 days. The third member shall provide disclosure statement to the first 2 DRB members, to the Department, and the Contractor. The professional experience of the third DRB member shall complement that of the first 2 DRB members. The third DRB member shall be subject to mutual approval of the Department and the Contractor. If the 2 DRB members cannot agree on the third nominee, they shall submit a list of nominees to the Department and the Contractor for final selection and approval.

If the Department and the Contractor cannot agree on the third DRB member, or if the first 2 DRB members are unable to agree upon a recommendation, the Department and the Contractor shall select 6 names from the current list of arbitrators certified by the Public Works Contract Arbitration Committee created by Article 7.2 of the State Contract Act. The 2 DRB members shall then select one of the 6 names by a blind draw.

The 3 DRB members shall appoint one member as a chairperson to provide leadership for the DRB's activities. The chairperson shall be approved by the Department and the Contractor. In the event of an impasse, the third DRB member shall become the chairperson.

The Department and Contractor shall complete and adhere to the Dispute Resolution Board Agreement. No DRB meeting shall take place until the Dispute Resolution Board Agreement has been signed by all parties, unless all parties agree to sign it at the first meeting.

If the DRB needs outside technical services, technical services shall be preapproved by both the Department and the Contractor.

DRB recommendations are nonbinding.

The Contractor shall not use the DRB for disputes between the subcontractors or suppliers that have no grounds for a lawsuit against the Department.

DRB member replacements are selected in the same manner as the original selection. The appointment of a replacement DRB member will begin promptly upon determination of the need for replacement. The Dispute Resolution Board Agreement shall be amended to reflect the change in the DRB.

Failure of the Contractor to participate in establishing the DRB will result in the withholding of 25 percent of the estimated value of all work performed during each estimate period that the Contractor fails to comply. DRB withholds will be released for payment on the next monthly progress payment following the date that the Contractor has provided assistance in establishing the DRB and no interest will be due the Contractor.

The Department and the Contractor shall bear the costs and expenses of the DRB equally.

Each DRB member shall be compensated at an agreed rate of $1,500 per day for time spent per meeting either at the start of the project, for scheduled progress, or dispute meetings. A member serving on more than one Department DRB or Dispute Resolution Advisor (DRA), regardless of the number of meetings per day shall not be paid more than the agreed rate per day. The agreed rate shall be considered full compensation for on-site time, travel expenses, transportation, lodging, time for travel, and incidentals for each day or portion thereof that the DRB member is at an authorized DRB meeting.

No additional compensation will be made for time spent by DRB members in review and research activities outside the official DRB meetings unless that time, such as time spent evaluating and preparing recommendations on specific issues presented to the DRB, has been specifically agreed to in advance by the Department and Contractor. Time away from the project, which has been specifically agreed to in advance by the Department and Contractor, will be compensated at an agreed rate of $150 per hour. The agreed amount of $150 per hour shall include all incidentals including expenses for telephone, fax, and computer services.

The Department will provide conference facilities for DRB meetings at no cost to the Contractor.

The Contractor shall make direct payments to each DRB member for their participation in authorized meetings and approved hourly rate charges from invoices submitted by each DRB member.

The Department will reimburse the Contractor for the Department's share of the costs.

There will be no markups applied to expenses connected with the DRB, either by the DRB members or by the Contractor when requesting payment of the Department's share of DRB expenses. Regardless of the DRB recommendation, neither party shall be entitled to reimbursement of DRB costs from the other party.

The Contractor shall submit extra work bills and include evidence of every payment to each DRB member in the form of a cancelled check or bank statement within 30 days of payment.

The cost of technical services requested by the DRB will be borne equally by the State and Contractor. There will be no markups for these costs.

A copy of the "Dispute Resolution Board Agreement" to be executed by the Department, Contractor, and the 3 DRB members after approval of the contract follows:

DISPUTE RESOLUTION BOARD AGREEMENT

_____
(Contract Identification)

Contract No. _____

THIS DISPUTE RESOLUTION BOARD AGREEMENT, hereinafter called "AGREEMENT", made and entered into this _____ day of _____, _____, between the State of California, acting through the California Department of Transportation and the Director of Transportation, hereinafter called the "STATE," _____ _____ hereinafter called the "CONTRACTOR," and the Dispute Resolution Board, hereinafter called the "DRB" consisting of the following members:

_____ ,
(DRB Member)

_____ ,
(DRB Member)

and _____
(DRB Chairperson)

WITNESSETH, that

WHEREAS, the STATE and the CONTRACTOR, hereinafter called the "parties," are now engaged in the construction on the State Highway project referenced above; and

WHEREAS, the Standard Specifications for the above referenced contract provides for the establishment and operation of the DRB to assist in resolving disputes; and

WHEREAS, the DRB is composed of three members, one selected by the STATE, one selected by the CONTRACTOR, and the third member selected by the other two members and approved by the parties; and

NOW THEREFORE, in consideration of the terms, conditions, covenants, and performance contained herein, or attached and incorporated and made a part hereof, the STATE, the CONTRACTOR, and the DRB members hereto agree as follows:

SECTION I DESCRIPTION OF WORK

To assist in the timely resolution of disputes between the parties, the contract provides for the establishment and the operation of the DRB. The DRB is to fairly and impartially consider disputes placed before it and provide recommendations for resolution of these disputes to the parties. The DRB shall provide recommendations based on the facts related to the dispute, the contract and applicable laws and regulations. The DRB shall perform the services necessary to participate in the DRB's actions as designated in Section III, Scope of Work.

SECTION II DRB QUALIFICATIONS

DRB members shall be knowledgeable in the type of construction and contract documents anticipated by the contract and shall have completed training through the Dispute Review Board Foundation.

No DRB member shall have prior direct involvement in this contract. No DRB member shall have a financial interest in this contract or parties thereto, including but not limited to the CONTRACTOR, subcontractors, suppliers, consultants, and legal and business services, within a period 6 months prior to award and during this contract. Exceptions to above are compensation for services on this or other DRBs and DRAs or retirement payments or pensions received from a party that are not tied to, dependent on or affected by the net worth of the party.

DRB members shall fully disclose all direct or indirect professional or personal relationships with all key members of the contract.

SECTION III SCOPE OF WORK

The scope of work of the DRB includes, but is not limited to, the following:

A. PROCEDURES

The DRB shall establish procedures that will govern the conduct of its business and reporting procedures in conformance with the requirements of the contract and the terms of this AGREEMENT. The DRB established procedures shall only be implemented upon approval of the parties.

The DRB Chairperson shall schedule progress and dispute meetings and any other DRB activities.

The parties shall not call on any of the DRB members, who served on this contract, as a witness in arbitration proceedings, which may arise from this contract.

DRB members shall have no claim against the STATE or the CONTRACTOR, or both, from claimed harm arising out of the parties' evaluations of the DRB's opinions.

During progress or dispute meetings, DRB members shall refrain from expressing opinions on the merits of statements on matters under dispute or potential dispute. Opinions of DRB members expressed in private sessions shall be kept strictly confidential. Individual DRB members shall not meet with, or discuss contract issues with individual parties. Discussions regarding the project between the DRB members and the parties shall be in the presence of all three members and both parties. Individual DRB members shall not undertake independent investigations of any kind pertaining to disputes or potential disputes, except with the knowledge of both parties and as expressly directed by the DRB Chairperson.

B. PROGRESS MEETINGS

DRB members shall visit the project site and meet with representatives of the parties to keep abreast of construction activities and to develop familiarity with the work in progress. Scheduled progress meetings shall be held at or near the project site. The DRB shall meet at least once at the start of the project, and at least once every 4 months thereafter. The frequency, exact time, and duration of additional site visits and progress meetings shall be as recommended by the DRB and approved by the parties consistent with the construction activities or matters under consideration and dispute. Scheduled progress meetings may be waived, if the parties are in agreement, when the only work remaining is plant establishment work. Each meeting shall consist of a round table discussion and a field inspection of the work being performed on the contract, if necessary. Each meeting shall be attended by representatives of both parties. The agenda shall generally be as follows:

1. Meeting opened by the DRB Chairperson.
2. Remarks by the STATE's representative.
3. A description by the CONTRACTOR's representative of work accomplished since the last meeting; the current schedule status of the work; and a forecast for the coming period.
4. An outline by the STATE's representative of the status of the work as the STATE views it.
5. An outline by the CONTRACTOR's representative of potential problems and a description of proposed solutions.
6. A brief description by the CONTRACTOR's and the STATE's representative of potential claims and disputes that have surfaced since the last meeting.
7. A summary by the STATE's representative, the CONTRACTOR's representative, or the DRB of the status of past potential claims and disputes.

The STATE's representative will prepare minutes of all progress meetings and circulate them for revision and approval by all concerned within 10 days of the meeting.

C. DISPUTE MEETING

The term "dispute meeting" as used in this subsection shall refer to both the informal and traditional dispute meeting processes, unless otherwise noted.

Either the STATE or the CONTRACTOR may request a dispute meeting with the DRB. The requesting party shall simultaneously notify the other party of each dispute meeting request. Upon being notified of the need for a dispute meeting, the DRB shall review and consider the dispute. The DRB shall determine the time and location of the dispute meeting with due consideration for the needs and preferences of the parties, while recognizing the importance of a speedy resolution to the dispute.

Dispute meetings shall be conducted at any location that would be convenient and provide required facilities and access to necessary documentation.

No DRB dispute meeting shall take place later than 30 days prior to acceptance of the contract.

Only the STATE's Area Construction Engineer, Resident Engineer, and Structure Representative and the CONTRACTOR's or subcontractor's, Superintendent or Project Manager may present information at a dispute meeting. There shall be no participation of persons who are not directly involved in the contract or who do not have direct knowledge of the dispute. The exception to this is technical services, as described below:

The DRB, with approval of the parties, may obtain technical services necessary to adequately review the disputes presented, including audit, geotechnical, schedule analysis and other services. The parties' technical staff may supply those services as appropriate. The cost of technical services, as agreed to by the parties, shall be borne equally by the two parties as specified in an approved contract change order. The CONTRACTOR shall not be entitled to markups for the payments made for these services.

At the dispute meeting the DRB may ask questions, seek clarification, and request further clarification of data presented by either of the parties as may be necessary to assist in making a fully informed recommendation. However, the DRB shall refrain from expressing opinions on the merits of statements on matters under dispute during the parties' presentations. The claimant shall discuss the dispute, followed by the other party. Each party shall then be allowed one or more rebuttals at the meeting until all aspects of the dispute are thoroughly covered. Each party will be given ample time to fully present its position, make rebuttals, provide relevant documents, and respond to DRB questions and requests.

There shall be no testimony under oath or cross-examination, during DRB dispute meetings. There shall be no reporting of the procedures by a shorthand reporter or by electronic means. Documents and verbal statements shall be received by the DRB in conformance with the procedures established at the first meeting between the DRB and the parties. These established procedures need not comply with prescribed legal laws of evidence.

Failure to attend a dispute meeting by either of the parties shall be conclusively considered by the DRB as indication that the non-attending party considers all written documents and correspondence submitted as their entire and complete argument.

After dispute meetings are concluded, the DRB shall meet in private and reach a conclusion supported by two or more members. Private sessions of the DRB may be held at a location other than the job site or by electronic conferencing as deemed appropriate, in order to expedite the process.

The DRB shall make every effort to reach a unanimous decision.

1. TRADITIONAL DISPUTE MEETING:

The following procedure shall be used for the traditional dispute meeting:

a. Within 21 days after receiving the STATE's written response to the CONTRACTOR's supplemental potential claim record, the CONTRACTOR shall refer the dispute to the DRB if the CONTRACTOR wishes to further pursue the dispute. The CONTRACTOR shall make the referral in writing to the DRB, simultaneously copied to the STATE. The written dispute referral shall describe the disputed matter in individual discrete segments, so that it will be clear to both parties and the DRB what discrete elements of the dispute have been resolved, and which remain unresolved, and shall include an estimate of the cost of the affected work and impacts, if any, on project completion.

b. The parties shall each be afforded an opportunity to be present and to be heard by the DRB, and to offer evidence. Either party furnishing written evidence or documentation to the DRB must furnish copies of such information to the other party a minimum of 15 days prior to the date the DRB is scheduled to convene the meeting for the dispute. Either party shall produce such additional evidence as the DRB may deem necessary to reach an understanding and a determination of the dispute. The party furnishing additional evidence shall furnish copies of such additional evidence to the other party at the same time the evidence is provided to the DRB. The DRB shall not consider evidence not furnished in conformance with the terms specified herein.

c. Upon receipt by the DRB of a written referral of a dispute, the DRB shall convene to review and consider the dispute. The dispute meeting shall be held no earlier than 30 days and no later than 60 days after receipt of the written referral unless otherwise agreed to by all parties.

d. The DRB may request clarifying information of either party within 10 days after the dispute meeting. Requested information shall be submitted to the DRB within 10 days of the DRB request.

e. The DRB shall furnish a written report to the parties with its conclusion(s) and recommendation(s). The DRB shall complete its report, including minority opinion, if any, and submit it to the parties within 30 days of the dispute meeting, except that time extensions may be granted at the request of the DRB with the written concurrence of the parties. The report shall summarize the facts considered, the contract language, law or regulation viewed by the DRB as pertinent to the dispute, and the DRB's interpretation and reasoning in arriving at its conclusion(s) and recommendation(s) and, if appropriate, recommends guidelines for determining compensation. The DRB's written opinion shall stand on its own, without attachments or appendices. The DRB Chairperson shall furnish a copy of the written recommendation report to the DRB Coordinator, Division of Construction, MS 44, P.O. Box 942874, Sacramento, CA 94274.

f. Within 30 days after receiving the DRB's report, the parties shall respond to the DRB in writing signifying that the dispute is either resolved or remains unresolved. Failure to provide the written response within the time specified, or a written rejection of the DRB's recommendation or a written response requesting the DRB reconsider their recommendation, shall conclusively indicate that the party(s) failing to respond accepts the DRB recommendation. Immediately after responses have been received from both parties, the DRB shall provide copies of both responses to the parties simultaneously. Either party may request clarification of elements of the DRB's report from the DRB prior to responding to the report. The DRB shall consider any clarification request only if submitted within 10 days of receipt of the DRB's report, and if submitted simultaneously in writing to both the DRB and the other party. Each party may submit only one request for clarification for any individual DRB report. The DRB shall respond, in writing, to requests for clarification within 10 days of receipt of such requests.
g. Either party may seek a reconsideration of the DRB's recommendation. The DRB shall only grant reconsideration based upon submission of new evidence and if the request is submitted within the 30 day time limit specified for response to the DRB's written report. Each party may submit only one request for reconsideration regarding an individual DRB recommendation.
h. If the parties are able to settle their dispute with the aid of the DRB's report, the STATE and the CONTRACTOR shall promptly accept and implement the settlement of the parties. If the parties cannot agree on compensation within 60 days of the acceptance by both parties of the settlement, either party may request the DRB to make a recommendation regarding compensation.

2. INFORMAL DISPUTE MEETING

An informal dispute meeting shall be convened, only if, the parties and the DRB agree that this dispute resolution process is appropriate to settle the dispute.

The following procedure shall be used for the informal dispute meeting:

a. The parties shall furnish the DRB with one copy of pertinent documents requested by the DRB that are or may become necessary for the DRB to perform its function. The party furnishing documents shall furnish such documents to the other party at the same time the document is provided to the DRB.
b. After the dispute meeting has concluded, the DRB members shall deliberate in private the same day until a response to the parties is reached or as otherwise agreed to by the parties.
c. The DRB then verbally delivers its recommendation with findings, including minority opinion, if any, to the parties.
d. After the recommendation is presented, the parties may ask for clarifications.
e. Occasionally the DRB may be unable to formulate a recommendation based on the information given at a dispute meeting. However, the DRB may provide the parties with advice on strengths and weaknesses of their prospective positions, in the hope of the parties reaching settlement.
f. If the parties are able to settle their dispute with the aid of the DRB's opinion, the STATE and the CONTRACTOR shall promptly accept and implement the settlement of the parties.
g. The DRB will not be bound by its verbal recommendation in the event that a dispute is later heard by the DRB in a traditional dispute meeting.

Unless the dispute is settled, use of the informal dispute meeting does not relieve the parties of their responsibilities under Section 5-1.15C, "Dispute Resolution Board," of the Standard Specifications or subsection, "Traditional Dispute Meeting," of this AGREEMENT. There will be no extension of time allowed for the process to permit the use of the informal dispute meeting, unless otherwise agreed to by the parties.

SECTION IV TIME FOR BEGINNING AND COMPLETION

DRB members shall not begin work under the terms of this AGREEMENT, until authorized in writing by the STATE or as agreed to by the parties. Once established, the DRB shall be in operation until the Director accepts the contract. If the contract is terminated in accordance with Section 8-1.08, "Termination of Control," of the Standard Specifications, the DRB will be dissolved.

SECTION V PAYMENT

Each DRB member shall be compensated at an agreed rate of $1,500 per day for time spent per meeting, either at start of project, or a scheduled progress or a dispute meeting. A member serving on more than one State DRB or DRA, regardless of the number of meetings per day, shall not be paid more than the agreed rate per day. The agreed rate shall be considered full compensation for on site time, travel expenses, transportation, lodging, time for travel and incidentals for each day, or portion thereof that the DRB member is at an authorized DRB meeting. No additional compensation will be made for time spent by DRB member to review and research activities outside the official DRB meetings unless that time, such as time spent evaluating and preparing recommendations on specific issues presented to the DRB, has been specifically agreed to in advance by the parties. Time away from the project, which has been specifically agreed to in advance by the parties, will be compensated at an agreed rate of $150 per hour. The agreed amount of $150 per hour shall include all incidentals including expenses for telephone, fax, and computer services. The State will provide administrative services such as conference facilities to the DRB.

A. PAYMENT PROCESSING

The CONTRACTOR shall make direct payments to each DRB member for their participation in authorized meetings and approved hourly rate charges, from invoices submitted by each DRB member, and technical services.

DRB members may submit invoices to the CONTRACTOR for partial payment for work performed and services rendered for their participation in authorized meetings not more often than once per month during the progress of the work. The invoices shall be in a format approved by the parties and accompanied by a general description of activities performed during that billing period. Payment for hourly fees, at the agreed rate, shall not be paid to a DRB member until the amount and extent of those fees are approved by the STATE and the CONTRACTOR.

B. INSPECTION OF COSTS RECORDS

DRB members and the CONTRACTOR shall keep available for inspection by representatives of the STATE and the United States federal government, for a period of 3 years after final payment, the cost records and accounts pertaining to this AGREEMENT. If any litigation, claim, or audit arising out of, in connection with, or related to this contract is initiated before the expiration of the 3-year period, the cost records and accounts shall be retained until such litigation, claim, or audit involving the records is completed.

SECTION VI ASSIGNMENT OF TASKS OF WORK

DRB members shall not assign the work of this AGREEMENT.

SECTION VII TERMINATION OF A DRB MEMBER

DRB members may resign after providing not less than 15 days written notice of their resignation to the STATE and the CONTRACTOR. A DRB member may be terminated, by either party, for failing to comply at all times with all required employment or financial disclosure conditions of DRB membership in conformance with the terms of the contract and this AGREEMENT.

Service of a DRB member may be terminated at any time with not less than 15 days notice as follows:

A. The State may terminate service of the State appointed member.
B. The Contractor may terminate service of the Contractor appointed member.
C. Upon the written recommendation of the State and Contractor appointed members for the removal of the third member.
D. Upon resignation of a member.

When a member of the DRB is replaced, the replacement member shall be appointed in the same manner as the replaced member was appointed. The appointment of a replacement DRB member will begin promptly upon determination of the need for replacement and shall be completed within 15 days. Changes in either of the DRB members chosen by the 2 parties will not require re-selection of the third member, unless both parties agree to such re-selection in writing. The Dispute Resolution Board Agreement shall be amended to reflect the change of a DRB member.

Each party shall document the need for replacement and substantiate the replacement request in writing to the other party and DRB members.

SECTION VIII LEGAL RELATIONS

The parties hereto mutually understand and agree that each DRB member in the performance of duties is acting in the capacity of an independent agent and not as an employee of either party.

No party to this AGREEMENT shall bear a greater responsibility for damages or personal injury than is normally provided by Federal or State of California Law.

Notwithstanding the provisions of this contract that require the CONTRACTOR to indemnify and hold harmless the STATE, the parties shall jointly indemnify and hold harmless the DRB members from and against all claims, damages, losses, and expenses, including but not limited to attorney's fees, arising out of and resulting from the findings and recommendations of the DRB.

SECTION IX CONFIDENTIALITY

The parties hereto mutually understand and agree that all documents and records provided by the parties in reference to issues brought before the DRB, which documents and records are marked "Confidential - for use by the DRB only," shall be kept in confidence and used only for the purpose of resolution of subject disputes, and for assisting in development of DRB findings and recommendations; that such documents and records will not be utilized or revealed to others, except to officials of the parties who are authorized to act on the subject disputes, for any purposes, during the life of this AGREEMENT. Upon termination of this AGREEMENT, said confidential documents and records, and all copies thereof, shall be returned to the parties who furnished them to the DRB. However, the parties understand that such documents may be subsequently discoverable and admissible in court or arbitration proceedings unless a protective order has been obtained by the party seeking further confidentiality.

SECTION X DISPUTES

Disputes between the parties arising out of the work or other terms of this AGREEMENT, which cannot be resolved by negotiation and mutual concurrence between the parties, or through the administrative process provided in the contract, shall be resolved by arbitration as provided in Section 9-1.10, "Arbitration," of the Standard Specifications. Disputes between the DRB and either party, which cannot be resolved by negotiation and mutual concurrence, shall be resolved in the appropriate forum.

SECTION XI VENUE, APPLICABLE LAW, AND PERSONAL JURISDICTION

In the event that any party deems it necessary to institute arbitration proceedings to enforce any right or obligation under this AGREEMENT, the parties hereto agree that such action shall be initiated in the Office of Administrative Hearings of the State of California. The parties hereto agree that all questions shall be resolved by arbitration by application of California law and that the parties to such arbitration shall have the right of appeal from such decisions to the Superior Court in conformance with the laws of the State of California. Venue for the arbitration shall be Sacramento or any other location as agreed to by the parties.

SECTION XII FEDERAL REVIEW AND REQUIREMENTS

On Federal-Aid contracts, the Federal Highway Administration shall have the right to review the work of the DRB in progress, except for private meetings or deliberations of the DRB that do not become part of the project records.

Other Federal requirements in this agreement shall only apply to Federal-Aid contracts.

SECTION XIII CERTIFICATION OF CONTRACTOR, DRB, AND STATE

IN WITNESS WHEREOF, the parties hereto have executed this AGREEMENT as of the day and year first above written.

DRB MEMBER

By: _____

Title: _____

DRB MEMBER

By: _____

Title :_____

DRB CHAIRPERSON

By :_____

Title :_____

CONTRACTOR

CALIFORNIA DEPARTMENT
OF TRANSPORTATION

By: _____

By: _____

Title: _____

Title: _____

Add:

5-1.16–5-17 (BLANK)

Add:

5-1.18 PROPERTY AND FACILITY PRESERVATION

5-1.18A General

Preserve property and facilities, including:

1. Adjacent property
2. Department's instrumentation
3. ESAs
4. Lands administered by other agencies
5. Railroads and railroad equipment
6. Roadside vegetation not to be removed
7. Utilities
8. Waterways

Immediately report damage to the Engineer.

If you cause damage, you are responsible.

Install sheet piling, cribbing, bulkheads, shores, or other supports necessary to support existing facilities or support material carrying the facilities.

Dispose of temporary facilities when they are no longer needed.

If you damage plants not to be removed:

1. Dispose of them outside the right of way unless the Engineer allows you to reduce them to chips and spread the chips within the highway at locations designated by the Engineer
2. Replace them

Replace plants with plants of the same species.

Replace trees with 24-inch-box trees.

Replace shrubs with No. 15 container shrubs.

Replace ground cover plants with plants from flats. Replace Carpobrutus ground cover plants with plants from cuttings. Plant ground cover plants 1 foot on center.

If a plant establishment period is specified, replace plants before the start of the plant establishment period; otherwise, replace plants at least 30 days before Contract acceptance.

Water each plant immediately after planting and saturate the backfill soil around and below the roots or ball of earth around the roots of each plant. Water as necessary to maintain plants in a healthy condition until Contract acceptance.

The Department may make a temporary repair to restore service to a damaged facility.

If working on or adjacent to railroad property, do not interfere with railroad operations.

For an excavation on or affecting railroad property, submit work plans showing the system to be used to protect railroad facilities. Allow 65 days for the Engineer's review of the plans. Do not perform work based on the plans until the Engineer notifies you they are accepted.

5-1.18B Nonhighway Facilities (Including Utilities)

The Department may rearrange a nonhighway facility during the Contract. Rearrangement of a nonhighway facility includes installation, relocation, alteration, or removal of the facility.The Department may authorize facility owners and their agents to enter the highway to perform rearrangement work for their facilities or to make connections or repairs to their property. Coordinate activities to avoid delays.

Notify the Engineer at least 3 business days before you contact the regional notification center under Govt Code § 4216 et seq. Failure to contact the notification center prohibits excavation.

Before starting work that could damage or interfere with underground infrastructure, locate the infrastructure described in the Contract, including laterals and other appurtenances, and determine the presence of other underground infrastructure inferred from visible facilities such as buildings, meters, or junction boxes.

Notify the Engineer if the infrastructure described in the Contract cannot be found. If after giving the notice, you find the infrastructure in a substantially different location than described, finding the infrastructure is paid for as extra work as specified in Section 4-1.03D, "Extra Work."

Underground infrastructure described in the Contract may be in different locations than described, and additional infrastructure may exist.

Upon discovering an underground main or trunk line not described in the Contract, immediately notify the Engineer and the infrastructure owner. The Engineer orders the locating and protecting of the infrastructure. The locating and protecting is paid for as extra work as specified in Section 4-1.03D, "Extra Work." If ordered, repair infrastructure damage. If the damage is not due to your negligence, the repair is paid for as extra work as specified in Section 4-1.03D, "Extra Work."

If necessary underground infrastructure rearrangement is not described in the Contract, the Engineer may order you to perform the work. The rearrangement is paid for as extra work as specified in Section 4-1.03D, "Extra Work."

If you want infrastructure rearrangement different from that described in the Contract:

1. Notify the Engineer
2. Make an arrangement with the infrastructure owner
3. Obtain authorization for the rearrangement
4. The Department does not adjust time or payment for rearrangement different from the Contract
5. Pay the infrastructure owner any additional cost

Immediately notify the Engineer of a delay due to the presence of main line underground infrastructure not described in the Contract or in a substantially different location or due to rearrangement different from the Contract. The Department pays for one of these delays in the same manner as specified for a right of way delay in Section 8-1.09, "Right of Way Delays."

^^

SECTION 6 CONTROL OF MATERIALS
(Issued 05-01-09)

Replace Section 6-1.05 with:

6-1.05 SPECIFIC BRAND OR TRADE NAME AND SUBSTITUTION

A reference to a specific brand or trade name establishes a quality standard and is not intended to limit competition. You may use a product that is equal to or better than the specified brand or trade name if approved.

Submit a substitution request within a time period that:

1. Follows Contract award
2. Allows 30 days for review
3. Causes no delay

Include substantiating data with the substitution request that proves the substitution:

1. Is of equal or better quality and suitability
2. Causes no delay in product delivery and installation

Add:

6-1.075 GUARANTEE

Guarantee the work remains free from substantial defects for 1 year after contract acceptance except for work parts for which you were relieved of maintenance and protection. Guarantee each of these relieved work parts for 1 year after the relief date.

The guarantee excludes damage or displacement caused by an event outside your control including:

1. Normal wear and tear
2. Improper operation
3. Insufficient maintenance
4. Abuse
5. Unauthorized change
6. Act of God

During the guarantee period, repair or replace each work portion having a substantial defect.

The Department does not pay for corrective work.

During corrective work activities, provide insurance coverage specified for coverage before contract acceptance.

The contract bonds must be in full force and effect until the later of:

1. Expiration of guarantee period
2. Completion of corrective work

If a warranty specification conflicts with Section 6-1.075, "Guarantee," comply with the warranty specification.

During the guarantee period, the Engineer monitors the completed work. If the Engineer finds work having a substantial defect, the Engineer lists work parts and furnishes you the list.

Within 10 days of receipt of the list, submit for authorization a detailed plan for correcting the work. Include a schedule that includes:

1. Start and completion dates
2. List of labor, equipment, materials, and any special services you plan to use
3. Work related to the corrective work, including traffic control and temporary and permanent pavement markings

The Engineer notifies you when the plan is authorized. Start corrective work and related work within 15 days of notice.

If the Engineer determines corrective work is urgently required to prevent injury or property damage:

1. The Engineer furnishes you a request to start emergency repair work and a list of parts requiring corrective work
2. Mobilize within 24 hours and start work
3. Submit a corrective work plan within 5 days of starting emergency repair work

If you fail to perform work as specified, the Department may perform the work and bill you.

In Section 6-1.08 delete the 2nd paragraph.

Add:

6-1.085 BUY AMERICA (23 CFR 635.410)

For a Federal-aid contract, furnish steel and iron materials to be incorporated into the work that are produced in the United States except:

1. Foreign pig iron and processed, pelletized, and reduced iron ore may be used in the domestic production of the steel and iron materials [60 Fed Reg 15478 (03/24/1995)]
2. If the total combined cost of the materials does not exceed the greater of 0.1 percent of the total bid or $2,500, material produced outside the United States may be used

Production includes:

1. Processing steel and iron materials, including smelting or other processes that alter the physical form or shape (such as rolling, extruding, machining, bending, grinding, and drilling) or chemical composition
2. Coating application, including epoxy coating, galvanizing, and painting, that protects or enhances the value of steel and iron materials

For steel and iron materials to be incorporated into the work, submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications that certifies all production processes occurred in the United States except for the above exceptions.

Add:

6-1.087 BUY AMERICA (PUB RES CODE § 42703(d))

Furnish crumb rubber to be incorporated into the work that is produced in the United States and is derived from waste tires taken from vehicles owned and operated in the United States.

For crumb rubber to be incorporated into the work, submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance," of the Standard Specifications that certifies only crumb rubber manufactured in the United States and derived from waste tires taken from vehicles owned and operated in the United States is used.

In Section 6-2.01 delete the 4th paragraph.

In Section 6-2.01 replace the 7th paragraph with:

Upon the Contractor's written request, the Department tests materials from an untested local source. If satisfactory material from that source is used in the work, the Department does not charge the Contractor for the tests; otherwise, the Department deducts the test cost.

In Section 6-2.01 delete the 8th paragraph.

In Section 6-2.02 delete the 3rd paragraph.

In Section 6-2.02 in the 7th paragraph, replace the 2nd sentence with:

The Department deducts the charges for the removed material.

In Section 6-2.03 in the 3rd paragraph, replace the 5th sentence with:

No allowance or additional compensation will be made for lost time or for delay in completing the work due to moving the Contractor's plant from the designated mandatory source to the alternative mandatory source, other than a time adjustment as specified in Section 8-1.09, "Delays."

In Section 6-3.01 delete the 4th paragraph.

In Section 6-3.01 in the 6th paragraph, delete the 1st sentence.

In Section 6-3.01 add:

As used in Section 6-3.01, "Testing," tests are tests to assure the quality and to determine the acceptability of the work.

The Department deducts costs of testing work found to be noncompliant.

^^

SECTION 7 LEGAL RELATIONS AND RESPONSIBILITY
(Issued 09-25-09)

Replace Section 7-1.01 with:

7-1.01 LAWS TO BE OBSERVED

Comply with laws, regulations, orders, decrees, and PLACs applicable to the project. Indemnify and defend the State against any claim or liability arising from the violation of a law, regulation, order, decree, or PLAC by you or your employees. Immediately report to the Engineer in writing a discrepancy or inconsistency between the contract and a law, regulation, order, decree, or PLAC.

In Section 7-1.01A replace the 1st clause with:

Work on the job site must comply with Labor Code §§ 1727 and 1770-1815 and 8 CA Code of Regs § 16000 et seq. Work includes roadside production and processing of materials.

In Section 7-1.01A(2) in the 1st paragraph, replace item 3 with:

3. Upon becoming aware of the subcontractor's failure to pay the specified prevailing rate of wages to the subcontractor's workers, the Contractor must diligently take corrective action to stop or rectify the failure, including withholding sufficient funds due the subcontractor for work performed on the public works project.

In Section 7-1.01A(2), replace the 2nd paragraph with:

Pursuant to Section 1775 of the Labor Code, the Division of Labor Standards Enforcement must notify the Contractor on a public works project within 15 days of the receipt by the Division of Labor Standards Enforcement of a complaint of the failure of a subcontractor on that public works project to pay workers the general prevailing rate of per diem wages. If the Division of Labor Standards Enforcement determines that employees of a subcontractor were not paid the general prevailing rate of per diem wages and if the Department did not withhold sufficient money under the contract to pay those employees the balance of wages owed under the general prevailing rate of per diem wages, the Contractor must withhold an amount of moneys due the subcontractor sufficient to pay those employees the general prevailing rate of per diem wages if requested by the Division of Labor Standards Enforcement. The Contractor must pay any money withheld from and owed to a subcontractor upon receipt of notification by the Division of Labor Standards Enforcement that the wage complaint has been resolved. If notice of the resolution of the wage complaint has not been received by the Contractor within 180 days of the filing of a valid notice of completion or acceptance of the public works project, whichever occurs later, the Contractor must pay all moneys withheld from the subcontractor to the Department. The Department withholds these moneys pending the final decision of an enforcement action.

In Section 7-1.01A(2) replace 7th paragraph with:

Changes in general prevailing wage determinations apply to the contract when the Director of Industrial Relations has issued them at least 10 days before advertisement (Labor Code § 1773.6 and 8 CA Code of Regs 16204).

In Section 7-1.01A(3) replace the 2nd paragraph with:

The Department withholds the penalties specified in subdivision (g) of Labor Code § 1776 for noncompliance with the requirements in Section 1776.

In Section 7-1.01A(3) replace the 4th paragraph with:

The Department withholds for delinquent or inadequate payroll records (Labor Code § 1771.5). If the Contractor has not submitted an adequate payroll record by the month's 15th day for the period ending on or before the 1st of that month, the Department withholds 10 percent of the monthly progress estimate, exclusive of mobilization. The Department does not withhold more than $10,000 or less than $1,000.

In Section 7-1.01A(3) delete the 5th paragraph.

Replace Section 7-1.01A(6) with:

7-1.01A(6) (Blank)

Replace Section 7-1.01A(7) with:

7-1.01A(7) (Blank)

Replace Section 7-1.01F with:

7-1.01F Environmental Stewardship

Comply with Section 14.

Replace Section 7-1.01I with:

7-1.01I (Blank)

In Section 7-1.02 in the 2nd paragraph, replace the 4th sentence with:

Trucks used to haul treated base, portland cement concrete, or hot mix asphalt shall enter onto the base to dump at the nearest practical entry point ahead of spreading equipment.

In Section 7-1.02 between the 4th and 5th paragraphs, add:

Loads imposed on existing, new, or partially completed structures shall not exceed the load carrying capacity of the structure or any portion of the structure as determined by AASHTO LRFD with interims and California Amendments, Design Strength Limit State II. The compressive strength of concrete (f'_c) to be used in computing the load carrying capacity shall be the smaller of the following:

1. Actual compressive strength at the time of loading
2. Value of f'_c shown on the plans for that portion of the structure or 2.5 times the value of f_c (extreme fiber compressive stress in concrete at service loads) shown on the plans for portions of the structure where no f'_c is shown

Replace Section 7-1.04 with:

7-1.04 PERMITS, LICENSES, AGREEMENTS, AND CERTIFICATIONS

7-1.04A General

Comply with PLACs. The Department makes PLAC changes under Section 4-1.03, "Changes."

7-1.04B Before Award

To make a change to a PLAC made available to you before award, submit the proposed change. The Department sends the proposed change to the appropriate authority for consideration.

7-1.04C After Award

Confirm with the Engineer which after-award PLACs are obtained by the Department and which are obtained by the Contractor.

To make a change to an after-award PLAC obtained by the Department, submit the proposed change. The Department sends the proposed change to the appropriate authority for consideration.

Obtain those PLACs to be issued to you and pay fees and costs associated with obtaining them. Submit copies of Contractor-obtained after-award PLACs for review.

In Section 7-1.06 in the 1st paragraph, add:

The Contractor's Injury and Illness Prevention Program shall be submitted to the Engineer. The program shall address the use of personal and company issued electronic devices during work. The use of entertainment and personal communication devices in the work zone shall not be allowed. Workers may use a communication device for business purposes in the work area, at a location where their safety and the safety of other workers and the traveling public is not compromised.

Replace Section 7-1.07 with:

7-1.07 Lead Compliance Plan

Section 7-1.07 applies if a bid item for a lead compliance plan is included in the Contract.

Prepare a work plan to prevent or minimize worker exposure to lead while managing and handling earth materials, paint system debris, traffic stripe residue, and pavement marking residue containing lead. Regulations containing specific Cal/OSHA requirements when working with lead include 8 CA Code of Regs § 1532.1.

The plan must contain the items listed in 8 CA Code of Regs § 1532.1(e)(2)(B). Before submittal, a CIH must sign and seal the plan. Submit the plan at least 7 days before starting any activity that presents the potential for lead exposure. The Engineer notifies you of the acceptability of the plan within 4 business days of receipt.

Before starting any activity that presents the potential for lead exposure to employees who have no prior training, including State employees, provide a safety training program to these employees that complies with 8 CA Code of Regs § 1532.1 and your lead compliance program.

Submit copies of air monitoring or job site inspection reports made by or under the direction of the CIH under 8 CA Code of Regs § 1532.1 within 10 days after the date of monitoring or inspection.

Supply personal protective equipment, training, and washing facilities required by your lead compliance plan for 5 State employees.

The contract lump sum price paid for lead compliance plan includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in preparing and implementing the plan as specified in this section.

Replace Section 7-1.08 with:

7-1.08 PUBLIC CONVENIENCE

Compliance with the provisions of this section does not relieve you of your responsibility for public safety.

Construction activities must not inconvenience the public or abutting property owners. Schedule and conduct work to avoid unnecessary inconvenience to the public and abutting property owners. Avoid undue delay in construction activities to reduce the public's exposure to construction.

Where possible, route traffic on new or existing paved surfaces.

Maintain convenient access to driveways, houses, and buildings. When the abutting property owner's access across the right of way line is to be eliminated or replaced under the contract, the existing access must not be closed until the replacement access facilities are usable. Construct temporary approaches to crossings and intersecting highways.

Provide a reasonably smooth and even surface for use by traffic at all time during excavation of roadways and construction of embankments. Before other grading activities, place fill at culverts and bridges to allow traffic to cross. If ordered, excavate roadway cuts in layers and construct embankments in partial widths at a time alternating construction from one side to the other and routing traffic over the side opposite the one under construction. Install or construct culverts on only 1/2 the width of the traveled way at a time; keep the traveled way portion being used by traffic open and unobstructed until the opposite side of the traveled way is ready for use by traffic.

Upon completion of rough grading or placing any subsequent layer, bring the surface of the roadbed to a smooth and even condition, free of humps and depressions and satisfactory for the use of the public.

After subgrade preparation for a specified layer of material has been completed, repair any damage to the roadbed or completed subgrade, including damage due to use by the public.

While subgrade and paving activities are underway, allow the public to use the shoulders. If half-width paving methods are used, allow the public to use the side of the roadbed opposite the one under construction. If enough width is available, keep open a passageway wide enough to accommodate at least 2 lanes of traffic at locations where subgrade and paving activities are underway. Shape shoulders or reshape subgrade as necessary to accommodate traffic during subgrade preparation and paving activities.

Apply water or dust palliative for the prevention or alleviation of dust nuisance.

Install signs, lights, flares, temporary railing (Type K), barricades and other facilities to direct traffic. Furnish flaggers whenever necessary to direct the movement of the public through or around the work.

You will be required to pay the cost of replacing or repairing all facilities installed under extra work for the convenience or direction or warning of the public which are lost while in your custody, or are damaged by your operations to such an extent as to require replacement or repair.

The Engineer may order or consent to your request to open a completed section of surfacing, pavement, or structure roadway surface for public use. You will not be compensated for any delay to your construction activities caused by the public. This does not relieve you from any other contractual responsibility.

Replace Section 7-1.09 with:

7-1.09 PUBLIC SAFETY

You are responsible to provide for public safety.

Do not construct a temporary facility that interferes with the safe passage of traffic.

Control dust resulting from the work, inside and outside the right-of-way.

Move workers, equipment, and materials without endangering traffic.

Whenever your operations create a condition hazardous to the public, furnish, erect and maintain those fences, temporary railing, barricades, lights, signs, and other devices and take any other necessary protective measures to prevent damage or injury to the public.

Any fences, temporary railing, barricades, lights, signs, or other devices furnished, erected and maintained by you are in addition to those for which payment is provided elsewhere in the specifications.

Provide flaggers whenever necessary to ensure that the public is given safe guidance through the work zone. Except as ordered, at locations where traffic is being routed through construction under one-way controls, move your equipment in compliance with the one-way controls.

Use of signs, lights, flags, or other protective devices must conform with the California MUTCD and as ordered. Signs, lights, flags or other protective devices must not obscure the visibility of, nor conflict in intent, meaning and function of either existing signs, lights and traffic control devices or any construction area signs or traffic control devices.

Keep existing traffic signals and highway lighting in operation. Other entities perform routine maintenance of these facilities during the work.

Cover signs that direct traffic to a closed area. Providing, maintaining, and removing the covers on construction area signs is paid as extra work under Section 4-1.03D, "Extra Work."

Install temporary illumination in a manner which the illumination and the illumination equipment does not interfere with public safety. The installation of general roadway illumination does not relieve you from furnishing and maintaining any protective devices.

Equipment must enter and leave the highway via existing ramps and crossovers and must move in the direction of public traffic. All movements of workmen and construction equipment on or across lanes open to public traffic must be performed in a manner that will not endanger the public. Your vehicles or other mobile equipment leaving an open traffic lane to enter the construction area, must slow down gradually in advance of the location of the turnoff to give traffic following an opportunity to slow down. When leaving a work area and entering a roadway carrying public traffic, your vehicles and equipment must yield to public traffic.

Immediately remove hauling spillage from roadway lanes or shoulders open to traffic. When hauling on roadways, trim loads and remove material from shelf areas to minimize spillage.

Notify the Engineer not less than 20 days and not more than 90 days before the anticipated start of an activity that will change the vertical or horizontal clearance available to public traffic, including shoulders.

If vertical clearance is temporarily reduced to 15.5 feet or less, place low clearance warning signs in accordance with the California MUTCD and as ordered. Signs must comply with the dimensions, color, and legend requirements of the California MUTCD and these specifications except that the signs must have black letters and numbers on an orange retroreflective background. W12-2P signs must be illuminated so that the signs are clearly visible.

Pave or provide full width continuous and cleared wood walks for pedestrian openings through falsework. Protect pedestrians from falling objects and curing water for concrete. Extend overhead protection for pedestrians not less than 4 feet beyond the edge of the bridge deck. Illuminate all pedestrian openings through falsework. Temporary pedestrian facilities must comply with the American with Disabilities Act of 1990 (ADA).

Do not store vehicles, material, or equipment in a way that:

1. Creates a hazard to the public
2. Obstructs traffic control devices

Do not install or place temporary facilities used to perform the work which interfere with the free and safe passage of public traffic.

If you appear to be neglectful or negligent in furnishing warning devices and taking protective measures, the Engineer may direct your attention to the existence of a hazard and the necessary warning devices must be furnished and installed and protective measures taken by you. If the Engineer points out the inadequacy of warning devices and protective measures, that action on the part of the Engineer does not relieve you from your responsibility for public safety or abrogate the obligation to furnish and pay for these devices and measures.

Install temporary railing (Type K) or other approved protection system under the following conditions:

1. Excavations: Where the near edge of the excavation is within 15 feet from the edge of an open traffic lane
2. Temporarily Unprotected Permanent Obstacles: When the work includes the installation of a fixed obstacle together with a protective system, such as a sign structure together with protective railing, and you elect to install the obstacle before installing the protective system; or you, for your convenience and as authorized, remove a portion of an existing protective railing at an obstacle and do not replace such railing completely the same day
3. Storage Areas: When material or equipment is stored within 15 feet of the edge of an open traffic lane and the storage is not otherwise prohibited by the provisions of these Standard Specifications and the special provisions
4. Height Differentials: When construction operations create a height differential greater than 0.15 feet within 15 feet of the edge of traffic lane

Temporary railing (Type K) does not need to be installed where excavations within 15 feet from edge of an open traffic lane are:

1. Covered with steel plates or concrete covers of adequate thickness to prevent accidental entry by traffic or the public
2. In side slopes, where the downhill slope is 4:1 (horizontal:vertical) or less unless a naturally occurring condition
3. Protected by existing barrier or railing

Offset the approach end of temporary railing (Type K) a minimum of 15 feet from the edge of an open traffic lane. Install the temporary railing on a skew toward the edge of the traffic lane of not more than one foot transversely to 10 feet longitudinally with respect to the edge of the traffic lane. If the 15-foot minimum offset cannot be achieved, the temporary railing must be installed on the 10 to 1 skew to obtain the maximum available offset between the approach end of the railing and the edge of the traffic lane, and an array of temporary crash cushion modules must be installed at the approach end of the temporary railing.

Secure in place temporary railing (Type K) before starting work for which the temporary railing is required.

Where 2 or more lanes in the same direction are adjacent to the area where the work is being performed, including shoulders, the adjacent lane must be closed under any of the following conditions:

1. Work is off the traveled way but within 6 feet of the edge of traveled way, and approach speed is greater than 45 miles per hour
2. Work is off the traveled way but within 3 feet of the edge of traveled way, and approach speed is less than 45 miles per hour

Closure of the adjacent traffic lane is not required when:

1. Performing work behind a barrier
2. Paving, grinding, or grooving
3. Installing, maintaining, or removing traffic control devices except temporary railing (Type K)

Do not reduce an open traffic lane width to less than 10 feet. When traffic cones or delineators are used for temporary edge delineation, the line of cones or delineators is considered the edge of the traveled way.

If a traffic lane is closed with channelizers for excavation work, move the devices to the adjacent edge of the traveled way when not excavating. Space the devices the same as specified for the lane closure.

Do not move or temporarily suspend anything over a traffic lane open to the public unless the public is protected.

Replace Section 7-1.11 with:

7-1.11 PRESERVATION OF PROPERTY

Comply with Section 5-1.18, "Property and Facility Preservation."

Replace Section 7-1.12 with:

7-1.12 INDEMNIFICATION AND INSURANCE

The Contractor's obligations regarding indemnification of the State of California and the requirements for insurance shall conform to the provisions in Section 3-1.05, "Insurance Policies," and Sections 7-1.12A, "Indemnification," and 7-1.12B, "Insurance," of this Section 7-1.12.

7-1.12A Indemnification

The Contractor shall defend, indemnify, and save harmless the State, including its officers, employees, and agents (excluding agents who are design professionals) from any and all claims, demands, causes of action, damages, costs, expenses, actual attorneys' fees, losses or liabilities, in law or in equity (Section 7-1.12A Claims) arising out of or in connection with the Contractor's performance of this contract for:

1. Bodily injury including, but not limited to, bodily injury, sickness or disease, emotional injury or death to persons, including, but not limited to, the public, any employees or agents of the Contractor, the State, or any other contractor; and
2. Damage to property of anyone including loss of use thereof; caused or alleged to be caused in whole or in part by any negligent or otherwise legally actionable act or omission of the Contractor or anyone directly or indirectly employed by the Contractor or anyone for whose acts the Contractor may be liable.

Except as otherwise provided by law, these requirements apply regardless of the existence or degree of fault of the State. The Contractor is not obligated to indemnify the State for Claims arising from conduct delineated in Civil Code Section 2782 and to Claims arising from any defective or substandard condition of the highway that existed at or before the start of work, unless this condition has been changed by the work or the scope of the work requires the Contractor to maintain existing highway facilities and the Claim arises from the Contractor's failure to maintain. The Contractor's defense and indemnity obligation shall extend to Claims arising after the work is completed and accepted if the Claims are directly related to alleged acts or omissions by the Contractor that occurred during the course of the work. State inspection is not a waiver of full compliance with these requirements.

The Contractor's obligation to defend and indemnify shall not be excused because of the Contractor's inability to evaluate liability or because the Contractor evaluates liability and determine that the Contractor is not liable. The Contractor shall respond within 30 days to the tender of any Claim for defense and indemnity by the State, unless this time has been extended by the State. If the Contractor fails to accept or reject a tender of defense and indemnity within 30 days, in addition to any other remedy authorized by law, the Department may withhold such funds the State reasonably considers necessary for its defense and indemnity until disposition has been made of the Claim or until the Contractor accepts or rejects the tender of defense, whichever occurs first.

With respect to third-party claims against the Contractor, the Contractor waives all rights of any type to express or implied indemnity against the State, its officers, employees, or agents (excluding agents who are design professionals).

Nothing in the Contract is intended to establish a standard of care owed to any member of the public or to extend to the public the status of a third-party beneficiary for any of these indemnification specifications.

7-1.12B Insurance

7-1.12B(1) General

Nothing in the contract is intended to establish a standard of care owed to any member of the public or to extend to the public the status of a third-party beneficiary for any of these insurance specifications.

7-1.12B(2) Casualty Insurance

The Contractor shall procure and maintain insurance on all of its operations with companies acceptable to the State as follows:

1. The Contractor shall keep all insurance in full force and effect from the beginning of the work through contract acceptance.
2. All insurance shall be with an insurance company with a rating from A.M. Best Financial Strength Rating of A- or better and a Financial Size Category of VII or better.

3. The Contractor shall maintain completed operations coverage with a carrier acceptable to the State through the expiration of the patent deficiency in construction statute of repose set forth in Code of Civil Procedure Section 337.1.

7-1.12B(3) Workers' Compensation and Employer's Liability Insurance

In accordance with Labor Code Section 1860, the Contractor shall secure the payment of worker's compensation in accordance with Labor Code Section 3700.

In accordance with Labor Code Section 1861, the Contractor shall submit to the Department the following certification before performing the work:

> I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract.

Contract execution constitutes certification submittal.

The Contractor shall provide Employer's Liability Insurance in amounts not less than:

1. $1,000,000 for each accident for bodily injury by accident
2. $1,000,000 policy limit for bodily injury by disease
3. $1,000,000 for each employee for bodily injury by disease

If there is an exposure of injury to the Contractor's employees under the U.S. Longshoremen's and Harbor Workers' Compensation Act, the Jones Act, or under laws, regulations, or statutes applicable to maritime employees, coverage shall be included for such injuries or claims.

7-1.12B(4) Liability Insurance

7-1.12B(4)(a) General

The Contractor shall carry General Liability and Umbrella or Excess Liability Insurance covering all operations by or on behalf of the Contractor providing insurance for bodily injury liability and property damage liability for the following limits and including coverage for:

1. Premises, operations, and mobile equipment
2. Products and completed operations
3. Broad form property damage (including completed operations)
4. Explosion, collapse, and underground hazards
5. Personal injury
6. Contractual liability

7-1.12B(4)(b) Liability Limits/Additional Insureds

The limits of liability shall be at least the amounts shown in the following table:

Total Bid	For Each Occurrence[1]	Aggregate for Products/Completed Operation	General Aggregate[2]	Umbrella or Excess Liability[3]
≤$1,000,000	$1,000,000	$2,000,000	$2,000,000	$5,000,000
>$1,000,000 ≤$10,000,000	$1,000,000	$2,000,000	$2,000,000	$10,000,000
>$10,000,000 ≤$25,000,000	$2,000,000	$2,000,000	$4,000,000	$15,000,000
>$25,000,000	$2,000,000	$2,000,000	$4,000,000	$25,000,000

1. Combined single limit for bodily injury and property damage.
2. This limit shall apply separately to the Contractor's work under this contract.
3. The umbrella or excess policy shall contain a clause stating that it takes effect (drops down) in the event the primary limits are impaired or exhausted.

The Contractor shall not require certified Small Business subcontractors to carry Liability Insurance that exceeds the limits in the table above. Notwithstanding the limits specified herein, at the option of the Contractor, the liability insurance limits for certified Small Business subcontractors of any tier may be less than those limits specified in the table. For Small Business subcontracts, "Total Bid" shall be interpreted as the amount of subcontracted work to a certified Small Business.

The State, including its officers, directors, agents (excluding agents who are design professionals), and employees, shall be named as additional insureds under the General Liability and Umbrella Liability Policies with respect to liability arising out of or connected with work or operations performed by or on behalf of the Contractor under this contract. Coverage for such additional insureds does not extend to liability:

1. Arising from any defective or substandard condition of the roadway which existed at or before the time the Contractor started work, unless such condition has been changed by the work or the scope of the work requires the Contractor to maintain existing roadway facilities and the claim arises from the Contractor's failure to maintain;
2. For claims occurring after the work is completed and accepted unless these claims are directly related to alleged acts or omissions of the Contractor that occurred during the course of the work; or
3. To the extent prohibited by Insurance Code Section 11580.04

Additional insured coverage shall be provided by a policy provision or by an endorsement providing coverage at least as broad as Additional Insured (Form B) endorsement form CG 2010, as published by the Insurance Services Office (ISO), or other form designated by the Department.

7-1.12B(4)(c) Contractor's Insurance Policy is Primary

The policy shall stipulate that the insurance afforded the additional insureds applies as primary insurance. Any other insurance or self-insurance maintained by the State is excess only and shall not be called upon to contribute with this insurance.

7-1.12B(5) Automobile Liability Insurance

The Contractor shall carry automobile liability insurance, including coverage for all owned, hired, and nonowned automobiles. The primary limits of liability shall be not less than $1,000,000 combined single limit each accident for bodily injury and property damage. The umbrella or excess liability coverage required under Section 7-1.12B(4)(b) also applies to automobile liability.

7-1.12B(6) Policy Forms, Endorsements, and Certificates

The Contractor shall provide its General Liability Insurance under Commercial General Liability policy form No. CG0001 as published by the Insurance Services Office (ISO) or under a policy form at least as broad as policy form No. CG0001.

7-1.12B(7) Deductibles

The State may expressly allow deductible clauses, which it does not consider excessive, overly broad, or harmful to the interests of the State. Regardless of the allowance of exclusions or deductions by the State, the Contractor is responsible for any deductible amount and shall warrant that the coverage provided to the State is in accordance with Section 7-1.12B, "Insurance."

7-1.12B(8) Enforcement

The Department may assure the Contractor's compliance with its insurance obligations. Ten days before an insurance policy lapses or is canceled during the contract period, the Contractor shall submit to the Department evidence of renewal or replacement of the policy.

If the Contractor fails to maintain any required insurance coverage, the Department may maintain this coverage and withhold or charge the expense to the Contractor or terminate the Contractor's control of the work in accordance with Section 8-1.08, "Termination of Control."

The Contractor is not relieved of its duties and responsibilities to indemnify, defend, and hold harmless the State, its officers, agents, and employees by the Department's acceptance of insurance policies and certificates.

Minimum insurance coverage amounts do not relieve the Contractor for liability in excess of such coverage, nor do they preclude the State from taking other actions available to it, including the withholding of funds under this contract.

7-1.12B(9) Self-Insurance

Self-insurance programs and self-insured retentions in insurance policies are subject to separate annual review and approval by the State.

If the Contractor uses a self-insurance program or self-insured retention, the Contractor shall provide the State with the same protection from liability and defense of suits as would be afforded by first-dollar insurance. Execution of the contract is the Contractor's acknowledgement that the Contractor will be bound by all laws as if the Contractor were an insurer as defined under Insurance Code Section 23 and that the self-insurance program or self-insured retention shall operate as insurance as defined under Insurance Code Section 22.

Replace Section 7-1.125 with:

7-1.125 Legal Actions Against the Department

If legal action is brought against the Department over compliance with a State or Federal law, rule, or regulation applicable to highway work, then:

1. If the Department, in complying with a court order, prohibits you from performing work, the resulting delay is a suspension related to your performance, unless the Department terminates the contract.
2. If a court order other than an order to show cause or the final judgment in the action prohibits the Department from requiring you to perform work, the Department may delete the prohibited work or terminate the contract.

In Section 7-1.13 delete the 5th and 6th paragraphs.

Add:

7-1.50 FEDERAL LAWS FOR FEDERAL-AID CONTRACTS

7-1.50A General

Section 7-1.50, "Federal Laws for Federal-Aid Contracts," includes specifications required in a Federal-aid construction contract and applies to a Federal-aid contract.

Form FHWA-1273 is included in the contract in Section 7-1.50B, "FHWA-1273." Some contract terms on the form are different than those used in other contract parts as shown in the following table:

FHWA-1273 Terms and Department Equivalencies

FHWA-1273 Term	Equivalent Term Used in Other Contract Parts
SHA	Department
SHA contracting officer	Engineer
SHA resident engineer	Engineer

7-1.50B FHWA-1273

FHWA-1273 Electronic version -- March 10, 1994
with revised Section VI

REQUIRED CONTRACT PROVISIONS FEDERAL-AID CONSTRUCTION CONTRACTS

I. General
II. Nondiscrimination
III. Nonsegregated Facilities
IV. Payment of Predetermined Minimum Wage
V. Statements and Payrolls
VI. Record of Materials, Supplies, and Labor
VII. Subletting or Assigning the Contract
VIII. Safety: Accident Prevention
IX. False Statements Concerning Highway Projects
X. Implementation of Clean Air Act and Federal Water Pollution Control Act
XI. Certification Regarding Debarment, Suspension, Ineligibility, and Voluntary Exclusion
XII. Certification Regarding Use of Contract Funds for Lobbying

ATTACHMENTS

A. Employment Preference for Appalachian Contracts (included in Appalachian contracts only)

I. GENERAL

1. These contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.
2. Except as otherwise provided for in each section, the contractor shall insert in each subcontract all of the stipulations contained in these Required Contract Provisions, and further require their inclusion in any lower tier subcontract or purchase order that may in turn be made. The Required Contract Provisions shall not be incorporated by reference in any case. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with these Required Contract Provisions.
3. A breach of any of the stipulations contained in these Required Contract Provisions shall be sufficient grounds for termination of the contract.
4. A breach of the following clauses of the Required Contract Provisions may also be grounds for debarment as provided in 29 CFR 5.12:

   Section I, paragraph 2;
   Section IV, paragraphs 1, 2, 3, 4, and 7;
   Section V, paragraphs 1 and 2a through 2g.

5. Disputes arising out of the labor standards provisions of Section IV (except paragraph 5) and Section V of these Required Contract Provisions shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the U.S. Department of Labor (DOL) as set forth in 29 CFR 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the DOL, or the contractor's employees or their representatives.
6. **Selection of Labor:** During the performance of this contract, the contractor shall not:

   a. discriminate against labor from any other State, possession, or territory of the United States (except for employment preference for Appalachian contracts, when applicable, as specified in Attachment A), or
   b. employ convict labor for any purpose within the limits of the project unless it is labor performed by convicts who are on parole, supervised release, or probation.

II. NONDISCRIMINATION

(Applicable to all Federal-aid construction contracts and to all related subcontracts of $10,000 or more.)

1. **Equal Employment Opportunity:** Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630 and 41 CFR 60) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The Equal Opportunity Construction Contract Specifications set forth under 41 CFR 60-4.3 and the provisions of the American Disabilities Act of 1990 (42 U.S.C. 12101 *et seq*.) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

   a. The contractor will work with the State highway agency (SHA) and the Federal Government in carrying out EEO obligations and in their review of his/her activities under the contract.
   b. The contractor will accept as his operating policy the following statement:

      "It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, preapprenticeship, and/or on-the-job training."

2. **EEO Officer:** The contractor will designate and make known to the SHA contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active contractor program of EEO and who must be assigned adequate authority and responsibility to do so.

3. **Dissemination of Policy:** All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

   a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.
   b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.
   c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minority group employees.
   d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.
   e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

4. **Recruitment:** When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minority groups in the area from which the project work force would normally be derived.

   a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minority group applicants. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority group applicants may be referred to the contractor for employment consideration.
   b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, he is expected to observe the provisions of that agreement to the extent that the system permits the contractor's compliance with EEO contract provisions. (The DOL has held that where implementation of such agreements have the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Executive Order 11246, as amended.)
   c. The contractor will encourage his present employees to refer minority group applicants for employment. Information and procedures with regard to referring minority group applicants will be discussed with employees.

5. **Personnel Actions:** Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:

   a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.
   b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.
   c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.
   d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with his obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of his avenues of appeal.

6. **Training and Promotion:**

   a. The contractor will assist in locating, qualifying, and increasing the skills of minority group and women employees, and applicants for employment.
   b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision.
   c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.
   d. The contractor will periodically review the training and promotion potential of minority group and women employees and will encourage eligible employees to apply for such training and promotion.

7. **Unions**: If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use his/her best efforts to obtain the cooperation of such unions to increase opportunities for minority groups and women within the unions, and to effect referrals by such unions of minority and female employees. Actions by the contractor either directly or through a contractor's association acting as agent will include the procedures set forth below:

   a. The contractor will use best efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minority group members and women for membership in the unions and increasing the skills of minority group employees and women so that they may qualify for higher paying employment.
   b. The contractor will use best efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.
   c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the SHA and shall set forth what efforts have been made to obtain such information.
   d. In the event the union is unable to provide the contractor with a reasonable flow of minority and women referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifiable minority group persons and women. (The DOL has held that it shall be no excuse that the union with which the contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority employees.) In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these specifications, such contractor shall immediately notify the SHA.

8. **Selection of Subcontractors, Procurement of Materials and Leasing of Equipment:** The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment.

   a. The contractor shall notify all potential subcontractors and suppliers of his/her EEO obligations under this contract.
   b. Disadvantaged business enterprises (DBE), as defined in 49 CFR 23, shall have equal opportunity to compete for and perform subcontracts which the contractor enters into pursuant to this contract. The contractor will use his best efforts to solicit bids from and to utilize DBE subcontractors or subcontractors with meaningful minority group and female representation among their employees. Contractors shall obtain lists of DBE construction firms from SHA personnel.
   c. The contractor will use his best efforts to ensure subcontractor compliance with their EEO obligations.

9. **Records and Reports:** The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following completion of the contract work and shall be available at reasonable times and places for inspection by authorized representatives of the SHA and the FHWA.

a. The records kept by the contractor shall document the following:

1. The number of minority and non-minority group members and women employed in each work classification on the project;
2. The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women;
3. The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minority and female employees; and
4. The progress and efforts being made in securing the services of DBE subcontractors or subcontractors with meaningful minority and female representation among their employees.

b. The contractors will submit an annual report to the SHA each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form FHWA-1391. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data.

III. NONSEGREGATED FACILITIES

(Applicable to all Federal-aid construction contracts and to all related subcontracts of $10,000 or more.)

a. By submission of this bid, the execution of this contract or subcontract, or the consummation of this material supply agreement or purchase order, as appropriate, the bidder, Federal-aid construction contractor, subcontractor, material supplier, or vendor, as appropriate, certifies that the firm does not maintain or provide for its employees any segregated facilities at any of its establishments, and that the firm does not permit its employees to perform their services at any location, under its control, where segregated facilities are maintained. The firm agrees that a breach of this certification is a violation of the EEO provisions of this contract. The firm further certifies that no employee will be denied access to adequate facilities on the basis of sex or disability.

b. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, timeclocks, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive, or are, in fact, segregated on the basis of race, color, religion, national origin, age or disability, because of habit, local custom, or otherwise. The only exception will be for the disabled when the demands for accessibility override (e.g. disabled parking).

c. The contractor agrees that it has obtained or will obtain identical certification from proposed subcontractors or material suppliers prior to award of subcontracts or consummation of material supply agreements of $10,000 or more and that it will retain such certifications in its files.

IV. PAYMENT OF PREDETERMINED MINIMUM WAGE

(Applicable to all Federal-aid construction contracts exceeding $2,000 and to all related subcontracts, except for projects located on roadways classified as local roads or rural minor collectors, which are exempt.)

1. **General:**

a. All mechanics and laborers employed or working upon the site of the work will be paid unconditionally and not less often than once a week and without subsequent deduction or rebate on any account [except such payroll deductions as are permitted by regulations (29 CFR 3) issued by the Secretary of Labor under the Copeland Act (40 U.S.C. 276c)] the full amounts of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment. The payment shall be computed at wage rates not less than those contained in the wage determination of the Secretary of Labor (hereinafter "the wage determination") which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor or its subcontractors and such laborers and mechanics. The wage determination (including any additional classifications and wage rates conformed under paragraph 2 of this Section IV and the DOL poster (WH-1321) or Form FHWA-1495) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers. For the purpose of this Section, contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1(b)(2) of the Davis- Bacon Act (40 U.S.C. 276a) on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of Section IV, paragraph 3b, hereof. Also, for the purpose of this Section, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs, which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in paragraphs 4 and 5 of this Section IV.

b. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein, provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed.
c. All rulings and interpretations of the Davis-Bacon Act and related acts contained in 29 CFR 1, 3, and 5 are herein incorporated by reference in this contract.

2. **Classification:**

a. The SHA contracting officer shall require that any class of laborers or mechanics employed under the contract, which is not listed in the wage determination, shall be classified in conformance with the wage determination.
b. The contracting officer shall approve an additional classification, wage rate and fringe benefits only when the following criteria have been met:

1. the work to be performed by the additional classification requested is not performed by a classification in the wage determination;
2. the additional classification is utilized in the area by the construction industry;
3. the proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination; and
4. with respect to helpers, when such a classification prevails in the area in which the work is performed.

c. If the contractor or subcontractors, as appropriate, the laborers and mechanics (if known) to be employed in the additional classification or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the DOL, Administrator of the Wage and Hour Division, Employment Standards Administration, Washington, D.C. 20210. The Wage and Hour Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
d. In the event the contractor or subcontractors, as appropriate, the laborers or mechanics to be employed in the additional classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. Said Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
e. The wage rate (including fringe benefits where appropriate) determined pursuant to paragraph 2c or 2d of this Section IV shall be paid to all workers performing work in the additional classification from the first day on which work is performed in the classification.

3. **Payment of Fringe Benefits:**

a. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor or subcontractors, as appropriate, shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly case equivalent thereof.
b. If the contractor or subcontractor, as appropriate, does not make payments to a trustee or other third person, he/she may consider as a part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, provided, that the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

4. **Apprentices and Trainees (Programs of the U.S. DOL) and Helpers:**

a. Apprentices:

1. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the DOL, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State apprenticeship agency recognized by the Bureau, or if a person is employed in his/her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State apprenticeship agency (where appropriate) to be eligible for probationary employment as an apprentice.
2. The allowable ratio of apprentices to journeyman-level employees on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any employee listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate listed in the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor or subcontractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman-level hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.
3. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman-level hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator for the Wage and Hour Division determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.
4. In the event the Bureau of Apprenticeship and Training, or a State apprenticeship agency recognized by the Bureau, withdraws approval of an apprenticeship program, the contractor or subcontractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the comparable work performed by regular employees until an acceptable program is approved.

b. Trainees:

1. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the DOL, Employment and Training Administration.
2. The ratio of trainees to journeyman-level employees on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.
3. Every trainee must be paid at not less than the rate specified in the approved program for his/her level of progress, expressed as a percentage of the journeyman-level hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman-level wage rate on the wage determination which provides for less than full fringe benefits for apprentices, in which case such trainees shall receive the same fringe benefits as apprentices.
4. In the event the Employment and Training Administration withdraws approval of a training program, the contractor or subcontractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Helpers:

Helpers will be permitted to work on a project if the helper classification is specified and defined on the applicable wage determination or is approved pursuant to the conformance procedure set forth in Section IV.2. Any worker listed on a payroll at a helper wage rate, who is not a helper under an approved definition, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed.

5. **Apprentices and Trainees (Programs of the U.S. DOT):**

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

6. **Withholding:**

The SHA shall upon its own action or upon written request of an authorized representative of the DOL withhold, or cause to be withheld, from the contractor or subcontractor under this contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements which is held by the same prime contractor, as much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the SHA contracting officer may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

7. **Overtime Requirements:**

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers, mechanics, watchmen, or guards (including apprentices, trainees, and helpers described in paragraphs 4 and 5 above) shall require or permit any laborer, mechanic, watchman, or guard in any workweek in which he/she is employed on such work, to work in excess of 40 hours in such workweek unless such laborer, mechanic, watchman, or guard receives compensation at a rate not less than one-and-one-half times his/her basic rate of pay for all hours worked in excess of 40 hours in such workweek.

8. **Violation:**

Liability for Unpaid Wages; Liquidated Damages: In the event of any violation of the clause set forth in paragraph 7 above, the contractor and any subcontractor responsible thereof shall be liable to the affected employee for his/her unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory) for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer, mechanic, watchman, or guard employed in violation of the clause set forth in paragraph 7, in the sum of $10 for each calendar day on which such employee was required or permitted to work in excess of the standard work week of 40 hours without payment of the overtime wages required by the clause set forth in paragraph 7.

9. **Withholding for Unpaid Wages and Liquidated Damages:**

The SHA shall upon its own action or upon written request of any authorized representative of the DOL withhold, or cause to be withheld, from any monies payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to the contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph 8 above.

V. STATEMENTS AND PAYROLLS

(Applicable to all Federal-aid construction contracts exceeding $2,000 and to all related subcontracts, except for projects located on roadways classified as local roads or rural collectors, which are exempt.)

1. **Compliance with Copeland Regulations (29 CFR 3):**

The contractor shall comply with the Copeland Regulations of the Secretary of Labor which are herein incorporated by reference.

2. **Payrolls and Payroll Records:**

a. Payrolls and basic records relating thereto shall be maintained by the contractor and each subcontractor during the course of the work and preserved for a period of 3 years from the date of completion of the contract for all laborers, mechanics, apprentices, trainees, watchmen, helpers, and guards working at the site of the work.

b. The payroll records shall contain the name, social security number, and address of each such employee; his or her correct classification; hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalent thereof the types described in Section 1(b)(2)(B) of the Davis Bacon Act); daily and weekly number of hours worked; deductions made; and actual wages paid. In addition, for Appalachian contracts, the payroll records shall contain a notation indicating whether the employee does, or does not, normally reside in the labor area as defined in Attachment A, paragraph 1. Whenever the Secretary of Labor, pursuant to Section IV, paragraph 3b, has found that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section 1(b)(2)(B) of the Davis Bacon Act, the contractor and each subcontractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, that the plan or program has been communicated in writing to the laborers or mechanics affected, and show the cost anticipated or the actual cost incurred in providing benefits. Contractors or subcontractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprentices and trainees, and ratios and wage rates prescribed in the applicable programs.

c. Each contractor and subcontractor shall furnish, each week in which any contract work is performed, to the SHA resident engineer a payroll of wages paid each of its employees (including apprentices, trainees, and helpers, described in Section IV, paragraphs 4 and 5, and watchmen and guards engaged on work during the preceding weekly payroll period). The payroll submitted shall set out accurately and completely all of the information required to be maintained under paragraph 2b of this Section V. This information may be submitted in any form desired. Optional Form WH-347 is available for this purpose and may be purchased from the Superintendent of Documents (Federal stock number 029- 005-0014-1), U.S. Government Printing Office, Washington, D.C. 20402. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors.

d. Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his/her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

   1. that the payroll for the payroll period contains the information required to be maintained under paragraph 2b of this Section V and that such information is correct and complete;
   2. that such laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in the Regulations, 29 CFR 3;
   3. that each laborer or mechanic has been paid not less that the applicable wage rate and fringe benefits or cash equivalent for the classification of worked performed, as specified in the applicable wage determination incorporated into the contract.

e. The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 2d of this Section V.

f. The falsification of any of the above certifications may subject the contractor to civil or criminal prosecution under 18 U.S.C. 1001 and 31 U.S.C. 231.

g. The contractor or subcontractor shall make the records required under paragraph 2b of this Section V available for inspection, copying, or transcription by authorized representatives of the SHA, the FHWA, or the DOL, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the SHA, the FHWA, the DOL, or all may, after written notice to the contractor, sponsor, applicant, or owner, take such actions as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

VI. RECORD OF MATERIALS, SUPPLIES, AND LABOR

(As of May 22, 2007, Form FHWA-47 is no longer required.)

VII. SUBLETTING OR ASSIGNING THE CONTRACT

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the State. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635).

   a. "Its own organization" shall be construed to include only workers employed and paid directly by the prime contractor and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor, assignee, or agent of the prime contractor.
   b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph 1 of Section VII is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.
3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the SHA contracting officer determines is necessary to assure the performance of the contract.
4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the SHA contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the SHA has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

VIII. SAFETY: ACCIDENT PREVENTION

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the SHA contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.
2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 333).
3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 333).

IX. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by Engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, the following notice shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

NOTICE TO ALL PERSONNEL ENGAGED ON FEDERAL-AID HIGHWAY PROJECTS

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined not more that $10,000 or imprisoned not more than 5 years or both."

X. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

(Applicable to all Federal-aid construction contracts and to all related subcontracts of $100,000 or more.)

By submission of this bid or the execution of this contract, or subcontract, as appropriate, the bidder, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any facility that is or will be utilized in the performance of this contract, unless such contract is exempt under the Clean Air Act, as amended (42 U.S.C. 1857 *et seq*., as amended by Pub.L. 91-604), and under the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 *et seq*., as amended by Pub.L. 92-500), Executive Order 11738, and regulations in implementation thereof (40 CFR 15) is not listed, on the date of contract award, on the U.S. Environmental Protection Agency (EPA) List of Violating Facilities pursuant to 40 CFR 15.20.
2. That the firm agrees to comply and remain in compliance with all the requirements of Section 114 of the Clean Air Act and Section 308 of the Federal Water Pollution Control Act and all regulations and guidelines listed thereunder.
3. That the firm shall promptly notify the SHA of the receipt of any communication from the Director, Office of Federal Activities, EPA, indicating that a facility that is or will be utilized for the contract is under consideration to be listed on the EPA List of Violating Facilities.
4. That the firm agrees to include or cause to be included the requirements of paragraph 1 through 4 of this Section X in every nonexempt subcontract, and further agrees to take such action as the government may direct as a means of enforcing such requirements.

XI. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

1. **Instructions for Certification - Primary Covered Transactions:**

(Applicable to all Federal-aid contracts - 49 CFR 29)

a. By signing and submitting this proposal, the prospective primary participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective primary participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the department or agency determined to enter into this transaction. If it is later determined that the prospective primary participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause of default.

d. The prospective primary participant shall provide immediate written notice to the department or agency to whom this proposal is submitted if any time the prospective primary participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "lower tier covered transaction," "participant," "person," "primary covered transaction," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the department or agency to which this proposal is submitted for assistance in obtaining a copy of those regulations.

f. The prospective primary participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.

g. The prospective primary participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," provided by the department or agency entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the nonprocurement portion of the "Lists of Parties Excluded From Federal Procurement or Nonprocurement Programs" (Nonprocurement List) which is compiled by the General Services Administration.

i. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph f of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Primary Covered Transactions

1. The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:

a. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
b. Have not within a 3-year period preceding this proposal been convicted of or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
c. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph 1b of this certification; and
d. Have not within a 3-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

2. Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

* * * * *

2. **Instructions for Certification - Lower Tier Covered Transactions:**

(Applicable to all subcontracts, purchase orders and other lower tier transactions of $25,000 or more - 49 CFR 29)
a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.
b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.
c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.
d. The terms "covered transaction," "debarred," "suspended," "ineligible," "primary covered transaction," "participant," "person," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.
e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.
f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.
g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the Nonprocurement List.
h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Covered Transactions:

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.
2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

* * * * *

XII. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

(Applicable to all Federal-aid construction contracts and to all related subcontracts which exceed $100,000 - 49 CFR 20)

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

   a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
   b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.
3. The prospective participant also agrees by submitting his or her bid or proposal that he or she shall require that the language of this certification be included in all lower tier subcontracts, which exceed $100,000 and that all such recipients shall certify and disclose accordingly.

7-1.50C Female and Minority Goals

To comply with Section II, "Nondiscrimination," of "Required Contract Provisions Federal-Aid Construction Contracts," the Department is including in Section 7-1.50C, "Female and Minority Goals," female and minority utilization goals for Federal-aid construction contracts and subcontracts that exceed $10,000.

The nationwide goal for female utilization is 6.9 percent.

The goals for minority utilization [45 Fed Reg 65984 (10/3/1980)] are as follows:

Minority Utilization Goals

	Economic Area	Goal (Percent)
174	Redding CA: Non-SMSA Counties: CA Lassen; CA Modoc; CA Plumas; CA Shasta; CA Siskiyou; CA Tehema	6.8
175	Eureka, CA Non-SMSA Counties: CA Del Norte; CA Humboldt; CA Trinity	6.6
176	San Francisco-Oakland-San Jose, CA: SMSA Counties: 7120 Salinas-Seaside-Monterey, CA CA Monterey 7360 San Francisco-Oakland CA Alameda; CA Contra Costa; CA Marin; CA San Francisco; CA San Mateo 7400 San Jose, CA CA Santa Clara, CA 7485 Santa Cruz, CA CA Santa Cruz 7500 Santa Rosa CA Sonoma 8720 Vallejo-Fairfield-Napa, CA CA Napa; CA Solano Non-SMSA Counties: CA Lake; CA Mendocino; CA San Benito	 28.9 25.6 19.6 14.9 9.1 17.1 23.2
177	Sacramento, CA: SMSA Counties: 6920 Sacramento, CA CA Placer; CA Sacramento; CA Yolo Non-SMSA Counties CA Butte; CA Colusa; CA El Dorado; CA Glenn; CA Nevada; CA Sierra; CA Sutter; CA Yuba	 16.1 14.3
178	Stockton-Modesto, CA: SMSA Counties: 5170 Modesto, CA CA Stanislaus 8120 Stockton, CA CA San Joaquin Non-SMSA Counties CA Alpine; CA Amador; CA Calaveras; CA Mariposa; CA Merced; CA Toulumne	 12.3 24.3 19.8
179	Fresno-Bakersfield, CA SMSA Counties: 0680 Bakersfield, CA CA Kern 2840 Fresno, CA CA Fresno Non-SMSA Counties: CA Kings; CA Madera; CA Tulare	 19.1 26.1 23.6
180	Los Angeles, CA: SMSA Counties: 0360 Anaheim-Santa Ana-Garden Grove, CA CA Orange 4480 Los Angeles-Long Beach, CA CA Los Angeles 6000 Oxnard-Simi Valley-Ventura, CA CA Ventura 6780 Riverside-San Bernardino-Ontario, CA CA Riverside; CA San Bernardino	 11.9 28.3 21.5 19.0

	7480 Santa Barbara-Santa Maria-Lompoc, CA CA Santa Barbara Non-SMSA Counties CA Inyo; CA Mono; CA San Luis Obispo	19.7 24.6
181	San Diego, CA: SMSA Counties 7320 San Diego, CA CA San Diego Non-SMSA Counties CA Imperial	 16.9 18.2

For each July during which work is performed under the contract, you and each non-material-supplier subcontractor with a subcontract of $10,000 or more must complete Form FHWA PR-1391 (Appendix C to 23 CFR 230). Submit the forms by August 15.

7-1.50D Training

Section 7-1.50D, "Training," applies if a number of trainees or apprentices is specified in the special provisions.

As part of your equal opportunity affirmative action program, provide on-the-job training to develop full journeymen in the types of trades or job classifications involved.

You have primary responsibility for meeting this training requirement.

If you subcontract a contract part, determine how many trainees or apprentices are to be trained by the subcontractor.

Include these training requirements in your subcontract.

Where feasible, 25 percent of apprentices or trainees in each occupation must be in their 1st year of apprenticeship or training.

Distribute the number of apprentices or trainees among the work classifications on the basis of your needs and the availability of journeymen in the various classifications within a reasonable recruitment area.

Before starting work, submit to the Department:

1. Number of apprentices or trainees to be trained for each classification
2. Training program to be used
3. Training starting date for each classification

Obtain the Department's approval for this submitted information before you start work. The Department credits you for each apprentice or trainee you employ on the work who is currently enrolled or becomes enrolled in an approved program.

The primary objective of Section 7-1.50D, "Training," is to train and upgrade minorities and women toward journeymen status. Make every effort to enroll minority and women apprentices or trainees, such as conducting systematic and direct recruitment through public and private sources likely to yield minority and women apprentices or trainees, to the extent they are available within a reasonable recruitment area. Show that you have made the efforts. In making these efforts, do not discriminate against any applicant for training.

Do not employ as an apprentice or trainee an employee:

1. In any classification in which the employee has successfully completed a training course leading to journeyman status or in which the employee has been employed as a journeyman
2. Who is not registered in a program approved by the US Department of Labor, Bureau of Apprenticeship and Training

Ask the employee if the employee has successfully completed a training course leading to journeyman status or has been employed as a journeyman. Your records must show the employee's answers to the questions.

In your training program, establish the minimum length and training type for each classification. The Department and FHWA approves a program if one of the following is met:

1. It is calculated to:

    1.1. Meet the your equal employment opportunity responsibilities
    1.2. Qualify the average apprentice or trainee for journeyman status in the classification involved by the end of the training period

2. It is registered with the U.S. Department of Labor, Bureau of Apprenticeship and Training and it is administered in a way consistent with the equal employment responsibilities of federal-aid highway construction contracts

Obtain the State's approval for your training program before you start work involving the classification covered by the program.

Provide training in the construction crafts, not in clerk-typist or secretarial-type positions. Training is allowed in lower level management positions such as office engineers, estimators, and timekeepers if the training is oriented toward construction applications. Training is allowed in the laborer classification if significant and meaningful training is provided and approved by the division office. Off-site training is allowed if the training is an integral part of an approved training program and does not make up a significant part of the overall training.

The Department reimburses you 80 cents per hour of training given an employee on this contract under an approved training program:

1. For on-site training
2. For off-site training if the apprentice or trainee is currently employed on a federal-aid project and you do at least one of the following:

    2.1. Contribute to the cost of the training
    2.2. Provide the instruction to the apprentice or trainee
    2.3. Pay the apprentice's or trainee's wages during the off-site training period

3. If you comply with Section 7-1.50D, "Training"

Each apprentice or trainee must:

1. Begin training on the project as soon as feasible after the start of work involving the apprentice's or trainee's skill
2. Remain on the project as long as training opportunities exist in the apprentice's or trainee's work classification or until the apprentice or trainee has completed the training program

Furnish the apprentice or trainee:

1. Copy of the program you will comply with in providing the training
2. Certification showing the type and length of training satisfactorily completed

Maintain records and submit reports documenting your performance under Section 7-1.50D, "Training."

^^

SECTION 8 PROSECUTION AND PROGRESS
(Issued 06-05-09)

Replace Section 8 with:

SECTION 8 PROSECUTION AND PROGRESS

8-1.01 (BLANK)

8-1.02 ASSIGNMENT

No third-party agreement relieves you or your surety of your responsibility to complete the work. Do not sell, transfer, or otherwise dispose of any contract part without prior written consent from the Department.

If you assign the right to receive contract payments, the Department accepts the assignment upon the Engineer's receipt of a notice. Assigned payments remain subject to deductions and withholds described in the contract. The Department may use withheld payments for work completion whether payments are assigned or not.

8-1.025 PRECONSTRUCTION CONFERENCE

Attend a preconstruction conference with key personnel, including your assigned representative, at a time and location determined by the Engineer. Submit documents as required before the preconstruction conference. You may begin work before the preconstruction conference.

Be prepared to discuss the following topics and documents:

Topics	Document
Potential claim and dispute resolution	Potential claim forms
Contractor's representation	Assignment of Contractor's representative
DBE and DVBE	Final utilization reports
Equipment	Equipment list
Labor compliance and equal employment opportunity	Job site posters and benefit and payroll reports
Material inspection	Notice of Materials to be Used
Materials on hand	Request for Payment for Materials on Hand
Measurements	--
Partnering	Field Guide to Partnering on Caltrans Construction Projects
Quality control	QC plans
Safety	Injury and Illness Prevention Program and job site posters
Schedule	Baseline schedule and Weekly Statement of Working Days
Subcontracting	Subcontracting Request
Surveying	Survey Request
Traffic control	Traffic contingency plan and traffic control plans
Utility work	--
Weight limitations	--
Water pollution control	SWPPP or WPCP
Work restrictions	PLACs
Working drawings	--

8-1.03 BEGINNING OF WORK

Begin work within 15 days after receiving notice that the contract has been approved by the Attorney General or the attorney appointed and authorized to represent the Department. Submit a written notice 72 hours before beginning work. If the project has more than one location of work, submit a separate notice for each location.

You may begin work before receiving the notice of contract approval if you:

1. Deliver the signed contract, bonds, and evidence of insurance to the Department
2. Submit 72-hour notice
3. Obtain an encroachment permit from the Department
4. Are authorized by the Department to begin
5. Perform work at your own risk
6. Perform work under the contract

The Engineer does not count working days for days worked before contract approval.

If the contract is approved, work already performed that complies with the contract is authorized.

If the contract does not get approved, leave the job site in a neat condition. If a facility has been changed, restore it to its former or equivalent condition at your expense.

The Department does not adjust time for beginning before the approval date.

8-1.04 PROGRESS SCHEDULE

8-1.04A General

Reserved

8-1.04B Critical Path Method Schedule

The following definitions apply to critical path method schedules:

activity: Task, event, or other project element on a schedule that contributes to completing the project. Activities have a description, start date, finish date, duration, and one or more logic ties.

baseline schedule: The initial schedule showing the original work plan beginning on the date of contract approval. This schedule shows no completed work to date and no negative float or negative lag to any activity.

controlling activity: Construction activity that extends the scheduled completion date if delayed.

critical path: Longest continuous chain of activities for the project that has the least amount of total float of all chains. In general, a delay on the critical path extends the scheduled completion date.

critical path method (CPM): Network based planning technique using activity durations and relationships between activities to calculate a schedule for the entire project.
revised schedule: Schedule that incorporates a proposed or past change to logic or activity durations.
scheduled completion date: Planned project completion date shown on the current schedule.
updated schedule: Current schedule developed from the accepted baseline and any subsequent accepted updated or revised schedules through regular monthly review to incorporate actual past progress.

Before or at the preconstruction conference, submit a CPM baseline schedule.

Submit a monthly updated schedule that includes the status of work completed to date and the work yet to be performed as planned.

On each schedule, show:

1. Planned and actual start and completion date of each work activity, including applicable:

    1.1. Submittal development
    1.2. Submittal review and approval
    1.3. Material procurement
    1.4. Contract milestones and constraints
    1.5. Equipment and plant setup
    1.6. Interfaces with outside entities
    1.7. Erection and removal of falsework and shoring
    1.8. Test periods
    1.9. Major traffic stage change
    1.10. Final cleanup

2. Order that you propose to prosecute the work
3. Logical links between the time-scaled work activities
4. All controlling activities
5. Legible description of each activity
6. At least one predecessor and one successor to each activity, except for project start and project end milestones
7. Duration of not less than one working day for each activity
8. Start milestone date as the contract approval date

You may include changes on updated schedules that do not alter the critical path or extend the schedule completion date compared to the current schedule. Changes may include:

1. Adding or deleting activities
2. Changing activity constraints
3. Changing durations
4. Changing logic

If any proposed change in planned work results in altering the critical path or extending the scheduled completion date, submit a revised schedule within 15 days of the proposed change.

For each schedule submittal:

1. Submit a plotted original, time-scaled network diagram on a sheet of at least 8.5" x 11" with a title block and timeline
2. If a computer program is used to make the schedule, submit a read-only compact disc or diskette containing the schedule data. Label the compact disc or diskette with:

    2.1. Contract number
    2.2. CPM schedule number and date produced
    2.3. File name

If there is no contract item for progress schedule (critical path method), full compensation for this work is included in the contract prices paid for the items of work involved, and no additional compensation will be allowed therefor.

8-1.05 TEMPORARY SUSPENSION OF WORK

8-1.05A General

The Engineer may suspend work wholly or in part due to any of the following:

1. Conditions are unsuitable for work progress.
2. You fail to do any of the following:

    2.1. Fulfill the Engineer's orders.
    2.2. Fulfill a contract part.
    2.3. Perform weather-dependent work when conditions are favorable so that weather-related unsuitable conditions are avoided or do not occur.

Upon the Engineer's written order of suspension, suspend work immediately. Provide for public safety and a smooth and unobstructed passageway through the work zone during the suspension as specified in Sections 7-1.08, "Public Convenience," and 7-1.09, "Public Safety." Resume work when ordered.

8-1.05B Suspensions Unrelated to Contractor Performance

For a suspension unrelated to your performance, providing for a smooth and unobstructed passageway through the work during the suspension will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

The days during a suspension unrelated to your performance are non-working days.

8-1.05C Suspensions Related to Contractor Performance

For a suspension related to your performance, the Department may provide for a smooth and unobstructed passageway through the work during the suspension and deduct the cost from payments.

The days during a suspension related to your performance are working days.

8-1.06 TIME OF COMPLETION

The time to complete the work is specified in the special provisions.

The Engineer issues a Weekly Statement of Working Days by the end of the following week unless the contract is suspended for reasons unrelated to your performance.

The Weekly Statement of Working Days shows:

1. Working days and non–working days during the reporting week
2. Time adjustments
3. Work completion date computations, including working days remaining
4. Controlling activities

You may protest a Weekly Statement of Working Days.

8-1.07 LIQUIDATED DAMAGES

8-1.07A General

The Department specifies liquidated damages (Pub Cont Code § 10226). Liquidated damages, if any, accrue starting on the 1st day after the expiration of the working days through the day of contract acceptance except as specified in Sections 8-1.07B, "Failure to Complete Work Parts within Specified Times," and 8-1.07C, "Failure to Complete Work Parts by Specified Dates."

The Department withholds liquidated damages before the accrual date if the anticipated liquidated damages may exceed the value of the remaining work.

Liquidated damages for all work, except plant establishment, are:

Liquidated Damages		
Total Bid		Liquidated Damages per Day
From over	To	
$0	$50,000	$1,200
$50,000	$120,000	$1,500
$120,000	$1,000,000	$1,900
$1,000,000	$5,000,000	$3,000
$5,000,000	$10,000,000	$5,400
$10,000,000	$30,000,000	$8,300
$30,000,000	$100,000,000	$10,500
$100,000,000	$250,000,000	$28,500

If all work, except plant establishment, is complete and the total number of working days has expired, liquidated damages are $950 per day.

8-1.07B Failure to Complete Work Parts within Specified Times

The Department may deduct specified damages from payments for each day in completing a work part beyond the time specified for completing the work part.

Damages for untimely completion of work parts may not be equal to the daily amount specified as liquidated damages for the project as a whole, but the Department does not simultaneously assess damages for untimely completion of work parts and for the whole work.

Damages accrue starting the 1st day after a work part exceeds the specified time through the day the specified work part is complete.

8-1.07C Failure to Complete Work Parts by Specified Dates

The Department may deduct specified damages from payments for each day in completing a work part beyond the specified completion date for the work part.

Damages for untimely work part completion may not be equal to the daily amount specified as liquidated damages for the project as a whole, but the Department does not simultaneously assess damages for untimely work part completion and the whole work.

Damages accrue starting the 1st day after an unmet completion date through the day the work part is complete.

8-1.07D Director Days

If the work is not completed within the working days, the Director may grant director days if it serves the State's best interest.

By granting director days, the Director adds working days to the contract. The Director may either grant enough days to eliminate the liquidated damages or fewer. In the latter case, the Department deducts liquidated damages for the remaining overrun in contract time. The Director may deduct the Department's engineering, inspection, and overhead costs incurred during the period of extension granted as director days.

8-1.08 TERMINATION OF CONTROL

The Department may terminate your control of the work for failure to do any of the following (Pub Cont Code § 10253):

1. Supply an adequate workforce
2. Supply material as described
3. Pay subcontractors (Pub Cont Code §10262)
4. Prosecute the work as described in the contract

The Department may also terminate your control for failure to maintain insurance coverage.

For a Federal-aid contract, the Department may terminate your control of the work for failure to include "Required Contract Provisions, Federal-Aid Construction Contracts" in subcontracts.

The Department gives you and your surety notice at least 5 days before terminating control. The notice describes the failures and the time allowed to remedy the failures. If failures are not remedied within the time provided, the Department takes control of the work.

The Department may complete the work if the Department terminates your control or you abandon the project (Pub Cont Code § 10255). The Department determines the unpaid balance under Pub Cont Code § 10258 and the contract.

At any time before final payment of all claims, the Department may convert a termination of control to a termination of contract.

8-1.09 DELAYS

8-1.09A General

An excusable delay is a delay of a controlling activity beyond your control, not foreseeable when the work began such as:

1. Change in the work
2. Department action that is not part of the contract
3. Presence of an underground utility main not described in the contract or in a location different from that specified
4. Described facility reconstruction not reconstructed as described, by the utility owner by the date specified, unless the reconstruction is solely for your convenience
5. Department's failure to obtain timely access to the right-of-way
6. Department's failure to perform an action in the time specified

A critical delay is a delay that extends the schedule completion date.

To request a delay-related time or payment adjustment, submit an RFI.

8-1.09B Time Adjustments

For an excusable critical delay, the Department may make a time adjustment. The Engineer uses information from the schedule to evaluate requests for time adjustments.

If requesting an adjustment, submit a revised schedule showing the delay's effect on the controlling activity. If the delay has:

1. Occurred, submit records of dates and what work was performed during the delayed activity
2. Not occurred, submit the expected dates or duration of the delayed activity

If the Engineer requests, update the schedule to the last working day before the start of the delay.

8-1.09C Payment Adjustments

The Department may make a payment adjustment for an excusable delay that affects your costs.

Only losses for idle equipment, idle workers, and equipment moving or transporting are eligible for delay-related payment adjustments.

The Engineer determines payment for idle time of equipment in the same manner as determinations are made for equipment used in the performance of force account work under Section 9-1.03, "Force Account," with the following exceptions:

1. Delay factor in the Labor Surcharge and Equipment Rental Rates applies to each equipment rental rate.
2. Daily number of payable hours equals the normal working hours during the delay, not to exceed 8 hours per day.
3. Delay days exclude non–working days.
4. Markups are not added.

The Engineer determines payment adjustment for idle workers under Section 9-1.03B, "Labor," but does not add markups.

The Engineer includes costs due to necessary extra equipment moving or transporting.

8-1.10 (BLANK)

8-1.11 TERMINATION OF CONTRACT

8-1.11A General

The Director may terminate the contract if it serves the State's best interest. The Department issues you a written notice, implements the termination, and pays you.

8-1.11B Relief from Responsibility for Work

On receiving a termination notice:

1. Stop work
2. Notify subcontractors and suppliers of the contract termination and stop contract-related work
3. Perform the Engineer-ordered work to secure the job site for termination
4. Remove equipment
5. If authorized, settle termination-related claims and liabilities involving subcontractors and suppliers; assign to the Department the rights, titles, or interests held by you with respect to these parties

8-1.11C Responsibility for Materials

On receiving a termination notice, protect unused material until:

1. You submit an inventory of materials already produced, purchased, or ordered but not yet used; include the location of the material.
2. The Engineer identifies materials that will be retained by the Department. Submit bills of sales or other records of material title.
3. The Engineer confirms that unused materials paid by progress payment and materials furnished by the State have been delivered and stored as ordered.
4. Titles are transferred for materials purchased by the Department.

Dispose of materials that will not be retained by the Department.

8-1.11D Contract Acceptance after Termination

The Engineer recommends contract acceptance after determining completion of:

1. Contract work ordered to be completed before termination
2. Other work ordered to secure the project before termination
3. Material delivery and title transfer

The Department pays you under Section 9-1.08, "Payment After Contract Acceptance."

8-1.11E Payment Adjustment for Termination

If the Department issues a termination notice, the Engineer determines payment for termination based on the following:

1. Direct cost for the work:

    1.1. Including mobilization, demobilization, securing the job site for termination, and losses from the sale of materials
    1.2. Not including the cost of materials you keep, profit realized from the sale of materials, the cost of material damaged by an occurrence as defined in Section 7-1.165, "Damage by Storm, Flood, Tsunami or Earthquake," and other credits.

2. Cost of remedial work, as estimated by the Engineer, is not reimbursed.
3. Allowance for profit not to exceed 4 percent of the cost of the work. Prove a likelihood of having made a profit had the contract not been terminated.
4. Material handling costs for material returned to the vendor or disposed of as ordered.
5. Costs in determining the payment adjustment due to the termination, excluding attorney fees and litigation costs.

Termination of the contract does not relieve the surety of its obligation for any just claims arising out of the work performed.

^^

SECTION 9 MEASUREMENT AND PAYMENT
(Issued 06-05-09)

Replace Section 9 with:

SECTION 9 MEASUREMENT AND PAYMENT

9-1.01 MEASUREMENT OF QUANTITIES

9-1.01A General

The Department determines bid item quantities under U.S. customary units.

9-1.01B Weighing Equipment and Procedures

9-1.01B(1) General

The Engineer measures material quantities for payment with devices that comply with:

1. 4 CA Code of Regs § 4000 et seq.
2. Bus & Prof Code § 12001 et seq.

To determine the material payment quantities, use measuring devices that have been sealed by the Department of Food and Agriculture's Division of Measurement Standards or its designated representative.

If a device is not type approved by the Division of Measurement Standards, type approve it under California Test 109.

Notify the Engineer at least 1 business day in advance of equipment testing.

Use material plant controllers having elements affecting the data accuracy and delivery that have been sealed by the Engineer. Make these elements available to the Engineer for inspection. If the elements are adequate for use, the Engineer seals them. If security seal manipulation occurs, stop material production. Do not resume production until the Engineer reinspects and reseals the device.

The Engineer measures material paid for by weight on Contractor-furnished sealed scales regularly inspected by the Department of Food and Agriculture's Division of Measurement Standards or its designated representative.

Obtain authorization of portable vehicle scale installations before sealing.

Proportioning scales must comply with Section 5-1.10, "Equipment."

9-1.01B(2) Equipment

Each scale must be long enough to fit an entire vehicle or a combination vehicle on the scale deck. The Department allows you to weigh a combination vehicle separately if you disconnect the vehicles.

Construct scale undersupports:

1. Using portland cement concrete containing at least 470 pounds of cement per cubic yard produced from commercial quality materials
2. Such that footing heights are at least 20 inches thick
3. With a bearing surface at least 30 inches wide and bearing pressure on the footing not over 4000 pounds per square foot

In constructing a scale:

1. Furnish drainage to prevent water from saturating the ground under the scale
2. Use bulkheads that prevent displacement
3. If shimming is necessary:

    3.1. Use securely attached metal shims or grout
    3.2 Do not use wedges to shim the supports
    3.3. Do not use shim material in excess of 3 inches

4. Install mechanical indicating elements level, plumb, and rigidly mounted on the concrete undersupports
5. For a hopper scale, rigidly attach hopper scale lever systems and mechanical indicating elements so no weight is lost from bending or support distortion

Each scale used to determine material payment quantities must be operated by a licensed weighmaster (Bus & Prof Code § 12700 et seq.).

Submit a public weighmaster's certificate or certified daily summary weigh sheets for each weighed material quantity. The Department may witness material weighing and check and compile the daily scale weight record.

Each vehicle operator must obtain weight or load slips from the weighmaster. Submit these records at the delivery point.

9-1.01B(3) Procedures

Daily, weigh empty vehicles used to haul material paid for by weight. Each vehicle must have a legible identification mark. The Department may verify material weight by having an empty and loaded vehicle weighed on any scale the Engineer designates.

For imported topsoil measured by volume, soil amendment, and mulch:

1. Each vehicle must allow a ready and accurate contents determination
2. Unless vehicles are of uniform capacity, each vehicle must have a legible identification mark showing its volume capacity
3. Load vehicles to at least the volume capacity
4. Level vehicle loads on arrival at the delivery point

If determining a quantity paid on a volume basis is impractical or if you request and the Engineer authorizes the request, the Engineer weighs the material and converts the result to a volume measurement. The Engineer determines the conversion factors and, if you agree, adopts this method of measurement.

9-1.01C Final Pay Items

The Department shows a bid item quantity as a final pay item for payment purposes only. For a final pay item, accept payment based on the verified Bid Item List quantity, regardless of actual quantity used unless dimensions are changed by the Engineer.

9-1.01D Quantities of Aggregate and Other Roadway Materials

The Engineer determines the weight of aggregate and other roadway materials that are being paid for by weight as shown and does not include the deducted weight of water in their payment quantities.

Material	Quantity Determination
Aggregate or other roadway material except as otherwise shown in this table	By deducting the weight of water in the material[a] in excess of 3 percent of the dry weight of the material from the weight of the material
Imported borrow, imported topsoil, aggregate subbase	By deducting the weight of water in the material[a] in excess of 6 percent of the dry weight of the material from the weight of the material
Straw	By deducting the weight of water in the material[a] in excess of 15 percent of the dry weight of the material from the weight of the material
Fiber[b]	Engineer does not deduct the weight of water
Aggregate base and aggregate for cement treated bases	As specified in Section 26, "Aggregate Bases," and Section 27, "Cement Treated Bases"

NOTE: Percentage of water is determined by California Test 226.
[a]At the time of weighing
[b]Weight of water in the fiber[a] must not exceed 15 percent of the dry weight of the fiber.

9-1.02 SCOPE OF PAYMENT

The Department pays you for furnishing the resources and activities required to complete the Contract work. The Department's payment is full compensation for furnishing the resources and activities, including:

1. Risk, loss, damage repair, or cost of whatever character arising from or relating to the work and performance of the work
2. PLACs and taxes

Full compensation for work specified in Sections 1 through 9 is included in the payment for the bid items involved unless:

1. Bid item for the work is shown on the verified Bid Item List
2. Work is specified as paid for as extra work

The Department does not pay for your loss, damage, repair, or extra costs of whatever character arising from or relating to the work that is a direct or indirect result of your choice of construction methods, materials, equipment, or manpower, unless specifically mandated by the Contract.

Payment is:

1. Full compensation for each bid item specified by the description and measurement unit shown on the verified Bid Item List
2. For the price bid for each bid item shown on the verified Bid Item List or as changed by change order with a specified price adjustment

If an alternative is described in the Contract, the Department pays based on the bid items for the details and specifications not described as an alternative.

The Department pays for work performed by change order based on one or a combination of the following:

1. Bid item prices
2. Force account
3. Agreed price
4. Specialist billing

If the Engineer chooses to pay for work performed by change order based on an agreed price, but you and the Engineer cannot agree on the price, the Department pays by force account.

If a portion of extra work is covered by bid items, the Department pays for this work as changed quantities in those items. The Department pays for the remaining portion of the extra work by force account or agreed price.

The Department pays 10 percent annual interest for unpaid and undisputed:

1. Progress payments
2. After-acceptance payment except for claims

For these payments, interest starts to accrue 30 days after the 1st working day following the 20th day of the month payment is due.

The Department pays 6 percent annual interest for unpaid and undisputed claims. Interest starts to accrue 61 days after the Department accepts a claim statement.

The Department pays 6 percent annual interest for awards in arbitration (Civ Code § 3289).

If the amount of a deduction or withhold exceeds final payment, the Department invoices you for the difference, to be paid upon receipt.

9-1.03 FORCE ACCOUNT PAYMENT

9-1.03A General

For work paid by force account, the Engineer compares the Department's records to your daily force account work report. When you and the Engineer agree on the contents of the daily force account work reports, the Engineer accepts the report and the Department pays for the work. If the records differ, the Department pays for the work based only on the information shown on the Department's records.

If a subcontractor performs work at force account, accept an additional 10 percent markup to the total cost of that work paid at force account, including markups specified in Section 9-1.03, as reimbursement for additional administrative costs.

The markups specified in labor, materials, and equipment include compensation for all delay costs, overhead costs, and profit.

If an item's payment is adjusted for work-character changes, the Department excludes your cost of determining the adjustment.

Payment for owner-operated labor and equipment is made at the market-priced invoice submitted.

9-1.03B Labor

Labor payment is full compensation for the cost of labor used in the direct performance of the work plus a 35 percent markup. Force account labor payment consists of:

1. Employer payment to the worker for:

    1.1. Basic hourly wage
    1.2. Health and welfare
    1.3. Pension
    1.4. Vacation
    1.5. Training
    1.6. Other State and federal recognized fringe benefit payments

2. Labor surcharge percentage in Labor Surcharge and Equipment Rental Rates current during the work paid at force account for:

    2.1. Workers' compensation insurance
    2.2. Social security
    2.3. Medicare
    2.4. Federal unemployment insurance
    2.5. State unemployment insurance
    2.6. State training taxes

3. Subsistence and travel allowances paid to the workers
4. Employer payment to supervisors, if authorized

The 35 percent markup consists of payment for all overhead costs related to labor but not designated as costs of labor used in the direct performance of the work including:

1. Home office overhead
2. Field office overhead
3. Bond costs
4. Profit
5. Labor liability insurance
6. Other fixed or administrative costs that are not costs of labor used in the direct performance of the work

9-1.03C Materials

Material payment is full compensation for materials you furnish and use in the work. The Engineer determines the cost based on the material purchase price, including delivery charges, except:

1. A 15 percent markup is added.
2. Supplier discounts are subtracted whether you took them or not.
3. If the Engineer believes the material purchase prices are excessive, the Department pays the lowest current wholesale price for a similar material quantity.
4. If you procured the materials from a source you wholly or partially own, the determined cost is based on the lower of the:

    4.1. Price paid by the purchaser for similar materials from that source on Contract items
    4.2. Current wholesale price for those materials

5. If you do not submit a material cost record within 30 days of billing, the determined cost is based on the lowest wholesale price:

    5.1. During that period
    5.2. In the quantities used

9-1.03D Equipment Rental

9-1.03D(1) General

Equipment rental payment is full compensation for:

1. Rental equipment costs, including moving rental equipment to and from the site of work performed by change order using its own power.
2. Transport equipment costs for rental equipment that cannot be transported economically using its own power. No payment is made during transport for the transported equipment.
3. 15 percent markup.

If you want to return the equipment to a location other than its original location, the payment to move the equipment must not exceed the cost of returning the equipment to its original location. If you use the equipment for work other than work paid by force account, the transportation cost is included in the other work.

Before moving or loading the equipment, obtain authorization for the equipment rental's original location.

The Engineer determines rental costs:

1. Using rates in Labor Surcharge and Equipment Rental Rates:

    1.1. By classifying equipment using manufacturer's ratings and manufacturer-approved changes.
    1.2. Current during the work paid by force account.
    1.3. Regardless of equipment ownership; but the Department uses the rental document rates or minimum rental cost terms if:

        1.3.1. Rented from equipment business you do not own.
        1.3.2. The Labor Surcharge and Equipment Rental Rates hourly rate is $10.00 per hour or less.

2. Using rates established by the Engineer for equipment not listed in Labor Surcharge and Equipment Rental Rates. You may submit cost information that helps the Engineer establish the rental rate; but the Department uses the rental document rates or minimum rental cost terms if:

    2.1. Rented from equipment business you do not own.
    2.2. The Engineer establishes a rate of $10.00 per hour or less.

3. Using rates for transport equipment not exceeding the hourly rates charged by established haulers.

Equipment rental rates include the cost of:

1. Fuel
2. Oil
3. Lubrication
4. Supplies
5. Small tools that are not consumed by use
6. Necessary attachments
7. Repairs and maintenance
8. Depreciation
9. Storage
10. Insurance
11. Incidentals

The Department pays for small tools consumed by use. The Engineer determines payment for small tools consumed by use based on Contractor-submitted invoices.

9-1.03D(2) Equipment On the Job Site

For equipment on the job site at the time required to perform work paid by force account, the time paid is the time:

1. To move the equipment to the location of work paid by force account plus an equal amount of time to move the equipment to another location on the job site when the work paid by force account is completed
2. To load and unload equipment
3. Equipment is operated to perform work paid by force account and:

    3.1. Hourly rates are paid in 1/2-hour increments
    3.2 Daily rates are paid in 1/2-day increments

When rented equipment on the job site is used to perform work at force account not required by the original contract work, the Engineer may authorize rates in excess of those in Labor Surcharge and Equipment Rental Rates if:

1. You submit a request to use rented equipment
2. Equipment is not available from your owned equipment fleet or from your subcontractors
3. Rented equipment is from an independent rental company
4. Proposed equipment rental rate is reasonable
5. Engineer authorizes the equipment source and the rental rate before you use the equipment

The Department pays for fuel consumed during operation of rented equipment not included in the invoiced rental rate.

9-1.03D(3) Equipment Not On the Job Site Required for Original Contract Work

For equipment not on the job site at the time required to perform work paid by force account and required for original Contract work, the time paid is the time the equipment is operated to perform work paid by force account and the time to move the equipment to a location on the job site when the work paid by force account is completed.

The minimum total time paid is:

1. 1 day if daily rates are paid
2. 8 hours if hourly rates are paid

If daily rates are recorded, equipment:

1. Idled is paid as 1/2 day
2. Operated 4 hours or less is paid as 1/2 day
3. Operated 4 hours or more is paid as 1 day

If the minimum total time exceeds 8 hours and if hourly rates are listed, the Department rounds up hours operated to the nearest 1/2-hour increment and pays based on the following table. The table does not apply when equipment is not operated due to breakdowns; in which case rental hours are the hours the equipment was operated.

Equipment Rental Hours

Hours operated	Hours paid
0.0	4.00
0.5	4.25
1.0	4.50
1.5	4.75
2.0	5.00
2.5	5.25
3.0	5.50
3.5	5.75
4.0	6.00
4.5	6.25
5.0	6.50
5.5	6.75
6.0	7.00
6.5	7.25
7.0	7.5
7.5	7.75
>8.0	hours used

9-1.03D(4) Equipment Not On the Job Site Not Required for Original Contract Work

For equipment not on the job site at the time required to perform work paid by force account and not required for original Contract work, the time paid is the time:

1. To move the equipment to the location of work paid by force account plus an equal amount of time to return the equipment to its source when the work paid by force account is completed
2. To load and unload equipment
3. Equipment is operated to perform work paid by force account

For this equipment, the Engineer may authorize rates in excess of those in Labor Surcharge and Equipment Rental Rates subject to the following:

1. Equipment is not available from your normal sources or from one of your subcontractors
2. Proposed equipment rental rate is reasonable
3. Engineer authorizes the equipment source and the rental rate before you use the equipment

9-1.03D(5) Non-Owner-Operated Dump Truck Rental

Submit the rental rate for non-owner-operated dump truck rental. The Engineer determines the payment rate. Payment for non-owner-operated dump truck rental is for the cost of renting a dump truck, including its driver. For the purpose of markup payment only, the non-owner-operated dump truck is rental equipment and the owner is a subcontractor.

9-1.04 EXTRA WORK PERFORMED BY SPECIALISTS

If the Engineer determines that you or your subcontractors are not capable of performing specialty extra work, a specialist may be used. Itemize the labor, material, and equipment rental costs unless it is not the special service industry's established practice to provide itemization; in which case, the Engineer accepts current market-priced invoices for the work.

The Engineer may accept an invoice as a specialist billing for work performed at an off–job site manufacturing plant or machine shop.

The Engineer determines the cost based on the specialist invoice price minus any available or offered discounts plus a 10 percent markup.

9-1.05 CHANGED QUANTITY PAYMENT ADJUSTMENTS

9-1.05A General

The unit prices specified in Section 9-1.05 are adjusted under Section 9-1.03, "Force Account."

9-1.05B Increases of More Than 25 Percent

If the total bid item quantity exceeds 125 percent of the quantity shown on the verified Bid Item List and if no approved Contract Change Order addresses payment for the quantity exceeding 125 percent, the Engineer may adjust the unit price for the excess quantity under Section 9-1.03, "Force Account," or the following:

1. The adjustment is the difference between the unit price and the unit cost of the total item pay quantity.
2. In determining the unit cost, the Engineer excludes the item's fixed costs. You have recovered the fixed costs in the payment for 125 percent shown on the verified Bid Item List.
3. After excluding fixed costs, the Engineer determines the item unit cost under Section 9-1.03, "Force Account."

If the payment for the number of units of a bid item in excess of 125 percent of the verified Bid Item List is less than $5,000 at the unit price, the Engineer may not adjust the unit price unless you request it.

9-1.05C Decreases of More Than 25 Percent

If the total item pay quantity is less than 75 percent of the quantity shown on the verified Bid Item List and if no approved Contract Change Order addresses payment for the quantity less than 75 percent, you may request a unit price adjustment. The Engineer may adjust the unit price for the decreased quantity under Section 9-1.03, "Force Account" or the following:

1. The adjustment is the difference between the unit price and the unit cost of the total pay quantity.
2. In determining the unit cost, the Engineer includes the item's fixed costs.
3. After including fixed costs, the Engineer determines the item unit cost under Section 9-1.03, "Force Account."

The Department does not pay more than 75 percent of the item total in the verified Bid Item List.

9-1.05D Eliminated Items

If the Engineer eliminates an item, the Department pays your costs incurred before the Engineer's elimination notification date.

If you order authorized material for an eliminated item before the notification date and the order cannot be canceled, either of the following occurs:

1. If the material is returnable to the vendor, the Engineer orders you to return the material and the Department pays your handling costs and vendor charges.
2. The Department pays your cost for the material and its handling and becomes the material owner.

The Engineer determines the payment for the eliminated bid item under Section 9-1.03, "Force Account."

9-1.06 WORK-CHARACTER CHANGES

The Department adjusts a bid item unit price based on the difference between the cost to perform the work as planned and the cost to perform the work as changed. The Engineer determines the payment adjustment under Section 9-1.03, "Force Account." The Department adjusts payment for only the work portion that changed in character.

9-1.07 PROGRESS PAYMENTS

9-1.07A General

The Department pays you based on Engineer-prepared monthly progress estimates. Each estimate reflects:

1. Total work completed during the pay period
2. Change order bills if approved by the 20th of a month
3. Amount for materials on hand
4. Amount earned for mobilization
5. Deductions
6. Withholds
7. Resolved potential claims
8. Payment adjustments

Submit certification stating the work complies with the QC procedures. The Engineer does not process a progress estimate without a signed certification.

You may protest a progress payment.

9-1.07B Schedule of Values

Section 9-1.07B applies to a lump sum bid item for which a schedule of values is specified to be submitted.

The sum of the amounts for the work units listed in the schedule of values must equal the lump sum price bid for the bid item.

Obtain authorization of a schedule of values before you perform work shown on the schedule. The Department does not process a progress payment for the bid item without an authorized schedule of values.

Accept progress payments for overhead, profit, bond costs, and other fixed or administrative costs as distributed proportionally among the items listed except that for a contract with a bid item for mobilization, accept progress payments for bond costs as included in the mobilization bid item.

For changed quantities of the work units listed, the Department adjusts payments in the same manner as specified for changed quantities of bid items under Section 9-1.05, "Changed Quantity Payment Adjustments."

9-1.07C Materials On Hand

A material on hand but not incorporated into the work is eligible for progress payment if:

1. Listed in a special provision as eligible and is in compliance with other Contract parts
2. Purchased
3. An invoice is submitted
4. Stored within the State and you submit evidence that the stored material is subject to the Department's control
5. Requested on the Department-furnished form

9-1.07D Mobilization

Mobilization is eligible for partial payments if the Contract includes a bid item for mobilization. The Department makes the partial payments under Pub Cont Code § 10264. If the Contract does not include a mobilization bid item, mobilization is included in the payment for the various bid items.

The Department pays the item total for mobilization in excess of 10 percent of the total bid in the 1st payment after Contract acceptance.

9-1.07E Withholds

9-1.07E(1) General

The Department may withhold payment for noncompliance.

The Department returns the noncompliance withhold in the progress payment following correction of noncompliance.

Withholds are not retentions under Pub Cont Code § 7107 and do not accrue interest under Pub Cont Code § 10261.5.

Withholds are cumulative and independent of deductions.

Section 9-1.07E does not include all withholds that may be taken; the Department may withhold other payments as specified.

9-1.07E(2) Progress Withholds

The Department withholds 10 percent of a partial payment for noncompliant progress. Noncompliant progress occurs when:

1. Total days to date exceed 75 percent of the revised Contract working days
2. Percent of working days elapsed exceeds the percent of value of work completed by more than 15 percent

The Engineer determines the percent of working days elapsed by dividing the total days to date by the revised Contract working days and converting the quotient to a percentage.

The Engineer determines the percent of value of work completed by summing payments made to date and the amount due on the current progress estimate, dividing this sum by the current total estimated value of the work, and converting the quotient to a percentage. These amounts are shown on the Progress Payment Voucher.

When the percent of working days elapsed minus the percent of value of work completed is less than or equal to 15 percent, the Department returns the withhold in the next progress payment.

9-1.07E(3) Performance Failure Withholds

During each estimate period you fail to comply with a Contract part, including submittal of a document as specified, the Department withholds a part of the progress payment. The documents include QC plans, schedules, traffic control plans, and water pollution control submittals.

For 1 performance failure, the Department withholds 25 percent of the progress payment but does not withhold more than 10 percent of the total bid.

For multiple performance failures, the Department withholds 100 percent of the progress payment but does not withhold more than 10 percent of the total bid.

9-1.07E(4) Stop Notice Withholds

The Department may withhold payments to cover claims filed under Civ Code § 3179 et seq.

9-1.07E(5) Penalty Withholds

Penalties include fines and damages that are proposed, assessed, or levied against you or the Department by a governmental agency or private lawsuit. Penalties are also payments made or costs incurred in settling alleged violations of federal, state, or local laws, regulations, requirements, or PLACs. The cost incurred may include the amount spent for mitigation or correcting a violation.

If you or the Department is assessed a penalty, the Department may withhold the penalty amount until the penalty disposition has been resolved. The Department may withhold penalty funds without notifying you.

Instead of the withhold, you may provide a bond equal to the highest estimated liability for any disputed penalties proposed.

9-1.07E(6)–9-1.07E(10) Reserved

9-1.07F Retentions

The Department does not retain moneys from progress payments due to the Contractor for work performed (Pub Cont Code § 7202).

9-1.07G–9-1.07K Reserved

9-1.08 PAYMENT AFTER CONTRACT ACCEPTANCE

9-1.08A General

Reserved

9-1.08B Payment Before Final Estimate

After Contract acceptance, the Department pays you based on the Engineer-prepared estimate that includes withholds and the balance due after deduction of previous payments.

9-1.08C Proposed Final Estimate

The Engineer estimates the amount of work completed and shows the amount payable in a proposed final estimate based on:

1. Contract items
2. Payment adjustments
3. Work paid by force account or agreed price
4. Extra work
5. Deductions

Submit either a written final estimate acceptance or a claim statement no later than the 30th day after receiving the proposed final estimate. Evidence of the Contractor's receipt of the final estimate and the Engineer's receipt of the Contractor's written acceptance or claim statement is a delivery service's proof of delivery or Engineer's written receipt if hand delivered.

If you claim that the final estimate is less than 90 percent of your total bid, the Department adjusts the final payment to cover your overhead. The adjustment is 10 percent of the difference between the total bid and the final estimate. The Department does not make this adjustment on a terminated contract.

9-1.08D Final Payment and Claims

9-1.08D(1) General

If you accept the proposed final estimate or do not submit a claim statement within 30 days of receiving the estimate, the Engineer furnishes the final estimate to you and the Department pays the amount due within 30 days. This final estimate and payment is conclusive except as specified in Sections 5-1.015, "Records," 6-1.075, "Guarantee," and 9-1.09, "Clerical Errors."

If you submit a claim statement within 30 days of receiving the Engineer's proposed final estimate, the Engineer furnishes a semifinal estimate to the Contractor and the Department pays the amount due within 30 days. The semifinal estimate is conclusive as to the amount of work completed and the amount payable except as affected by the claims or as specified in Sections 5-1.015, "Records," 6-1.075, "Guarantee," and 9-1.09, "Clerical Errors."

9-1.08D(2) Claim Statement

9-1.08D(2)(a) General

For each claim, submit a claim statement showing only the identification number that corresponds to the Full and Final Potential Claim Record and the final amount of additional payment requested except:

1. If the final amount of requested payment differs from the amount requested in the Full and Final Potential Claim Record
2. For a claim for quantities, withholds, deductions, liquidated damages, or change order bills
3. For an overhead claim

If the final amount of requested payment differs from the amount requested in the Full and Final Potential Claim Record, submit:

1. Identification number that corresponds to the Full and Final Potential Claim Record
2. Final amount of additional payment requested
3. Basis for the changed amount
4. Contract documentation that supports the changed amount
5. Statement of the reasons the Contract documentation supports the claim

The Engineer notifies you of an omission of or a disparity in the exclusive identification number. Within 15 days of the notification, correct the omission or disparity. If the omission or disparity is not resolved after the 15 days, the Engineer assigns a new number.

For a claim for quantities, withholds, deductions, or change order bills submit:

1. Final amount of additional payment requested
2. Enough detail to enable the Engineer to determine the basis and amounts of the additional payment requested

9-1.08D(2)(b) Overhead Claims

Include with an overhead claim:

1. Final amount of additional payment requested
2. Independent CPA audit report

Failure to submit the audit report with an overhead claim with the claim statement is a waiver of the overhead claim and operates as a bar to arbitration on the claim (Pub Cont Code § 10240.2).

The Department deducts an amount for field and home office overhead paid on added work from any claim for overhead. The value of the added work equals the value of the work completed minus the total bid. The home office overhead deduction equals 5 percent of the added work. The field office overhead deduction equals 5-1/2 percent of the added work.

If you intend to pursue a claim for reimbursement for field or home office overhead beyond that provided expressly by the Contract:

1. Notify the Engineer within 30 days of receipt of the proposed final estimate of your intent to seek reimbursement for specific overhead costs beyond that provided by the Contract
2. Specifically identify each claim and each date associated with each claim from which you seek reimbursement for specific overhead costs beyond that provided by the Contract
3. Timely submit all other claims
4. Within 30 days of receipt of the proposed final estimate, submit an audit report prepared by an independent CPA

    4.1. The audit report must show calculations with supporting documentation of actual home office and project field overhead costs
    4.2. The calculations must specify the actual daily rates for both field and home office overhead for the entire duration of the project expressed as a rate per working day
    4.3. The start and end dates of the actual project performance period, number of working days, overhead cost pools, and all allocation bases must be disclosed in the calculations of your actual field and home office overhead daily rates
    4.4. Neither daily rate may include a markup for profit

5. Field overhead costs from which the daily rate is calculated must be:

    5.1. Allowable under 48 CFR 31
    5.2. Supported by reliable records
    5.3. Related solely to the project
    5.4. Incurred during the actual project performance period
    5.5. Comprised of only time-related field overhead costs
    5.6. Not a direct cost

6. Home office overhead costs from which the daily rate is calculated must be:

    6.1. Allowable under 48 CFR 31
    6.2. Supported by reliable records
    6.3. Incurred during the actual project performance period
    6.4. Comprised of only fixed home office overhead costs
    6.5. Not a direct cost

The actual rate of time-related overhead is subject to authorization by the Engineer.

The CPA's audit must be performed under the Attestation Standards published by the American Institute of Certified Public Accountants. The CPA's audit report must express an opinion whether or not your calculations of your actual field and home office overhead daily rates comply with Section 9-1.08D(2)(b), "Overhead Claims." The attest documentation prepared by the CPA in connection with the audit must be reproduced and submitted for review with the audit report.

The Department provides markups for all work paid by force account. Overhead for field and home office costs are included in the markups. Overhead claims in excess of Contract markups are not allowed under the Contract. If you seek reimbursement for costs not allowed under the Contract, the Department does not pay your cost of performing the independent CPA examination specified in section 9-1.08D(2)(b), "Overhead Claims," including preparation of the audit report.

9-1.08D(2)(c) Declaration

Submit a declaration that includes the following language with the claim statement:

> I declare under penalty of perjury, according to the laws of the State of California, that the foregoing claims, with specific reference to the California False Claims Act (Govt Code § 12650 et seq.) and to the extent the project contains federal funding, the U.S. False Claims Act (31 USC § 3729 et seq.), are true and correct, and that this declaration was signed on _____(date)_____, 20__ at _____, California.

9-1.08D(2)(d) Waiver

A claim is waived if:

1. Claim does not have a corresponding Full and Final Potential Claim Record identification number
2. Claim does not have the same nature, circumstances, and basis of claim as the corresponding Full and Final Potential Claim Record
3. Claim is not included in the claim statement
4. You do not comply with the claim procedures
5. You do not submit the declaration specified in 9-1.08D(2)(c), "Declaration"

9-1.08D(3) Final Determination of Claims

Failure to allow timely access to claim supporting data when requested waives the claim.

The Department's costs in reviewing or auditing a claim not supported by the Contractor's accounting or other records are damages incurred by the State within the meaning of the California False Claims Act.

If the Engineer determines that a claim requires additional analysis, the Engineer schedules a board of review meeting. Meet with the board of review and make a presentation supporting the claim.

After claim review completion by the Engineer or board of review, the Department makes the final determination of claims and furnishes it to the Contractor.

After the determination, the Engineer furnishes a final estimate to the Contractor and the Department pays the amount due within 30 days. The final estimate is conclusive as to the amount of work completed and the amount payable except as specified in Sections 5-1.015, "Records," 6-1.075, "Guarantee," and 9-1.09, "Clerical Errors."

The Contractor's failure to comply with the claim procedures is a bar to arbitration under Pub Cont Code § 10240.2.

9-1.09 CLERICAL ERRORS

For 3 years after Contract acceptance, estimates and payments are open to correction and adjustment for clerical errors. Either the Department or the Contractor pays to the other the amount due except for clerical errors resulting in an adjustment less than $200; in which case, no payment is made.

9-1.10 ARBITRATION

Pub Cont Code § 10240 through 10240.13 provides for the resolution of contract claims by arbitration.

Start arbitration by filing a complaint with the Office of Administrative Hearings in Sacramento (1 CA Code Regs § 1350). File the arbitration complaint no later than 90 days after receiving the Department's final written decision on a claim (Pub Cont Code § 10240.1).

^^

SECTION 10 DUST CONTROL
(Issued 02-06-09)

Replace Section 10 with:
SECTION 10 (BLANK)

^^

SECTION 11 MOBILIZATION
(Issued 06-05-09)

Replace Section 11 with:
SECTION 11 (BLANK)

^^

SECTION 12 CONSTRUCTION AREA TRAFFIC CONTROL DEVICES
(Issued 11-07-08)

In Section 12-1.01 in the 2nd paragraph, replace the 1st sentence with:

Attention is directed to Part 6 of the California MUTCD.

Replace Section 12-2.01 with:

12-2.01 FLAGGERS

Flaggers while on duty and assigned to traffic control or to give warning to the public that the highway is under construction and of any dangerous conditions to be encountered as a result thereof, shall perform their duties and shall be provided with the necessary equipment in conformance with Part 6 of the California MUTCD. The equipment shall be furnished and kept clean and in good repair by the Contractor at the Contractor's expense.

All flaggers shall wear safety apparel meeting the requirements of ANSI/ISEA 107-2004 for Class 2 or 3 garment and complying with 71 Fed Reg 67792.

In Section 12-3.01 replace the 1st paragraph with:

In addition to the requirements in Part 6 of the California MUTCD, all devices used by the Contractor in the performance of the work shall conform to the provisions in this Section 12-3.

In Section 12-3.06 in the 1st paragraph, replace the 2nd sentence with:

Construction area signs are shown in or referred to in Part 6 of the California MUTCD.

In Section 12-3.06 in the 4th paragraph, replace the 1st sentence with:

All construction area signs shall conform to the dimensions, color and legend requirements of the plans, Part 6 of the California MUTCD and these specifications.

In Section 12-3.06 in the 8th paragraph, replace the 1st sentence with:

Used signs with the specified sheeting material will be considered satisfactory if they conform to the requirements for visibility and legibility and the colors conform to the requirements in Part 6 of the California MUTCD.

^^

SECTION 14 (BLANK)
(Issued 06-05-09)

Replace Section 14 with:
SECTION 14 ENVIRONMENTAL STEWARDSHIP
14-1 GENERAL

14-1.01 GENERAL

Environmental stewardship includes both environmental compliance and environmental resource management.

If an ESA is shown on the plans:

1. The boundaries shown are approximate; the Department marks the exact boundaries on the ground
2. Do not enter the ESA unless authorized
3. If the ESA is breached, immediately:
   3.1. Secure the area and stop all operations within 60 feet of the ESA boundary
   3.2. Notify the Engineer
4. If the ESA is damaged, the Department determines what efforts are necessary to remedy the damage and who performs the remedy; you are responsible for remedies and charges.

14-2 CULTURAL RESOURCES

14-2.01 GENERAL

Reserved

14-2.02 ARCHAEOLOGICAL RESOURCES

If archaeological resources are discovered at the job site, do not disturb the resources and immediately:

1. Stop all work within a 60-foot radius of the discovery
2. Protect the discovery area
3. Notify the Engineer

The Department investigates. Do not take archaeological resources from the job site. Do not resume work within the discovery area until authorized.

If, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of an archaeological find, or investigation or recovery of archeological materials, you will be compensated for resulting losses, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays."

If ordered, furnish resources to assist in the investigation or recovery of archaeological resources. This work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

14-2.03 ARCHAEOLOGICAL MONITORING AREA

Section 14-2.03 applies if an AMA is described in the Contract.

The Department assigns an archaeological monitor to monitor job site activities within the AMA. Do not work within the AMA unless the archeological monitor is present.

The Engineer and the Department archaeological monitor conduct an AMA location field review with you at least 5 business days before start of work. The Department marks the exact boundaries of the AMA on the ground.

If temporary fence (Type ESA) for an AMA is described in the Contract, install temporary fence (Type ESA) to define the boundaries of the AMA during the AMA location field review.

At least 5 business days before starting work within an AMA, submit a schedule of days and hours to be worked for the Engineer's approval. If you require changes in the schedule, submit an update for the Engineer's approval at least 5 business days before any changed work day.

If archaeological resources are discovered within an AMA, comply with Section 14-2.02, "Archaeological Resources."

14-2.04 HISTORIC STRUCTURES

Reserved

14-3 COMMUNITY IMPACTS AND ENVIRONMENTAL JUSTICE

Reserved

14-4 NATIVE AMERICAN CONCERNS

Reserved

14-5 AESTHETICS

Reserved

14-6 BIOLOGICAL RESOURCES

14-6.01 GENERAL

Reserved

14-6.02 BIRD PROTECTION

Protect migratory and nongame birds, their occupied nests, and their eggs.

The Department anticipates nesting or attempted nesting from February 15 to September 1.

The federal Migratory Bird Treaty Act, 16 USC § 703–711, and 50 CFR Pt 10 and Fish & Game Code §§ 3503, 3513, and 3800 protect migratory and nongame birds, their occupied nests, and their eggs.

The federal Endangered Species Act of 1973, 16 USC §§ 1531 and 1543, and the California Endangered Species Act, Fish & Game Code §§ 2050–2115.5, prohibit the take of listed species and protect occupied and unoccupied nests of threatened and endangered bird species.

The Bald and Golden Eagle Protection Act, 16 USC § 668, prohibits the destruction of bald and golden eagles and their occupied and unoccupied nests.

If migratory or nongame bird nests are discovered that may be adversely affected by construction activities or an injured or killed bird is found, immediately:

1. Stop all work within a 100-foot radius of the discovery.
2. Notify the Engineer.

The Department investigates. Do not resume work within the specified radius of the discovery until authorized.

When ordered, use exclusion devices, take nesting prevention measures, remove and dispose of partially constructed and unoccupied nests of migratory or nongame birds on a regular basis to prevent their occupation, or perform any combination of these. This work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

Prevent nest materials from falling into waterways.

Bird protection that causes a delay to the controlling activity is a condition unfavorable to the suitable prosecution of work as specified in Section 8-1.05, "Temporary Suspension of Work."

14-7 PALEONTOLOGICAL RESOURCES

If paleontological resources are discovered at the job site, do not disturb the material and immediately:

1. Stop all work within a 60-foot radius of the discovery
2. Protect the area
3. Notify the Engineer

The Department investigates and modifies the dimensions of the protected area if necessary. Do not take paleontological resources from the job site. Do not resume work within the specified radius of the discovery until authorized.

14-8 NOISE AND VIBRATION

14-8.01 GENERAL

Reserved

14-8.02 NOISE CONTROL

Do not exceed 86 dBa at 50 feet from the job site activities from 9 p.m. to 6 a.m.

Equip an internal combustion engine with the manufacturer-recommended muffler. Do not operate an internal combustion engine on the job site without the appropriate muffler.

14-9 AIR QUALITY

14-9.01 AIR POLLUTION CONTROL

Comply with air pollution control rules, regulations, ordinances, and statutes that apply to work performed under the Contract, including air pollution control rules, regulations, ordinances, and statutes provided in Govt Code § 11017 (Pub Cont Code § 10231).

Do not burn material to be disposed of.

14-9.02 DUST CONTROL

Prevent and alleviate dust by applying water, dust palliative, or both under Section 14-9.01.

Apply water under Section 17, "Watering."

Apply dust palliative under Section 18,"Dust Palliative."

If ordered, apply water, dust palliative, or both to control dust caused by public traffic. This work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

14-10 SOLID WASTE DISPOSAL AND RECYCLING

14-10.01 SOLID WASTE DISPOSAL AND RECYCLING

Submit an annual Solid Waste Disposal and Recycling Report between January 1 and 15 for each year work is performed under the Contract at any time during the previous calendar year. Show the types and amounts of project-generated solid waste taken to or diverted from landfills or reused on the project from January 1 through December 31 of the previous calendar year.

Submit a final annual Solid Waste Disposal and Recycling Report within 5 business days after Contract acceptance. Show the types and amounts of project-generated solid waste taken to or diverted from landfills or reused on the project from January 1 to Contract acceptance.

For each failure to submit a completed form, the Department withholds $10,000.

14-11 HAZARDOUS WASTE AND CONTAMINATION

14-11.01 GENERAL

Reserved

14-11.02 ASBESTOS AND HAZARDOUS SUBSTANCES

Upon discovery, immediately stop working in and notify the Engineer of areas where asbestos or a hazardous substance is present if the:

1. Contractor reasonably believes the substance is asbestos as defined in Labor Code § 6501.7 or a hazardous substance as defined in Health & Safety Code §§ 25316 and 25317
2. Presence is not described in the Contract
3. Substance has not been made harmless

14-12 OTHER INTERAGENCY RELATIONS

Reserved

14-13 PAYMENT

Payment for work specified in Section 14 is included in the payment for the bid items involved unless:

1. Bid item for the work is shown in the verified Bid Item List
2. Work is specified as paid for as extra work

^^

SECTION 15 EXISTING HIGHWAY FACILITIES

(Issued 05-01-09)

In Section 15-1.02 replace the 1st paragraph with:

Existing facilities which are to remain in place shall be protected in conformance with the provisions in Sections 5-1.18, "Property and Facility Preservation," and 7-1.12, "Indemnification and Insurance."

^^

SECTION 19 EARTHWORK

(Issued 11-21-08)

Replace Section 19-1.02 with:

19-1.02 (BLANK)

Replace Section 19-1.03 with:

19-1.03 GRADE TOLERANCE

Immediately prior to placing subsequent layers of material thereon, the grading plane shall conform to one of the following:

A. When hot mix asphalt is to be placed on the grading plane, the grading plane at any point shall not vary more than 0.05 foot above or below the grade established by the Engineer.
B. When subbase or base material to be placed on the grading plane is to be paid for by the ton, the grading plane at any point shall not vary more than 0.10 foot above or below the grade established by the Engineer.
C. When the material to be placed on the grading plane is to be paid for by the cubic yard, the grading plane at any point shall be not more than 0.05 foot above the grade established by the Engineer.

In Section 19-3.025C replace the 1st paragraph with:

Cementitious material used in soil cement bedding shall conform to the provisions in Section 90-2.01, "Cementitious Materials." Supplementary cementitious material will not be required.

In Section 19-3.025C replace the 4th paragraph with:

The aggregate, cementitious material, and water shall be proportioned either by weight or by volume. Soil cement bedding shall contain not less than 282 pounds of cementitious material per cubic yard. The water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed.

In Section 19-3.062 replace the 1st paragraph with:

Slurry cement backfill shall consist of a fluid, workable mixture of aggregate, cementitious material, and water.

In Section 19-3.062 replace the 5th paragraph with:

Cementitious material shall conform to the provisions in Section 90-2.01, "Cementitious Materials." Supplementary cementitious material will not be required.

In Section 19-3.062 replace the 8th paragraph with:

The aggregate, cementitious material, and water shall be proportioned either by weight or by volume. Slurry cement backfill shall contain not less than 188 pounds of cementitious material per cubic yard. The water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed.

^^

SECTION 20 EROSION CONTROL AND HIGHWAY PLANTING
(Issued 08-17-07)

Replace Section 20-2.03 with:

20-2.03 SOIL AMENDMENT

Soil amendment shall comply with the requirements in the California Food and Agricultural Code.

Soil amendment producers shall comply with the following:

1. Be fully permitted to produce compost as specified under the California Integrated Waste Management Board, Local Enforcement Agencies and any other State and Local Agencies that regulate Solid Waste Facilities. If exempt from State permitting requirements, the composting facility must certify that it follows guidelines and procedures for production of compost meeting the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7.
2. Be a participant in United States Composting Council's Seal of Testing Assurance program.

Soil amendment shall be composted and may be derived from any single, or mixture of any of the following feedstock materials:

1. Green material consisting of chipped, shredded, or ground vegetation; or clean processed recycled wood products
2. Biosolids
3. Manure
4. Mixed food waste

Soil amendment feedstock materials shall be composted to reduce weed seeds, pathogens and deleterious materials as specified under Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7, Section 17868.3.

Soil amendment shall not be derived from mixed municipal solid waste and must be reasonably free of visible contaminates. Soil amendment must not contain paint, petroleum products, pesticides or any other chemical residues harmful to animal life or plant growth. Soil amendment must not possess objectionable odors.

Metal concentrations in soil amendment must not exceed the maximum metal concentrations listed in Title 14, California Code of Regulations, Division 7, Chapter 3.1, Section 17868.2.

Soil amendment must comply with the following:

Physical/Chemical Requirements

Property	Test Method	Requirement
pH	*TMECC 04.11-A, Elastometric pH 1:5 Slurry Method, pH Units	6.0–8.0
Soluble Salts	TMECC 04.10-A, Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0-10.0
Moisture Content	TMECC 03.09-A, Total Solids & Moisture at 70+/- 5 deg C, % Wet Weight Basis	30–60
Organic Matter Content	TMECC 05.07-A, Loss-On-Ignition Organic Matter Method (LOI), % Dry Weight Basis	30–65
Maturity	TMECC 05.05-A, Germination and Vigor Seed Emergence Seedling Vigor % Relative to Positive Control	 80 or Above 80 or Above
Stability	TMECC 05.08-B, Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	8 or below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	95% Passing 5/8 inch 70% Passing 3/8 inch
Pathogen	TMECC 07.01-B, Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	Pass
Pathogen	TMECC 07.01-B, Salmonella < 3 MPN/4 grams dry wt.	Pass
Physical Contaminants	TMECC 02.02-C, Man Made Inert Removal and Classification: Plastic, Glass and Metal, % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C, Man Made Inert Removal and Classification: Sharps (Sewing needles, straight pins and hypodermic needles), % > 4mm fraction	None Detected

*TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

Prior to application, the Contractor shall provide the Engineer with a copy of the soil amendment producer's Compost Technical Data Sheet and a copy of the compost producers STA certification. The Compost Technical Data Sheet shall include laboratory analytical test results, directions for product use, and a list of product ingredients.

Prior to application, the Contractor shall provide the Engineer with a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

In Section 20-2.10 delete the 8th, 9th, and 10th paragraphs.

In Section 20-3.04A delete the last paragraph.

Replace Section 20-4.055 with:

20-4.055 PRUNING

Pruning of plants shall be consistent with American National Standards Institute (ANSI), "Tree, Shrub and Other Woody Plant Maintenance Standard Practices," ANSI 300 (Part 1)-2001 and "Best Management Practices Tree Pruning," 2002 (ISBN 1-881956318), published by the International Society of Arboriculture, P.O. Boc 3129, Champaign, IL 61826.

^^

SECTION 24 LIME STABILIZATION
(Issued 06-05-09)

Replace Section 24 with:

SECTION 24 LIME STABILIZED SOIL

24-1.01 GENERAL

24-1.01A Summary

Section 24 includes specifications for stabilizing soil by mixing lime and water with soil and compacting the mixture to the specified dimensions.

24-1.01B Definitions

lime: Quicklime made from high-calcium or dolomitic sources specified under ASTM C 51. For high-calcium quicklime, the calcium oxide content must be greater than 90 percent. For dolomitic quicklime, the calcium oxide content must be greater than 55 percent and the combined calcium oxide and magnesium oxide content must be greater than 90 percent.

mellowing period: The time between the initial and final mixing to promote initial chemical reactions between lime, water, and soil.

24-1.01C Submittals

From 30 to 180 days before use, submit one 10-pound sample of each lime product proposed and from each source.

Submit lime samples in airtight containers under ASTM C 50. Mark the sample date on the container. Include the MSDS and chemical and physical analysis with the submittal.

With the lime samples, submit a Certificate of Compliance from the pre-qualified lime source under Section 6-1.07, "Certificates of Compliance," with a statement certifying the lime furnished is the same as that pre-qualified.

Fifteen days before starting soil stabilization activities, submit for the Engineer's approval a laboratory to perform quality control tests. The laboratory must be qualified under the Department's Independent Assurance Program.

Before you apply lime in slurry form, submit the slurry's lime content for Engineer's approval 25 days before application.

Before performing quality control sampling and testing, submit the time and location the sampling and testing will occur. Submit quality control testing results within 24 hours of receiving the results.

Submit a weighmaster certificate or bill of lading with each load of lime delivered to the jobsite.

24-1.01D Quality Control and Assurance

General

Perform quality control testing in the presence of the Engineer.

Place unique, sequentially numbered lock seals on each load and affix them to trailer blow down valves that are locked open. The bill of lading for each lime delivery must have that specific lock seal number legibly and visibly imprinted.

The Engineer samples each lime delivery truck at the job site and randomly tests them off-site.

Pre-qualification of Lime Sources

Lime sources must be listed on the Department's pre-qualified products list. The list is available at the METS web site.

The pre-qualified list for lime sources describes the application procedures for inclusion on the list.

Preparing Soil

After you prepare an area for lime soil stabilization, test the soil to be stabilized every 500 cubic yards for relative compaction under California Test 231 and moisture content under California Test 226, and verify the surface grades.

Applying Lime

The Engineer determines the final application rate for each lime product proposed from the samples submitted. If the soil being stabilized changes, the Engineer changes the application rate. Based on California Test 373, the Engineer reports the application rates as the percent of lime by dry weight of soil. The Engineer provides the optimum moisture content determined under California Test 373 for each application rate.

Before applying lime, measure the temperature at the ground surface.

If lime in dry form is used, the Engineer verifies the application rate using the drop pan method once per 40,000 square feet stabilized, or twice per day, whichever is greater.

If lime in slurry form is used, report the quantity of slurry placed by measuring the volume of slurry in the holding tank once per 40,000 square feet stabilized, or twice per day, whichever is greater.

Mixing

For each day of initial mixing, test the moisture content. Sample the material immediately after initial mixing.

Randomly test the adequacy of the final mixing with a phenolphthalein indicator solution.

During mixing operations, measure the ground temperature at full mixing depth.

After mixing and before compacting, determine maximum density under California Test 216 from composite samples of the mixed material and at each distinct change in material. Test the moisture content of the mixed material under California Test 226. Test the gradation for compliance with "Materials."

Compaction

Test relative compaction on a wet weight basis.

After initial compaction, determine in-place density under California Test 231 and moisture content under California Test 226 at the same locations. The testing frequency must be 1 test per 250 cubic yards of lime stabilized soil. Test in 0.50-foot depth intervals.

Before requesting to compact material in layers greater than 0.50 foot, construct a test strip in the production area and demonstrate the test strip passes compaction tests using the proposed thickness. The test strip must contain no more material than 1 day's production. The Engineer tests at not more than 0.50-foot depth intervals regardless of the thickness of your layers.

Construct test pads by scraping away material to the depth ordered by the Engineer. If a compaction test fails corrective action must include the layers of material already placed above the test pad elevation.

Finish Grading

Do not proceed with construction activities for subsequent layers of material until the Engineer verifies the final grades of the lime stabilized soil.

Dispute Resolution

You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result discrepancies. Notify the Engineer within 5 days of receiving a test result if you dispute the test result.

If you or the Engineer dispute each other's test results, submit written quality control test results and copies of paperwork including worksheets used to determine the disputed test results to the Engineer. An Independent Third Party (ITP) performs referee testing. Before the ITP participates in a dispute resolution, the ITP must be accredited under the Department's Independent Assurance Program. The ITP must be independent of the project. By mutual agreement, the ITP is chosen from:

1. A Department laboratory
2. A Department laboratory in a district or region not in the district or region the project is located
3. The Transportation Laboratory
4. A laboratory not currently employed by you or your lime producer

If split quality control or acceptance samples are not available, the ITP uses any available material representing the disputed material for evaluation.

24-1.02 MATERIALS

24-1.02A Lime

Lime must comply with ASTM C 977 and the following:

Lime

Quality Characteristic	ASTM	Specification
Available Calcium and Magnesium Oxide(min., %)	C 25[a]	High Calcium Quicklime: CaO > 90 Dolomitic Quicklime: CaO > 55 and CaO + MgO > 90
Loss on ignition (max., %)	C 25	7 (total loss) 5 (carbon dioxide) 2 (free moisture)
Slaking rate	C 110	30 °C rise in 8 minutes

Notes:
[a] You may use ASTM C25 or ASTM C1301 and ASTM C1271.

A 0.5-pound sample of lime dry-sieved in a mechanical sieve shaker for 10 minutes ±30 seconds must comply with:

Sieve Sizes	Percentage Passing
3/8-inch	98-100

Slurry must:

1. Be free of contaminants
2. Contain at least the minimum dry solids
3. Have uniform consistency

If you prepare lime slurry, prepare it at the jobsite.

24-1.02B Water

If available, use potable water. Inform the Engineer if a water source other than potable water is used. If not using potable water, water for mixing soil and lime must:

1. Contain no more than 650 parts per million of chlorides as Cl, and no more than 1,300 parts per million of sulfates as SO_4
2. Not contain an amount of impurities that will cause a reduction in the strength of the stabilize soil

24-1.02C Mixed Material

Take a composite sample from 5 random locations after initial mixing. The moisture content of the composite sample tested under California Test 226 must be a minimum of 3 percent greater than optimum. Determine the moisture versus density relationship of the composite sample material determined under California Test 216, except Part 2, Section E, Paragraph 6 is modified as follows:

> After adjustment of the moisture content, compact each of the remaining test specimens in the mold, then record the water adjustment, tamper reading, and the corresponding adjusted wet density from the chart on Table 1 using the column corresponding to the actual wet weight of the test specimen compacted. Note each of these wet weights on Line I.

The mixed material before compaction excluding rock must comply with:

Sieve Sizes	Percentage Passing
1"	98 - 100
No. 4	60 - 100

24-1.02D Curing Treatment

Curing treatment may be any of the following:

1. Water cure
2. Curing seal
3. Moist material blanket

Curing seal must be SS or CSS grade asphaltic emulsion under Section 94, "Asphaltic Emulsions."

24-1.03 CONSTRUCTION

24-1.03A General

If using different types of lime or lime from more than one source, do not mix them. The Engineer determines separate application rates.

Deliver lime in full loads unless it is the last load needed for a work shift.

Apply lime at ground temperatures above 35 °F. Do not apply lime if you expect the ground temperature to drop below 35 °F before you complete mixing and compacting.

During mixing, maintain the in-place moisture of the soil to be stabilized a minimum 3 percent above the optimum moisture determined under California Test 216 as modified in "Mixed Material." During compaction and finish grading, add water to the surface to prevent drying until the next layer of mixed material is placed, or until you apply curing treatment.

Scarify the surface of lime stabilized soil at least 2 inches between each layer. Do not scarify the final surface of the lime stabilized soil.

Between the time of applying lime and 3 days after applying curing treatment, only allow equipment or vehicles on the soil being stabilized that are essential to the work.

24-1.03B Preparing Soil

Except for soil clods, remove rocks or solids larger than 1/3 of the layer thickness. Regardless of the layer thickness, remove rocks and solids greater than 4 inches. Notify the Engineer if you encounter rocks or solids greater than 1/3 of the layer thickness.

Before adding lime, place the soil to be stabilized to within 0.08 foot of the specified lines and grades and compact to not less than 90 percent relative compaction.

24-1.03C Applying Lime

Apply lime uniformly over the area to be stabilized using a vane spreader.

The Engineer determines the final application rate. Do not vary from this application rate by more than 5 percent.

Apply lime in dry form. If you request and the Engineer approves, you may apply lime in slurry form.

Lime slurry must be in suspension during application. Apply lime slurry uniformly making successive passes over a measured section or roadway until the specified lime content is reached. Apply the residue from lime slurry over the length of the roadway being processed.

24-1.03D Mixing

Lime and soil to be stabilized must be mixed uniformly at least twice to within 0.10 foot of the specified depth at any point. If the mixing depth exceeds the specified depth by more than 10 percent, add lime in proportion to the exceeded depth. The Department does not pay for this added lime.

Mix lime on the same day it is applied. After the initial mixing, allow a mellowing period for at least 36 hours before final mixing. Moisture content during the mellowing period determined under California Test 226 must be at least 3 percent higher than the optimum moisture content. You may add water and mix during the mellowing period.

Remix until the mixture is uniform with no streaks or pockets of lime.

Except for clods larger than 1 inch, mixed material must have a color reaction with sprayed phenolphthalein alcohol indicator solution.

Complete all the mixing work within 7 days of the initial application of lime.

24-1.03E Compaction

Begin compacting immediately after final mixing, but not less than 36 hours after the beginning of initial mixing.

Compact by using sheepsfoot or segmented wheel rollers immediately followed by steel drum or pneumatic-tired rollers. Do not use vibratory rollers.

If you request and the Engineer approves, you may compact mixed material in layers greater than 0.50 foot.

If the specified thickness is 0.50 foot or less, compact in one layer. If the specified thickness is more than 0.50 foot, compact in 2 or more layers of approximately equal thickness. The maximum compacted thickness of any one layer must not exceed 0.50 foot unless you first demonstrate your equipment and methods provide uniform distribution of lime and achieve the specified compaction.

Use other compaction methods in areas inaccessible to rollers.

Compact the lime stabilized soil to at least 95 percent relative compaction determined under California Test 216 as modified under "Mixed Material." The relative compaction is determined on a wet weight basis.

24-1.03F Finish Grading

Maintain the moisture content of the lime stabilized soil through the entire finish grading operation at a minimum of 3 percent above optimum moisture content.

The finished surface of the lime stabilized soil must not vary more than 0.08 foot above or below the grade established by the Engineer unless the lime stabilized soil is to be covered by material paid for by the cubic yard, in which case the finished surface may not vary above the grade established by the Engineer.

If lime stabilized soil is above the allowable tolerance, trim, remove, and dispose of the excess material. Do not leave loose material on the finished surface. If finish rolling cannot be completed within 2 hours of trimming, defer trimming.

If lime stabilized soil is below the allowable tolerance, you may use trimmed material to fill low areas only if final grading and final compaction occurs within 48 hours of beginning initial compaction. Before placing trimmed material, scarify the surface of the area to be filled at least 2 inches deep.

Finish rolling of trimmed surfaces must be performed with at least 1 complete coverage with steel drum or pneumatic-tired rollers.

24-1.03G Curing

General

Choose the method of curing.

Apply the chosen cure method within 48 hours of completing the sheepsfoot or segmented wheel compaction. Apply the chosen cure method within the same day of any trimming and finish grading.

Water Cure

Water may be used to cure the finished surface before you place a moist material blanket, or apply curing seal. Keep the surface above the optimum moisture content of the lime stabilized soil. Use this method for no more than 3 days, after which you must place a curing seal or moist material blanket.

Curing Seal

Curing seal equipment must have a gage indicating the volume of curing seal in the storage tank.

If curing seal is used, apply it:

1. To the finished surface of lime stabilized soil under Section 94-1.06, "Applying," of the Standard Specifications
2. At a rate from 0.10 to 0.20 gallon per square yard. The Engineer determines the exact rate
3. When the lime stabilized soil is at optimum moisture
4. When the ambient temperature is above 40 °F and rising

Repair damaged curing seal the same day the damage occurs.

Moist Material Blanket

Moist material blanket consists of moist structural material. Moist material blanket may be a temporary or permanent layer of material of sufficient thickness to prevent drying of the lime stabilized soil. You may use moist material blanket if the lime stabilized soil can bear the weight of construction equipment. Maintain the moist material blanket above the optimum moisture content, as appropriate, until the next structural layer is placed.

24-1.04 MEASUREMENT AND PAYMENT

Lime stabilized soil is measured by the square yard determined from horizontal measurements of the planned surface of the lime stabilized soil.

Curing seal is measured under Section 94, "Asphaltic Emulsions." The amount of curing seal used is determined from the gauge specified for the curing equipment.

The contract item prices for the work involved with lime stabilized soil are paid:

1. Per square yard for lime stabilized soil
2. Per ton for lime
3. Per ton for asphaltic emulsion (curing seal)

Payment for the contract items involved with lime stabilized soil includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the lime stabilized soil, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The Department does not adjust payment for lime.

Quantities of lime wasted or disposed of in a manner not specified, or remaining on hand after completion of the work, will not be paid for. If you use a partial load of lime, weigh the truck and the remaining lime on a scale under Section 9-1.01, "Measurement of Quantities," and submit a weighmaster certificate to the Engineer.

Full compensation for preparing soil to be stabilized is included in the contract price paid per square yard for lime stabilized soil, and no separate payment is made therefor, except removing and disposing of rocks and solids larger 1/3 of the layer thickness and larger than 4 inches from native soil or embankment other than imported borrow is paid for as extra work as provided in Section 4-1.03D, "Extra Work." Removing and disposing of rocks and solids larger than 1/3 of the lift thickness and larger than 4 inches from imported borrow is at your expense.

Full compensation for mixing, compacting, and maintaining the moisture content of the lime stabilized soil is included in the contract price paid per square yard for lime stabilized soil, and no separate payment is made therefor.

Full compensation for applying lime is included in the contract price paid per ton for lime, and no additional compensation is allowed therefor.

If the dispute resolution ITP determines the Engineer's test results are correct, the Engineer deducts the ITP's testing costs from payments. If the ITP determines your test results are correct, the State pays the ITP testing costs.

^^

SECTION 25 AGGREGATE SUBBASES
(Issued 02-16-07)

In Section 25-1.02A replace the 1st paragraph with:

Aggregate must be clean and free from organic matter and other deleterious substances. Aggregate must consist of any combination of:

1. Broken stone
2. Crushed gravel
3. Natural rough surfaced gravel
4. Sand
5. Up to 100 percent of any combination of processed:

    5.1. Asphalt concrete
    5.2. Portland cement concrete
    5.3. Lean concrete base
    5.4. Cement treated base

Replace Section 25-1.02B with:

25-1.02B Class 4 Aggregate Subbase

Aggregate must be clean and free from organic matter and other deleterious substances. Aggregate must consist of any combination of:

1. Broken stone
2. Crushed gravel
3. Natural rough surfaced gravel
4. Sand
5. Up to 100 percent of any combination of processed:

    5.1. Asphalt concrete
    5.2. Portland cement concrete
    5.3. Lean concrete base
    5.4. Cement treated base

^^

SECTION 26 AGGREGATE BASES
(Issued 02-16-07)

In Section 26-1.02A replace the 1st paragraph with:

Aggregate must be clean and free from organic matter and other deleterious substances. Aggregate must consist of any combination of:

1. Broken stone
2. Crushed gravel
3. Natural rough surfaced gravel
4. Sand
5. Up to 100 percent of any combination of processed:

    5.1. Asphalt concrete
    5.2. Portland cement concrete
    5.3. Lean concrete base
    5.4. Cement treated base

In Section 26-1.02B replace the 1st paragraph with:

Aggregate must be clean and free from organic matter and other deleterious substances. Aggregate must consist of any combination of:

1. Broken stone
2. Crushed gravel
3. Natural rough surfaced gravel
4. Sand
5. Up to 100 percent of any combination of processed:

    5.1. Asphalt concrete
    5.2. Portland cement concrete
    5.3. Lean concrete base
    5.4. Cement treated base

^^

SECTION 27 CEMENT TREATED BASES
(Issued 07-31-07)

In Section 27-1.02 replace the 1st paragraph with:

Cement shall be Type II portland cement conforming to the provisions in Section 90-2.01A, "Cement."

In Section 27-1.02 replace the 3rd paragraph with:

Aggregate for use in Class A cement treated base shall be of such quality that when mixed with cement in an amount not to exceed 5 percent by weight of the dry aggregate and compacted at optimum moisture content, the compressive strength of a sample of the compacted mixture shall not be less than 750 pounds per square inch at 7 days, when tested by California Test 312.

In Section 27-1.02 replace the 4th paragraph with:

Aggregate for use in Class B cement treated base shall have a Resistance (R-value) of not less than 60 before mixing with cement and a Resistance (R-value) of not less than 80 after mixing with cement in an amount not to exceed 2.5 percent by weight of the dry aggregate.

In Section 27-1.07 replace the 9th paragraph with:

When surfacing material is hot mix asphalt, the low areas shall be filled with hot mix asphalt conforming to the requirements for the lowest layer of hot mix asphalt to be placed as surfacing. This filling shall be done as a separate operation prior to placing the lowest layer of surfacing, and full compensation for this filling will be considered as included in the contract price paid for cement treated base and no additional compensation will be allowed therefor.

^^

SECTION 28 LEAN CONCRETE BASE
(Issued 05-15-09)

In Section 28-1.02 replace the 1st paragraph with:

Cement shall be Type II portland cement conforming to the provisions in Section 90-2.01A, "Cement."

In Section 28-1.02 replace the 6th paragraph with:

Aggregate shall be of such quality that, when mixed with cement in an amount not to exceed 300 pounds per cubic yard, and tested in conformance with the requirements in California Test 548, the compressive strength of a sample will be not less than 700 pounds per square inch at 7 days.

Replace Section 28-1.05 with:

Placing of lean concrete base shall conform to the provisions for placing concrete pavement in Section 40-3.04, "Placing Concrete," except that the third paragraph in Section 40-3.04A, "General," shall not apply.

Unless otherwise required by the plans or the special provisions, lean concrete base shall be constructed in not less than 12-foot widths separated by construction joints. Lean concrete base constructed monolithically in widths greater than 26 feet shall be constructed with a longitudinal contraction joint offset not more than 3 feet from the centerline of the width being constructed.

Longitudinal contraction joints in lean concrete base shall be constructed in conformance with the provisions in Section 40-3.08E, "Sawing Method."

When concrete pavement is to be placed over lean concrete base, longitudinal construction joints and longitudinal contraction joints in the lean concrete base shall not be within one foot of planned longitudinal contraction joints nor longitudinal constuction joints in the concrete pavement.

Lean concrete base shall not be mixed nor placed while the atmospheric temperature is below 35 °F, and shall not be placed on frozen ground.

In Section 28-1.06 replace the 1st and 2nd paragraphs with:

Lean concrete base shall be spread, compacted, and shaped in conformance with the provisions in Section 40-3.04D, "Stationary Side Form Construction," and Section 40-3.04E, "Slip-Form Construction."

In advance of curing operations, lean concrete base to be surfaced with hot mix asphalt shall be textured with a drag strip of burlap, a broom or a spring steel tine device which will produce scoring in the finished surface. The scoring shall be parallel with the centerline or transverse thereto. The operation shall be performed at a time and in a manner to produce the coarsest texture practical for the method used.

In Section 28-1.08 replace the 2nd paragraph with:

Hardened lean concrete base with a surface lower than 0.05 foot below the grade established by the Engineer shall be removed and replaced with lean concrete base which complies with these specifications, or if permitted by the Engineer, the low areas shall be filled with pavement material as follows:

1. When pavement material is hot mix asphalt, the low areas shall be filled with hot mix asphalt conforming to the requirements for the lowest layer of hot mix asphalt to be placed as pavement. This shall be done as a separate operation prior to placing the lowest layer of pavement, and full compensation for this filling will be considered as included in the contract price paid per cubic yard for lean concrete base and no additional compensation will be allowed therefor.
2. When pavement material is portland cement concrete, the low areas shall be filled with pavement concrete at the time and in the same operation that the pavement is placed. Full compensation for this filling will be considered as included in the contract price paid per cubic yard for lean concrete base and no additional compensation will be allowed therefor.

^^

SECTION 29 TREATED PERMEABLE BASES
(Issued 05-15-09)

In Section 29-1.02B replace the 2nd paragraph with:

Cement shall be Type II portland cement conforming to the provisions in Section 90-2.01A, "Cement."

In Section 29-1.04A replace the 1st paragraph with:

Aggregates and asphalt for asphalt treated permeable base shall be stored, proportioned and mixed in the same manner provided for storing, proportioning and mixing aggregates and asphalt for hot mix asphalt in Section 39-1.08, "Production," except as follows:

1. The aggregate need not be separated into sizes.
2. The temperature of the aggregate before adding the asphalt binder shall be not less than 275° F nor more than 325° F.
3. Asphalt treated permeable base stored in excess of 2 hours shall not be used in the work.
4. The aggregate shall be combined with 2.5 percent paving asphalt by weight of the dry aggregate. After testing samples of the Contractor's proposed aggregate supply, the Engineer may order an increase or decrease in the asphalt content. If an increase or decrease is ordered, and the increase or decrease exceeds the specified amount by more than 0.1 percent by weight of the dry aggregate, the compensation payable to the Contractor for the asphalt treated permeable base will be increased or decreased on the basis of the total increase or decrease in asphalt.
5. The asphalt content of the asphalt mixture will be determined, at the option of the Engineer, by extraction tests in conformance with the requirements in California Test 310 or 362, or will be determined in conformance with the requirements in California Test 379. The bitumen ratio pounds of asphalt per 100 pounds of dry aggregate shall not vary by more than 0.5 pound of asphalt above or 0.5 pound of asphalt below the amount designated by the Engineer. Compliance with this requirement will be determined either by taking samples from trucks at the plant or from the mat behind the paver before rolling. If the sample is taken from the mat behind the paver, the bitumen ratio shall be not less than the amount designated by the Engineer, less 0.7 pound of asphalt per 100 pounds of dry aggregate.

In Section 29-1.04B replace the 2nd paragraph with:

Cement treated permeable base shall contain not less than 287 pounds of cement per cubic yard.

In Section 29-1.05 replace the 1st paragraph with:

Asphalt treated permeable base shall be spread and compacted as specified for hot mix asphalt under the "Method" construction process in Section 39, "Hot Mix Asphalt," and these specifications.

In Section 29-1.05 in the 8th paragraph, replace the 2nd sentence with:

The filter fabric shall conform to the provisions in Section 88-1.02, "Filtration," and shall be placed in conformance with the provisions for placing filter fabric for edge drains in Section 68-3.03, "Installation."

In Section 29-1.06 replace the 1st and 2nd paragraphs with:

Cement treated base shall be placed, spread, compacted, and shaped in conformance with the provisions in Section 40-3.04D, "Stationary Side Form Construction," and Section 40-3.04E, "Slip-Form Construction," except that vibrators shall not be used and the third paragraph in Section 40-3.04A, "General," shall not apply.

In Section 29-1.06 in the 9th paragraph, replace the 2nd sentence with:

The filter fabric shall conform to the provisions in Section 88-1.02, "Filtration," and shall be placed in conformance with the provisions for placing filter fabric for edge drains in Section 68-3.03, "Installation."

In Section 29-1.07 replace the 2nd paragraph with:

Hardened treated permeable base with a surface lower than 0.05 foot below the grade established by the Engineer shall be removed and replaced with treated permeable base which complies with these specifications, or if permitted by the Engineer, the low areas shall be filled with pavement material as follows:

1. When pavement material is hot mix asphalt, the low areas shall be filled with hot mix asphalt conforming to the requirements for the lowest layer of hot mix asphalt to be placed as pavement. This shall be done as a separate operation prior to placing the lowest layer of pavement.
2. When pavement material is portland cement concrete, the low areas shall be filled with pavement concrete at the time and in the same operation in which the pavement is placed.
3. Full compensation for filling low areas will be considered as included in the contract price paid per cubic yard for treated permeable base and no additional compensation will be allowed therefor.

^^

SECTION 37 BITUMINOUS SEALS
(Issued 06-05-09)

In Section 37-1.03 replace the 4th through 6th paragraphs with:

On 2-lane two-way roadways, W8-7 "LOOSE GRAVEL" signs and W13-1 (35) speed advisory signs shall be furnished and placed adjacent to both sides of the traveled way where screenings are being spread on a traffic lane. The first W8-7 sign in each direction shall be placed where traffic first encounters loose screenings, regardless of which lane the screenings are being spread on. The W13-1 (35) signs need not be placed in those areas with posted speed limits of less than 40 MPH. The signs shall be placed at maximum 2,000-foot intervals along each side of the traveled way and at public roads or streets entering the seal coat area as directed by the Engineer.

On multilane roadways (freeways, expressways and multilane conventional highways) where screenings are being spread on a traffic lane, W8-7 "LOOSE GRAVEL" signs and W13-1 (35) speed advisory signs shall be furnished and placed adjacent to the outside edge of the traveled way nearest to the lane being worked on. The first W8-7 sign shall be placed where the screenings begin with respect to the direction of travel on that lane. The W13-1 (35) signs need not be placed in those areas with posted speed limits of less than 40 MPH. The signs shall be placed at maximum 2,000-foot intervals along the edge of traveled way and at on-ramps, public roads or streets entering the seal coat area as directed by the Engineer.

The W8-7 and W13-1 signs shall be maintained in place at each location until final brooming of the seal coat surface at that location is completed. The W8-7 and W13-1 signs shall conform to the provisions for construction area signs in Section 12, "Construction Area Traffic Control Devices." The signs may be set on temporary portable supports with the W13-1 below the W8-7 or on barricades with the W13-1 sign alternating with the W8-7 sign.

In Section 37-1.07 replace the 2nd paragraph with:

Rollers shall be oscillating type pneumatic-tired rollers. A minimum of 2 pneumatic-tired rollers conforming to the provisions in Section 39-3.03 "Spreading and Compacting Equipment," shall be furnished.

In Section 37-1.09 replace the 2nd paragraph with:

The above prices and payments shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in applying seal coat, complete in place, including furnishing, placing, maintaining, and removing W8-7 and W13-1 signs, when required, and temporary supports or barricades for the signs, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

In Section 37-2.05 replace the 6th paragraph with:

In addition to conforming to the provisions in Section 5-1.10, "Equipment," the identifying number of mixer-spreader trucks shall be at least 2 inches in height, located on the front and rear of the vehicle.

^^

SECTION 39 ASPHALT CONCRETE
(Issued 06-05-09)

Replace Section 39 with:

SECTION 39 HOT MIX ASPHALT

39-1 GENERAL

39-1.01 DESCRIPTION

Section 39 includes specifications for producing and placing hot mix asphalt (HMA) by mixing aggregate and asphalt binder at a mixing plant and spreading and compacting the HMA mixture.

The special provisions specify one or more type of HMA, including:

1. Type A
2. Type B
3. Open graded friction course (OGFC). OGFC includes hot mix asphalt (open graded), rubberized hot mix asphalt (open graded) (RHMA-O) and rubberized hot mix asphalt (open graded high binder) (RHMA-O-HB)
4. Rubberized hot mix asphalt (gap graded) (RHMA-G)

The special provisions specify the HMA construction process, including:

1. Standard
2. Method
3. Quality Control / Quality Assurance (QC / QA)

39-1.02 MATERIALS

39-1.02A Geosynthetic Pavement Interlayer

Geosynthetic pavement interlayer must comply with the specifications for pavement fabric or paving mat in Section 88-1.07, "Pavement Interlayer."

39-1.02B Tack Coat

Tack coat must comply with the specifications for asphaltic emulsion in Section 94, "Asphaltic Emulsion," or asphalt binder in Section 92, "Asphalts." Choose the type and grade.

Notify the Engineer if you dilute asphaltic emulsion with water. The weight ratio of added water to asphaltic emulsion must not exceed 1 to 1.

Measure added water either by weight or volume in compliance with the specifications for weighing, measuring, and metering devices under Section 9-1.01, "Measurement of Quantities," or you may use water meters from water districts, cities, or counties. If you measure water by volume, apply a conversion factor to determine the correct weight.

With each dilution, submit in writing:

1. The weight ratio of water to bituminous material in the original asphaltic emulsion
2. The weight of asphaltic emulsion before diluting
3. The weight of added water
4. The final dilution weight ratio of water to asphaltic emulsion

39-1.02C Asphalt Binder

Asphalt binder in HMA must comply with Section 92, "Asphalts," or Section 39-1.02D, "Asphalt Rubber Binder." The special provisions specify the grade.

Asphalt binder for geosynthetic pavement interlayer must comply with Section 92, "Asphalts." Choose from Grades PG 64-10, PG 64-16, or PG 70-10.

39-1.02D Asphalt Rubber Binder

General

Use asphalt rubber binder in RHMA-G, RHMA-O, and RHMA-O-HB. Asphalt rubber binder must be a combination of:

1. Asphalt binder
2. Asphalt modifier
3. Crumb rubber modifier (CRM)

The combined asphalt binder and asphalt modifier must be 80.0 ± 2.0 percent by weight of the asphalt rubber binder.

Asphalt Modifier

Asphalt modifier must be a resinous, high flash point, and aromatic hydrocarbon, and comply with:

Asphalt Modifier for Asphalt Rubber Binder

Quality Characteristic	ASTM	Specification
Viscosity, m^2/s (x 10^{-6}) at 100 °C	D 445	X ± 3 [a]
Flash Point, CL.O.C., °C	D 92	207 minimum
Molecular Analysis		
Asphaltenes, percent by mass	D 2007	0.1 maximum
Aromatics, percent by mass	D 2007	55 minimum

Note:
[a] The symbol "X" is the proposed asphalt modifier viscosity. "X" must be between 19 and 36. A change in "X" requires a new asphalt rubber binder design.

Asphalt modifier must be from 2.0 percent to 6.0 percent by weight of the asphalt binder in the asphalt rubber binder.

Crumb Rubber Modifier

CRM consists of a ground or granulated combination of scrap tire CRM and high natural CRM. CRM must be 75.0 ± 2.0 percent scrap tire CRM and 25.0 ± 2.0 percent high natural CRM by total weight of CRM. Scrap tire CRM must be from any combination of automobile tires, truck tires, or tire buffings.

Sample and test scrap tire CRM and high natural CRM separately. CRM must comply with:

Crumb Rubber Modifier for Asphalt Rubber Binder

Quality Characteristic	Test Method	Specification
Scrap tire CRM gradation (% passing No. 8 sieve)	LP-10	100
High natural CRM gradation (% passing No. 10 sieve)	LP-10	100
Wire in CRM (% max.)	LP-10	0.01
Fabric in CRM (% max.)	LP-10	0.05
CRM particle length (inch max.) [a]	--	3/16
CRM specific gravity [a]	CT 208	1.1 – 1.2
Natural rubber content in high natural CRM (%) [a]	ASTM D 297	40.0 – 48.0

Note:
[a] Test at mix design and for Certificate of Compliance.

Only use CRM ground and granulated at ambient temperature. If steel and fiber are cryogenically separated, it must occur before grinding and granulating. Only use cryogenically produced CRM particles that can be ground or granulated and not pass through the grinder or granulator.

CRM must be dry, free-flowing particles that do not stick together. CRM must not cause foaming when combined with the asphalt binder and asphalt modifier. You may add calcium carbonate or talc up to 3 percent by weight of CRM.

Asphalt Rubber Binder Design and Profile

Submit in writing an asphalt rubber binder design and profile that complies with the asphalt rubber binder specifications. In the design, designate the asphalt, asphalt modifier, and CRM and their proportions. The profile must include the same component sources for the asphalt rubber binder used.

Design the asphalt rubber binder from testing you perform for each quality characteristic and for the reaction temperatures expected during production. The 24-hour (1,440-minute) interaction period determines the design profile. At a minimum, mix asphalt rubber binder components, take samples, and perform and record the following tests:

Asphalt Rubber Binder Reaction Design Profile

Test	Minutes of Reaction [a]							Limits
	45	60	90	120	240	360	1440	
Cone penetration @ 77 °F, 0.10-mm (ASTM D 217)	X [b]				X		X	25 - 70
Resilience @ 77 °F, percent rebound (ASTM D 5329)	X				X		X	18 min.
Field softening point, °F (ASTM D 36)	X				X		X	125 - 165
Viscosity, centipoises (LP-11)	X	X	X	X	X	X	X	1,500 - 4,000

Notes:
[a] Six hours (360 minutes) after CRM addition, reduce the oven temperature to 275 °F for a period of 16 hours. After the 16-hour (1320 minutes) cool-down after CRM addition, reheat the binder to the reaction temperature expected during production for sampling and testing at 24 hours (1440 minutes).
[b] "X" denotes required testing

Asphalt Rubber Binder

After interacting for a minimum of 45 minutes, asphalt rubber binder must comply with:

Asphalt Rubber Binder

Quality Characteristic	Test for Quality Control or Acceptance	Test Method	Specification	
			Minimum	Maximum
Cone penetration @ 77 °F, 0.10-mm	Acceptance	ASTM D 217	25	70
Resilience @ 77 °F, percent rebound	Acceptance	ASTM D 5329	18	--
Field softening point, °F	Acceptance	ASTM D 36	125	165
Viscosity @ 375 °F, centipoises	Quality Control	LP-11	1,500	4,000

39-1.02E Aggregate

Aggregate must be clean and free from deleterious substances. Aggregate:

1. Retained on the No. 4 sieve is coarse
2. Passing the No. 4 sieve is fine

3. Added and passing the No. 30 sieve is supplemental fine, including:

   3.1. Hydrated lime
   3.2. Portland cement
   3.3. Fines from dust collectors

The special provisions specify the aggregate gradation for each HMA type.

The specified aggregate gradation is before the addition of asphalt binder and includes supplemental fines. The Engineer tests for aggregate grading under California Test 202, modified by California Test 105 if there is a difference in specific gravity of 0.2 or more between the coarse and fine parts of different aggregate blends.

Choose a sieve size target value (TV) within each target value limit presented in the aggregate gradation tables.

Aggregate Gradation
(Percentage Passing)
HMA Types A and B

3/4–inch HMA Types A and B

Sieve Sizes	Target Value Limits	Allowable Tolerance
1"	100	—
3/4"	90 - 100	TV ±5
1/2"	70 - 90	TV ±6
No. 4	45 - 55	TV ±7
No. 8	32 - 40	TV ±5
No. 30	12 - 21	TV ±4
No. 200	2 - 7	TV ±2

1/2–inch HMA Types A and B

Sieve Sizes	Target Value Limits	Allowable Tolerance
3/4"	100	—
1/2"	95 - 99	TV ±6
3/8"	75 - 95	TV ±6
No. 4	55 - 66	TV ±7
No. 8	38 - 49	TV ±5
No. 30	15 - 27	TV ±4
No. 200	2 - 8	TV ±2

3/8–inch HMA Types A and B

Sieve Sizes	Target Value Limits	Allowable Tolerance
1/2"	100	—
3/8"	95 - 100	TV ±6
No. 4	58 - 72	TV ±7
No. 8	34 - 48	TV ±6
No. 30	18 - 32	TV ±5
No. 200	2 - 9	TV ±2

No. 4 HMA Types A and B

Sieve Sizes	Target Value Limits	Allowable Tolerance
3/8"	100	—
No. 4	95 - 100	TV ±7
No. 8	72 - 77	TV ±7
No. 30	37 - 43	TV ±7
No. 200	2 - 12	TV ±4

Rubberized Hot Mix Asphalt - Gap Graded (RHMA-G)

3/4–inch RHMA-G

Sieve Sizes	Target Value Limits	Allowable Tolerance
1"	100	—
3/4"	95 - 100	TV ±5
1/2"	83 - 87	TV ±6
3/8"	65 - 70	TV ±6
No. 4	28 - 42	TV ±7
No. 8	14 - 22	TV ±5
No. 200	0 - 6	TV ±2

1/2–inch RHMA-G

Sieve Sizes	Target Value Limits	Allowable Tolerance
3/4"	100	—
1/2"	90 - 100	TV ±6
3/8"	83 - 87	TV ±6
No. 4	28 - 42	TV ±7
No. 8	14 - 22	TV ±5
No. 200	0 - 6	TV ±2

Open Graded Friction Course (OGFC)

1–inch OGFC

Sieve Sizes	Target Value Limits	Allowable Tolerance
1 1/2"	100	—
1"	99 - 100	TV ±5
3/4"	85 - 96	TV ±5
1/2"	55 - 71	TV ±6
No. 4	10 - 25	TV ±7
No. 8	6 - 16	TV ±5
No. 200	1 - 6	TV ±2

1/2–inch OGFC

Sieve Sizes	Target Value Limits	Allowable Tolerance
3/4"	100	—
1/2"	95 - 100	TV ±6
3/8"	78 - 89	TV ±6
No. 4	28 - 37	TV ±7
No. 8	7 - 18	TV ±5
No. 30	0 - 10	TV ±4
No. 200	0 - 3	TV ±2

3/8–inch OGFC

Sieve Sizes	Target Value Limits	Allowable Tolerance
1/2"	100	—
3/8"	90 - 100	TV ±6
No. 4	29 - 36	TV ±7
No. 8	7 - 18	TV ±6
No. 30	0 - 10	TV ±5
No. 200	0 - 3	TV ±2

Before the addition of asphalt binder and lime treatment, aggregate must comply with:

Aggregate Quality

Quality Characteristic	Test Method	HMA Type			
		A	B	RHMA-G	OGFC
Percent of crushed particles	CT 205				
Coarse aggregate (% min.)					
One fractured face		90	25	--	90
Two fractured faces		75	--	90	75
Fine aggregate (% min) (Passing No. 4 sieve and retained on No. 8 sieve.)					
One fractured face		70	20	70	90
Los Angeles Rattler (% max.)	CT 211				
Loss at 100 Rev.		12	--	12	12
Loss at 500 Rev.		45	50	40	40
Sand equivalent (min.) [a]	CT 217	47	42	47	--
Fine aggregate angularity (% min.) [b]	AASHTO T 304 Method A	45	45	45	--
Flat and elongated particles (% max. by weight @ 5:1)	ASTM D 4791	10	10	10	10

Notes:
[a] Reported value must be the average of 3 tests from a single sample.
[b] The Engineer waives this specification if HMA contains less than 10 percent of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

39-1.02F Reclaimed Asphalt Pavement

You may produce HMA using reclaimed asphalt pavement (RAP). HMA produced using RAP must comply with the specifications for HMA except aggregate quality specifications do not apply to RAP. You may substitute RAP aggregate for a part of the virgin aggregate in HMA in a quantity not exceeding 15.0 percent of the aggregate blend. Do not use RAP in OGFC and RHMA-G.

Assign the substitution rate of RAP aggregate for virgin aggregate with the job mix formula (JMF) submittal. The JMF must include the percent of RAP used. If you change your assigned RAP aggregate substitution rate by more than 5 percent (within the 15.0 percent limit), submit a new JMF.

Process RAP from asphalt concrete. You may process and stockpile RAP throughout the project's life. Prevent material contamination and segregation. Store RAP in stockpiles on smooth surfaces free of debris and organic material. Processed RAP stockpiles must consist only of homogeneous RAP.

39-1.03 HOT MIX ASPHALT MIX DESIGN REQUIREMENTS

39-1.03A General

A mix design consists of performing California Test 367 and laboratory procedures on combinations of aggregate gradations and asphalt binder contents to determine the optimum binder content (OBC) and HMA mixture qualities. If RAP is used, use Laboratory Procedure LP-9. The result of the mix design becomes the proposed JMF.

Use Form CEM-3512 to document aggregate quality and mix design data. Use Form CEM-3511 to present the JMF.

Laboratories testing aggregate qualities and preparing the mix design and JMF must be qualified under the Department's Independent Assurance Program. Take samples under California Test 125.

The Engineer reviews the aggregate qualities, mix design, and JMF and verifies and accepts the JMF.

You may change the JMF during production. Do not use the changed JMF until the Engineer accepts it. Except when adjusting the JMF in compliance with Section 39-1.03E, "Job Mix Formula Verification," perform a new mix design and submit in writing a new JMF submittal for changing any of the following:

1. Target asphalt binder percentage
2. Asphalt binder supplier
3. Asphalt rubber binder supplier
4. Component materials used in asphalt rubber binder or percentage of any component materials
5. Combined aggregate gradation
6. Aggregate sources
7. Substitution rate for RAP aggregate of more than 5 percent
8. Any material in the JMF

For OGFC, submit in writing a complete JMF submittal except asphalt binder content. The Engineer determines the asphalt binder content under California Test 368 within 20 days of your complete JMF submittal and provides you a Form CEM-3513.

39-1.03B Hot Mix Asphalt Mix Design

Perform a mix design that produces HMA in compliance with:

Hot Mix Asphalt Mix Design Requirements

Quality Characteristic	Test Method	HMA Type		
		A	B	RHMA-G
Air voids content (%)	CT 367[a]	4.0	4.0	Special Provisions
Voids in mineral aggregate (% min.)	LP-2			
No. 4 grading		17.0	17.0	--
3/8" grading		15.0	15.0	--
1/2" grading		14.0	14.0	18.0 – 23.0[b]
3/4" grading		13.0	13.0	18.0 – 23.0[b]
Voids filled with asphalt (%)	LP-3			
No. 4 grading		76.0 – 80.0	76.0 – 80.0	Note d
3/8" grading		73.0 – 76.0	73.0 – 76.0	
1/2" grading		65.0 – 75.0	65.0 – 75.0	
3/4" grading		65.0 – 75.0	65.0 – 75.0	
Dust proportion	LP-4			
No. 4 and 3/8" gradings		0.9 – 2.0	0.9 – 2.0	Note d
1/2" and 3/4" gradings		0.6 – 1.3	0.6 – 1.3	
Stabilometer value (min.) [c]	CT 366			
No. 4 and 3/8" gradings		30	30	--
1/2" and 3/4" gradings		37	35	23

Notes:

[a] Calculate the air voids content of each specimen using California Test 309 and Lab Procedure LP-1. Modify California Test 367, Paragraph C5, to use the exact air voids content specified in the selection of OBC.
[b] Voids in mineral aggregate for RHMA-G must be within this range.
[c] Modify California Test 304, Part 2.B.2.c: "After compaction in the compactor, cool to 140 °± 5 °F by allowing the briquettes to cool at room temperature for 0.5-hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."
[d] Report this value in the JMF submittal.

For stability and air voids content, prepare 3 briquettes at the OBC and test for compliance. Report the average of 3 tests. Prepare new briquettes and test if the range of stability for the 3 briquettes is more than 8 points. The average air void content may vary from the specified air void content by ±0.5 percent.

You may use the briquettes used for stability testing to determine bulk specific gravity under CT 308. If you use the same briquettes and tests using bulk specific gravity fail, you may prepare 3 new briquettes and determine a new bulk specific gravity.

39-1.03C Job Mix Formula Submittal

Each JMF submittal must consist of:

1. Proposed JMF on Form CEM-3511
2. Mix design documentation on Form CEM-3512 dated within 12 months of submittal
3. JMF verification on Form CEM-3513, if applicable
4. JMF renewal on Form CEM-3514, if applicable
5. Materials Safety Data Sheets (MSDS) for:

5.1. Asphalt binder
5.2. Base asphalt binder used in asphalt rubber binder
5.3. CRM and asphalt modifier used in asphalt rubber binder
5.4. Blended asphalt rubber binder mixture
5.5. Supplemental fine aggregate except fines from dust collectors
5.6. Antistrip additives

If the Engineer requests in writing, sample the following materials in the presence of the Engineer and place in labeled containers weighing no more than 50 pounds each:

1. Coarse, fine, and supplemental fine aggregate from stockpiles, cold feed belts, or hot bins. Samples must include at least 120 pounds for each coarse aggregate, 80 pounds for each fine aggregate, and 10 pounds for each type of supplemental fines. The Department combines these aggregate samples to comply with the JMF target values submitted on Form CEM-3511.
2. RAP from stockpiles or RAP system. Samples must be at least 60 pounds.
3. Asphalt binder from the binder supplier. Samples must be in two 1-quart cylindrical shaped cans with open top and friction lids.
4. Asphalt rubber binder with the components blended in the proportions to be used. Samples must be in four 1-quart cylindrical shaped cans with open top and friction lids.

Notify the Engineer in writing at least 2 business days before sampling materials. For aggregate and RAP, split the samples into at least 4 parts. Submit 3 parts to the Engineer and use 1 part for your testing.

39-1.03D Job Mix Formula Review

The Engineer reviews each mix design and proposed JMF within 5 business days from the complete JMF submittal. The review consists of reviewing the mix design procedures and comparing the proposed JMF with the specifications.

The Engineer may verify aggregate qualities during this review period.

39-1.03E Job Mix Formula Verification

If you cannot submit a Department-verified JMF on Form CEM-3513 dated within 12 months before HMA production, the Engineer verifies the JMF.

Based on your testing and production experience, you may submit on Form CEM-3511 an adjusted JMF before the Engineer's verification testing. JMF adjustments may include a change in the:

1. Asphalt binder content target value up to ±0.6 percent from the optimum binder content value submitted on Form CEM-3512 except do not adjust the target value for asphalt rubber binder for RHMA-G below 7.0 percent
2. Aggregate gradation target values within the target value limits specified in the aggregate gradation tables

For HMA Type A, Type B, and RHMA-G, the Engineer verifies the JMF from samples taken from HMA produced by the plant to be used. Notify the Engineer in writing at least 2 business days before sampling materials.

In the Engineer's presence and from the same production run, take samples of:

1. Aggregate
2. Asphalt binder
3. RAP
4. HMA

Sample aggregate from cold feed belts or hot bins. Sample RAP from the RAP system. Sample HMA under California Test 125 except if you request in writing and the Engineer approves, you may sample from any of the following locations:

1. The plant
2. A truck
3. A windrow
4. The paver hopper
5. The mat behind the paver

You may sample from a different project including a non-Department project if you make arrangements for the Engineer to be present during sampling.

For aggregate, RAP, and HMA, split the samples into at least 4 parts and label their containers. Submit 3 split parts to the Engineer and use 1 part for your testing.

The Engineer verifies each proposed JMF within 20 days of receiving verification samples. If you request in writing, the Engineer verifies RHMA-G quality requirements within 3 business days of sampling. Verification is testing for compliance with the specifications for:

1. Aggregate quality
2. Aggregate gradation (JMF TV ± tolerance)
3. Asphalt binder content (JMF TV ± tolerance)
4. HMA quality specified in the table Hot Mix Asphalt Mix Design Requirements except:

    4.1. Air voids content (design value ± 2.0 percent)
    4.2. Voids filled with asphalt (report only if an adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC)
    4.3. Dust proportion (report only if an adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC)

The Engineer prepares 3 briquettes from a single split sample. To verify the JMF for stability and air voids content, the Engineer tests the 3 briquettes and reports the average of 3 tests. The Engineer prepares new briquettes if the range of stability for the 3 briquettes is more than 8 points.

The Engineer may use the briquettes used for stability testing to determine bulk specific gravity under CT 308. If the Engineer uses the same briquettes and the tests using bulk specific gravity fail, the Engineer prepares 3 new briquettes and determines a new bulk specific gravity.

If the Engineer verifies the JMF, the Engineer provides you a Form CEM-3513.

If the Engineer's tests on plant-produced samples do not verify the JMF, the Engineer notifies you in writing and you must submit a new JMF submittal or submit an adjusted JMF based on your testing. JMF adjustments may include a change in the:

1. Asphalt binder content target value up to ±0.6 percent from the optimum binder content value submitted on Form CEM-3512 except do not adjust the target value for asphalt rubber binder for RHMA-G below 7.0 percent
2. Aggregate gradation target values within the target value limits specified in the aggregate gradation tables

You may adjust the JMF only once due to a failed verification test. An adjusted JMF requires a new Form CEM-3511 and verification of a plant-produced sample.

The Engineer reverifies the JMF if HMA production has stopped for longer than 30 days and the verified JMF is older than 12 months.

For each HMA type and aggregate size specified, the Engineer verifies at the State's expense up to 2 proposed JMF including a JMF adjusted after verification failure. The Engineer deducts $3,000 from payments for each verification exceeding this limit. This deduction does not apply to verifications initiated by the Engineer or if a JMF expires while HMA production is stopped longer than 30 days.

39-1.03F Job Mix Formula Renewal

You may request a JMF renewal by submitting the following:

1. Proposed JMF on Form CEM-3511
2. A previously verified JMF documented on Form CEM-3513 dated within 12 months
3. Mix design documentation on Form CEM-3512 used for the previously verified JMF

If the Engineer requests in writing, sample the following materials in the presence of the Engineer and place in labeled containers weighing no more than 50 pounds each:

1. Coarse, fine, and supplemental fine aggregate from stockpiles, cold feed belts, or hot bins. Samples must include at least 120 pounds for each coarse aggregate, 80 pounds for each fine aggregate, and 10 pounds for each type of supplemental fines. The Department combines these aggregate samples to comply with the JMF target values submitted on Form CEM-3511.
2. RAP from stockpiles or RAP system. Samples must be at least 60 pounds.

3. Asphalt binder from the binder supplier. Samples must be in two 1-quart cylindrical shaped cans with open top and friction lids.
4. Asphalt rubber binder with the components blended in the proportions to be used. Samples must be in four 1-quart cylindrical shaped cans with open top and friction lids.

Notify the Engineer in writing at least 2 business days before sampling materials. For aggregate and RAP, split samples into at least 4 parts. Submit 3 parts to the Engineer and use 1 part for your testing.

The Engineer reviews each complete JMF renewal submittal within 5 business days.

The Engineer may verify aggregate qualities during this review period.

Notify the Engineer in writing at least 2 business days before sampling materials. For aggregate, RAP, and HMA, split the samples into at least 4 parts. Submit 3 parts to the Engineer and use 1 part for your testing.

The Engineer verifies the JMF renewal submittal under Section 39-1.03E, "Job Mix Formula Verification," except:

1. The Engineer retains samples until you provide test results for your part on Form CEM-3514.
2. The Engineer tests samples of materials obtained from the HMA production unit after you submit test results that comply with the specifications for the quality characteristics under Section 39-1.03E, "Job Mix Formula Verification."
3. The Engineer verifies each proposed JMF within 30 days of receiving verification samples.
4. You may not adjust the JMF due to a failed verification.
5. For each HMA type and aggregate gradation specified, the Engineer verifies at the State's expense 1 proposed JMF.

If the Engineer verifies the JMF renewal, the Engineer provides you a Form CEM-3513.

39-1.03G Job Mix Formula Acceptance

You may start HMA production if:

1. The Engineer's review of the JMF shows compliance with the specifications.
2. The Department has verified the JMF within 12 months before HMA production.
3. The Engineer accepts the verified JMF.

39-1.04 CONTRACTOR QUALITY CONTROL

39-1.04A General

Establish, maintain, and change a quality control system to ensure materials and work comply with the specifications. Submit quality control test results to the Engineer within 3 days of a request except when QC / QA is specified.

You must identify the HMA sampling location in your Quality Control Plan. During production, take samples under California Test 125 except if you request in writing and the Engineer approves, you may sample HMA from:

1. The plant
2. The truck
3. A windrow
4. The paver hopper
5. The mat behind the paver

39-1.04B Prepaving Conference

Meet with the Engineer at a prepaving conference at a mutually agreed time and place. Discuss methods of performing the production and paving work.

39-1.04C Asphalt Rubber Binder

Take asphalt rubber binder samples from the feed line connecting the asphalt rubber binder tank to the HMA plant. Sample and test asphalt rubber binder under Laboratory Procedure LP-11.

Test asphalt rubber binder for compliance with the viscosity specifications in Section 39-1.02, "Materials." During asphalt rubber binder production and HMA production using asphalt rubber binder, measure viscosity every hour with not less than 1 reading for each asphalt rubber binder batch. Log measurements with corresponding time and asphalt rubber binder temperature. Submit the log daily in writing.

Submit a Certificate of Compliance under Section 6-1.07, "Certificates of Compliance." With the Certificate of Compliance, submit test results in writing for CRM and asphalt modifier with each truckload delivered to the HMA plant. A Certificate of Compliance for asphalt modifier must not represent more than 5,000 pounds. Use an AASHTO-certified laboratory for testing.

Sample and test gradation and wire and fabric content of CRM once per 10,000 pounds of scrap tire CRM and once per 3,400 pounds of high natural CRM. Sample and test scrap tire CRM and high natural CRM separately.

Submit certified weight slips in writing for the CRM and asphalt modifier furnished.

39-1.04D Aggregate

Determine the aggregate moisture content and RAP moisture content in continuous mixing plants at least twice a day during production and adjust the plant controller. Determine the RAP moisture content in batch mixing plants at least twice a day during production and adjust the plant controller.

39-1.04E Reclaimed Asphalt Pavement

Perform RAP quality control testing each day.

Sample RAP once daily and determine the RAP aggregate gradation under Laboratory Procedure LP-9 and submit the results to the Engineer in writing with the combined aggregate gradation.

39-1.04F Density Cores

To determine density for Standard and QC / QA projects, take 4-inch or 6-inch diameter density cores at least once every 5 business days. Take 1 density core for every 250 tons of HMA from random locations the Engineer designates. Take density cores in the Engineer's presence and backfill and compact holes with material authorized by the Engineer. Before submitting a density core to the Engineer, mark it with the density core's location and place it in a protective container.

If a density core is damaged, replace it with a density core taken within 1 foot longitudinally from the original density core. Relocate any density core located within 1 foot of a rumble strip to 1 foot transversely away from the rumble strip.

39-1.04G Briquettes

Prepare 3 briquettes for each stability and air voids content determination. Report the average of 3 tests. Prepare new briquettes and test if the range of stability for the 3 briquettes is more than 12 points.

You may use the briquettes used for stability testing to determine bulk specific gravity under CT 308. If you use these briquettes and tests using bulk specific gravity fail, you may prepare 3 new briquettes and determine a new bulk specific gravity.

39-1.05 ENGINEER'S ACCEPTANCE

The Engineer's acceptance of HMA is specified in the sections for each HMA construction process.

The Engineer samples materials for testing under California Test 125 and the applicable test method except samples may be taken from:

1. The plant from:

    1.1. A truck
    1.2. An automatic sampling device

2. The mat behind the paver

Sampling must be independent of Contractor quality control, statistically-based, and random.

If you request, the Engineer splits samples and provides you with a part.

The Engineer accepts HMA based on:

1. Accepted JMF
2. Accepted QCP for Standard and QC / QA
3. Compliance with the HMA Acceptance tables
4. Acceptance of a lot for QC / QA
5. Visual inspection

The Engineer prepares 3 briquettes for each stability and air voids content determination. The Engineer reports the average of 3 tests. The Engineer prepares new briquettes and test if the range of stability for the 3 briquettes is more than 8 points.

The Engineer may use the briquettes used for stability testing to determine bulk specific gravity under CT 308. If the Engineer uses the same briquettes and the tests using bulk specific gravity fail, the Engineer prepares 3 new briquettes and determines a new bulk specific gravity.

39-1.06 DISPUTE RESOLUTION

You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result discrepancies. Notify the Engineer in writing within 5 days of receiving a test result if you dispute the test result.

If you or the Engineer dispute each other's test results, submit written quality control test results and copies of paperwork including worksheets used to determine the disputed test results to the Engineer. An Independent Third Party (ITP) performs referee testing. Before the ITP participates in a dispute resolution, the ITP must be accredited under the Department's Independent Assurance Program. The ITP must be independent of the project. By mutual agreement, the ITP is chosen from:

1. A Department laboratory
2. A Department laboratory in a district or region not in the district or region the project is located
3. The Transportation Laboratory
4. A laboratory not currently employed by you or your HMA producer

If split quality control or acceptance samples are not available, the ITP uses any available material representing the disputed HMA for evaluation.

39-1.07 PRODUCTION START-UP EVALUATION

The Engineer evaluates HMA production and placement at production start-up.

Within the first 750 tons produced on the first day of HMA production, in the Engineer's presence and from the same production run, take samples of:

1. Aggregate
2. Asphalt binder
3. RAP
4. HMA

Sample aggregate from cold feed belts or hot bins. Take RAP samples from the RAP system. Sample HMA under California Test 125 except if you request in writing and the Engineer approves, you may sample HMA from:

1. The plant
2. The truck
3. A windrow
4. The paver hopper
5. The mat behind the paver

For aggregate, RAP, and HMA, split the samples into at least 4 parts and label their containers. Submit 3 split parts to the Engineer and keep 1 part.

For Standard and QC / QA projects, you and the Engineer must test the split samples and report test results in writing within 3 business days of sampling. If you proceed before receipt of the test results, the Engineer may consider the HMA placed to be represented by these test results.

For Standard and QC / QA projects, take 4-inch or 6-inch diameter density cores within the first 750 tons on the first day of HMA production. For each density core, the Engineer reports the bulk specific gravity determined under California Test 308, Method A in addition to the percent of maximum theoretical density. You may test for in-place density at the density core locations and include them in your production tests for percent of maximum theoretical density.

39-1.08 PRODUCTION

39-1.08A General

Produce HMA in a batch mixing plant or a continuous mixing plant. Proportion aggregate by hot or cold feed control.

HMA plants must be Department-qualified. Before production, the HMA plant must have a current qualification under the Department's Materials Plant Quality Program.

During production, you may adjust:

1. Hot or cold feed proportion controls for virgin aggregate and RAP
2. The set point for asphalt binder content

39-1.08B Mixing

Mix HMA ingredients into a homogeneous mixture of coated aggregates.

Asphalt binder must be between 275 °F and 375 °F when mixed with aggregate.

Asphalt rubber binder must be between 375 °F and 425 °F when mixed with aggregate.

When mixed with asphalt binder, aggregate must not be more than 325 °F except aggregate for OGFC with unmodified asphalt binder must be not more than 275 °F. Aggregate temperature specifications do not apply when you use RAP.

HMA with or without RAP must not be more than 325 °F.

39-1.08C Asphalt Rubber Binder

Deliver scrap tire CRM and high natural CRM in separate bags.

Either proportion and mix asphalt binder, asphalt modifier, and CRM simultaneously or premix the asphalt binder and asphalt modifier before adding CRM. If you premix asphalt binder and asphalt modifier, mix them for at least 20 minutes. When you add CRM, the asphalt binder and asphalt modifier must be between 375 °F and 440 °F.

Do not use asphalt rubber binder during the first 45 minutes of the reaction period. During this period, the asphalt rubber binder mixture must be between 350 °F and the lower of 425 °F or 25 °F below the asphalt binder's flash point indicated in the MSDS.

If any asphalt rubber binder is not used within 4 hours after the reaction period, discontinue heating. If the asphalt rubber binder drops below 375 °F, reheat before use. If you add more scrap tire CRM to the reheated asphalt rubber binder, the binder must undergo a 45-minute reaction period. The added scrap tire CRM must not exceed 10 percent of the total asphalt rubber binder weight. Reheated and reacted asphalt rubber binder must comply with the viscosity specifications for asphalt rubber binder in Section 39-1.02, "Materials." Do not reheat asphalt rubber binder more than twice.

39-1.09 SUBGRADE, TACK COAT, AND GEOSYNTHETIC PAVEMENT INTERLAYER

39-1.09A General

Prepare subgrade or apply tack coat to surfaces receiving HMA. If specified, place geosynthetic pavement interlayer over a coat of asphalt binder.

39-1.09B Subgrade

Subgrade to receive HMA must comply with the compaction and elevation tolerance specifications in the sections for the material involved. Subgrade must be free of loose and extraneous material. If HMA is paved on existing base or pavement, remove loose paving particles, dirt, and other extraneous material by any means including flushing and sweeping.

39-1.09C Tack Coat

Apply tack coat:

1. To existing pavement including planed surfaces
2. Between HMA layers
3. To vertical surfaces of:

    3.1. Curbs
    3.2. Gutters
    3.3. Construction joints

Before placing HMA, apply tack coat in 1 application at the minimum residual rate specified for the condition of the underlying surface:

Tack Coat Application Rates for HMA Type A, Type B, and RHMA-G

HMA over:	Minimum Residual Rates (gallons per square yard)		
	CSS1/CSS1h, SS1/SS1h and QS1h/CQS1h Asphaltic Emulsion	CRS1/CRS2, RS1/RS2 and QS1/CQS1 Asphaltic Emulsion	Asphalt Binder and PMRS2/PMCRS2 and PMRS2h/PMCRS2h Asphaltic Emulsion
New HMA (between layers)	0.02	0.03	0.02
Existing AC and PCC pavement	0.03	0.04	0.03
Planed pavement	0.05	0.06	0.04

Tack Coat Application Rates for OGFC

OGFC over:	Minimum Residual Rates (gallons per square yard)		
	CSS1/CSS1h, SS1/SS1h and QS1h/CQS1h Asphaltic Emulsion	CRS1/CRS2, RS1/RS2 and QS1/CQS1 Asphaltic Emulsion	Asphalt Binder and PMRS2/PMCRS2 and PMRS2h/PMCRS2h Asphaltic Emulsion
New HMA	0.03	0.04	0.03
Existing AC and PCC pavement	0.05	0.06	0.04
Planed pavement	0.06	0.07	0.05

If you dilute asphaltic emulsion, mix until homogeneous before application.

Apply to vertical surfaces with a residual tack coat rate that will thoroughly coat the vertical face without running off.

If you request in writing and the Engineer authorizes, you may:

1. Change tack coat rates
2. Omit tack coat between layers of new HMA during the same work shift if:

    2.1. No dust, dirt, or extraneous material is present
    2.2. The surface is at least 140 °F

Immediately in advance of placing HMA, apply additional tack coat to damaged areas or where loose or extraneous material is removed.

Close areas receiving tack coat to traffic. Do not track tack coat onto pavement surfaces beyond the job site.

Asphalt binder tack coat must be between 285 °F and 350 °F when applied.

39-1.09D Geosynthetic Pavement Interlayer

Place geosynthetic pavement interlayer in compliance with the manufacturer's recommendations.

Before placing the geosynthetic pavement interlayer and asphalt binder:

1. Repair cracks 1/4 inch and wider, spalls, and holes in the pavement. The State pays for this repair work under Section 4-1.03D, "Extra Work."
2. Clean the pavement of loose and extraneous material.

Immediately before placing the interlayer, apply 0.25 gallon ± 0.03 gallon of asphalt binder per square yard of interlayer or until the fabric is saturated. Apply asphalt binder the width of the geosynthetic pavement interlayer plus 3 inches on each side. At interlayer overlaps, apply asphalt binder on the lower interlayer the same overlap distance as the upper interlayer.

Align and place the interlayer with no overlapping wrinkles, except a wrinkle that overlaps may remain if it is less than 1/2 inch thick. If the overlapping wrinkle is more than 1/2 inch thick, cut the wrinkle out and overlap the interlayer no more than 2 inches.

The minimum HMA thickness over the interlayer must be 0.12 foot thick including conform tapers. Do not place the interlayer on a wet or frozen surface.

Overlap the interlayer borders between 2 inches and 4 inches. In the direction of paving, overlap the following roll with the preceding roll at any break.

You may use rolling equipment to correct distortions or wrinkles in the interlayer.

If asphalt binder tracked onto the interlayer or brought to the surface by construction equipment causes interlayer displacement, cover it with a small quantity of HMA.

Before placing HMA on the interlayer, do not expose the interlayer to:

1. Traffic except for crossings under traffic control and only after you place a small HMA quantity
2. Sharp turns from construction equipment
3. Damaging elements

Pave HMA on the interlayer during the same work shift.

39-1.10 SPREADING AND COMPACTING EQUIPMENT

Paving equipment for spreading must be:

1. Self-propelled
2. Mechanical
3. Equipped with a screed or strike-off assembly that can distribute HMA the full width of a traffic lane
4. Equipped with a full-width compacting device
5. Equipped with automatic screed controls and sensing devices that control the thickness, longitudinal grade, and transverse screed slope

Install and maintain grade and slope references.

The screed must produce a uniform HMA surface texture without tearing, shoving, or gouging.

The paver must not leave marks such as ridges and indentations unless you can eliminate them by rolling.

Rollers must be equipped with a system that prevents HMA from sticking to the wheels. You may use a parting agent that does not damage the HMA or impede the bonding of layers.

In areas inaccessible to spreading and compacting equipment:

1. Spread the HMA by any means to obtain the specified lines, grades and cross sections.
2. Use a pneumatic tamper, plate compactor, or equivalent to achieve thorough compaction.

39-1.11 TRANSPORTING, SPREADING, AND COMPACTING

Do not pave HMA on a wet pavement or frozen surface.

You may deposit HMA in a windrow and load it in the paver if:

1. Paver is equipped with a hopper that automatically feeds the screed
2. Loading equipment can pick up the windrowed material and deposit it in the paver hopper without damaging base material
3. Activities for deposit, pick-up, loading, and paving are continuous
4. HMA temperature in the windrow does not fall below 260 °F

You may pave HMA in 1 or more layers on areas less than 5 feet wide and outside the traveled way including shoulders. You may use mechanical equipment other than a paver for these areas. The equipment must produce a uniform smoothness and texture.

HMA handled, spread, or windrowed must not stain the finished surface of any improvement including pavement.

Do not use petroleum products such as kerosene or diesel fuel to release HMA from trucks, spreaders, or compactors.

HMA must be free of:

1. Segregation
2. Coarse or fine aggregate pockets
3. Hardened lumps

Longitudinal joints in the top layer must match specified lane edges. Alternate longitudinal joint offsets in lower layers at least 0.5 foot from each side of the specified lane edges. You may request in writing other longitudinal joint placement patterns.

Until the adjoining through lane's top layer has been paved, do not pave the top layer of:

1. Shoulders
2. Tapers
3. Transitions
4. Road connections
5. Driveways
6. Curve widenings
7. Chain control lanes
8. Turnouts
9. Turn pockets

If the number of lanes change, pave each through lane's top layer before paving a tapering lane's top layer. Simultaneous to paving a through lane's top layer, you may pave an adjoining area's top layer including shoulders. Do not operate spreading equipment on any area's top layer until completing final compaction.

If HMA (leveling) is specified, fill and level irregularities and ruts with HMA before spreading HMA over base, existing surfaces, or bridge decks. You may use mechanical equipment other than a paver for these areas. The equipment must produce a uniform smoothness and texture. HMA used to change an existing surface's cross slope or profile is not HMA (leveling).

If placing HMA against the edge of existing pavement, sawcut or grind the pavement straight and vertical along the joint and remove extraneous material without damaging the surface remaining in place. If placing HMA against the edge of a longitudinal or transverse construction joint and the joint is damaged or not placed to a neat line, sawcut or grind the pavement straight and vertical along the joint and remove extraneous material without damaging the surface remaining in place. Repair or remove and replace damaged pavement at your expense.

Rolling must leave the completed surface compacted and smooth without tearing, cracking, or shoving. Complete finish rolling activities before the pavement surface temperature is:

1. Below 150 °F for HMA with unmodified binder
2. Below 140 °F for HMA with modified binder
3. Below 200 °F for RHMA-G

If a vibratory roller is used as a finish roller, turn the vibrator off.

Do not use a pneumatic tired roller to compact RHMA-G.

For Standard and QC/QA, if a 3/4-inch aggregate grading is specified, you may use a 1/2-inch aggregate grading if the specified paved thickness is from 0.15 foot to 0.20 foot thick.

Spread and compact HMA under Section 39-3.03, "Spreading and Compacting Equipment," and Section 39-3.04, "Transporting, Spreading, and Compacting," for any of the following:

1. Specified paved thickness is less than 0.15 foot.
2. Specified paved thickness is less than 0.20 foot and a 3/4-inch aggregate grading is specified and used.
3. You spread and compact at:

    3.1. Asphalt concrete surfacing replacement areas
    3.2. Leveling courses
    3.3. Areas the Engineer determines conventional compaction and compaction measurement methods are impeded

Do not allow traffic on new HMA pavement until its mid-depth temperature is below 160 °F.

If you request in writing and the Engineer authorizes, you may cool HMA Type A and Type B with water when rolling activities are complete. Apply water under Section 17, "Watering."

Spread sand at a rate between 1 pound and 2 pounds per square yard on new RHMA-G, RHMA-O, and RHMA-O-HB pavement when finish rolling is complete. Sand must be free of clay or organic matter. Sand must comply with Section 90-3.03, "Fine Aggregate Grading." Keep traffic off the pavement until spreading sand is complete.

39-1.12 SMOOTHNESS

39-1.12A General

Determine HMA smoothness with a profilograph and a straightedge.

Smoothness specifications do not apply to OGFC placed on existing pavement not constructed under the same project.

If portland cement concrete is placed on HMA:

1. Cold plane the HMA finished surface to within specified tolerances if it is higher than the grade specified by the Engineer.
2. Remove and replace HMA if the finished surface is lower than 0.05 foot below the grade specified by the Engineer.

39-1.12B Straightedge

The HMA pavement top layer must not vary from the lower edge of a 12-foot long straightedge:

1. More than 0.01 foot when the straight edge is laid parallel with the centerline
2. More than 0.02 foot when the straightedge is laid perpendicular to the centerline and extends from edge to edge of a traffic lane
3. More than 0.02 foot when the straightedge is laid within 24 feet of a pavement conform

39-1.12C Profilograph

Under California Test 526, determine the zero (null) blanking band Profile Index (PI_0) and must-grinds on the top layer of HMA Type A, Type B, and RHMA-G pavement. Take 2 profiles within each traffic lane, 3 feet from and parallel with the edge of each lane.

A must-grind is a deviation of 0.3 inch or more in a length of 25 feet. You must correct must-grinds.

For OGFC, only determine must-grinds when placed over HMA constructed under the same project. The top layer of the underlying HMA must comply with the smoothness specifications before placing OGFC.

Profile pavement in the Engineer's presence. Choose the time of profiling.

On tangents and horizontal curves with a centerline radius of curvature 2,000 feet or more, the PI_0 must be at most 3 inches per 0.1-mile section.

On horizontal curves with a centerline radius of curvature between 1,000 feet and 2,000 feet including pavement within the superelevation transitions, the PI_0 must be at most 6 inches per 0.1-mile section.

Before the Engineer accepts HMA pavement for smoothness, submit written final profilograms.

Submit 1 electronic copy of profile information in Microsoft Excel and 1 electronic copy of longitudinal pavement profiles in ".erd" format or other ProVAL compatible format to the Engineer and to:

Smoothness@dot.ca.gov

The following HMA pavement areas do not require a PI_0. You must measure these areas with a 12-foot straightedge and determine must-grinds with a profilograph:

1. New HMA with a total thickness less than or equal to 0.25 foot
2. HMA sections of city or county streets and roads, turn lanes and collector lanes that are less than 1,500 feet in length

The following HMA pavement areas do not require a PI_0. You must measure these areas with a 12-foot straightedge:

1. Horizontal curves with a centerline radius of curvature less than 1,000 feet including pavement within the superelevation transitions of those curves
2. Within 12 feet of a transverse joint separating the pavement from:

    2.1. Existing pavement not constructed under the same project
    2.2. A bridge deck or approach slab

3. Exit ramp termini, truck weigh stations, and weigh-in-motion areas
4. If steep grades and superelevation rates greater than 6 percent are present on:

    4.1. Ramps
    4.2. Connectors

5. Turn lanes
6. Areas within 15 feet of manholes or drainage transitions
7. Acceleration and deceleration lanes for at-grade intersections
8. Shoulders and miscellaneous areas
9. HMA pavement within 3 feet from and parallel to the construction joints formed between curbs, gutters, or existing pavement

39-1.12D Smoothness Correction

If the top layer of HMA Type A, Type B, or RHMA-G pavement does not comply with the smoothness specifications, grind the pavement to within tolerances, remove and replace it, or place a layer of HMA. The Engineer must authorize your choice of correction before the work begins.

Remove and replace the areas of OGFC not in compliance with the must-grind and straightedge specifications, except you may grind OGFC for correcting smoothness:

1. At a transverse joint separating the pavement from pavement not constructed under the same project
2. Within 12 feet of a transverse joint separating the pavement from a bridge deck or approach slab

Corrected HMA pavement areas must be uniform rectangles with edges:

1. Parallel to the nearest HMA pavement edge or lane line
2. Perpendicular to the pavement centerline

Measure the corrected HMA pavement surface with a profilograph and a 12-foot straightedge and correct the pavement to within specified tolerances. If a must-grind area or straightedged pavement cannot be corrected to within specified tolerances, remove and replace the pavement.

On ground areas not overlaid with OGFC, apply fog seal coat under Section 37-1, "Seal Coats."

39-1.13 MISCELLANEOUS AREAS AND DIKES

Miscellaneous areas are outside the traveled way and include:

1. Median areas not including inside shoulders
2. Island areas
3. Sidewalks
4. Gutters
5. Gutter flares
6. Ditches
7. Overside drains
8. Aprons at the ends of drainage structures

Spread miscellaneous areas in 1 layer and compact to the specified lines and grades.

For miscellaneous areas and dikes:

1. Do not submit a JMF.
2. Choose the 3/8-inch or 1/2-inch HMA Type A and Type B aggregate gradations.
3. Minimum asphalt binder content must be 6.8 percent for 3/8-inch aggregate and 6.0 percent for 1/2-inch aggregate. If you request in writing and the Engineer authorizes, you may reduce the minimum asphalt binder content.
4. Choose asphalt binder Grade PG 70-10 or the same grade specified for HMA.

39-2 STANDARD

39-2.01 DESCRIPTION

If HMA is specified as Standard, construct it under Section 39-1, "General," this Section 39-2, "Standard," and Section 39-5, "Measurement and Payment."

39-2.02 CONTRACTOR QUALITY CONTROL

39-2.02A Quality Control Plan

Establish, implement, and maintain a Quality Control Plan (QCP) for HMA. The QCP must describe the organization and procedures you will use to:

1. Control the quality characteristics
2. Determine when corrective actions are needed (action limits)
3. Implement corrective actions

When you submit the proposed JMF, submit the written QCP. You and the Engineer must discuss the QCP during the prepaving conference.

The QCP must address the elements affecting HMA quality including:

1. Aggregate
2. Asphalt binder
3. Additives
4. Production
5. Paving

The Engineer reviews each QCP within 5 business days from the submittal. Hold HMA production until the Engineer accepts the QCP in writing. The Engineer's QCP acceptance does not mean your compliance with the QCP will result in acceptable HMA. Section 39-1.05, "Engineer's Acceptance," specifies HMA acceptance.

39-2.02B Quality Control Testing

Perform sampling and testing at the specified frequency for the following quality characteristics:

Minimum Quality Control – Standard

Quality Characteristic	Test Method	Minimum Sampling and Testing Frequency	HMA Type			
			A	B	RHMA-G	OGFC
Aggregate gradation[a]	CT 202	1 per 750 tons and any remaining part	JMF ± Tolerance [b]	JMF ± Tolerance [b]	JMF ± Tolerance [b]	JMF ± Tolerance [b]
Sand equivalent (min.) [c]	CT 217		47	42	47	--
Asphalt binder content (%)	CT 379 or 382		JMF ± 0.45	JMF ± 0.45	JMF ± 0.50	JMF ± 0.50
HMA moisture content (%, max.)	CT 226 or CT 370	1 per 2,500 tons but not less than 1 per paving day	1.0	1.0	1.0	1.0
Percent of maximum theoretical density (%) [d, e]	Quality control plan	2 per business day (min.)	91 - 97	91 - 97	91 - 97	--
Stabilometer value (min.) [c, f] No. 4 and 3/8" gradings 1/2" and 3/4" gradings	CT 366	One per 4,000 tons or 2 per 5 business days, which-ever is more	 30 37	 30 35	 -- 23	 -- --
Air voids content (%) [c, g]	CT 367		4 ± 2	4 ± 2	Specification ± 2	--
Aggregate moisture content at continuous mixing plants and RAP moisture content at continuous mixing plants and batch mixing plants [h]	CT 226 or CT 370	2 per day during production	--	--	--	--
Percent of crushed particles coarse aggregate (%, min.) One fractured face Two fractured faces Fine aggregate (%, min) (Passing No. 4 sieve and retained on No. 8 sieve.) One fractured face	CT 205	As necessary and designat-ed in the QCP. At least once per project	 90 75 70	 25 -- 20	 -- 90 70	 90 75 90
Los Angeles Rattler (%, max.) Loss at 100 rev. Loss at 500 rev.	CT 211		 12 45	 -- 50	 12 40	 12 40
Flat and elongated particles (%, max. by weight @ 5:1)	ASTM D 4791		Report only	Report only	Report only	Report only

Fine aggregate angularity (%, min.)	AASHTO T 304, Method A		45	45	45	--
Voids filled with asphalt (%) [i] No. 4 grading 3/8" grading 1/2" grading 3/4" grading	LP-3		 76.0 – 80.0 73.0 – 76.0 65.0 – 75.0 65.0 – 75.0	 76.0 – 80.0 73.0 – 76.0 65.0 – 75.0 65.0 – 75.0	Report only	--
Voids in mineral aggregate (% min.) [i] No. 4 grading 3/8" grading 1/2" grading 3/4" grading	LP-2		 17.0 15.0 14.0 13.0	 17.0 15.0 14.0 13.0	 -- -- 18.0 – 23.0 [j] 18.0 – 23.0 [j]	--
Dust proportion [i] No. 4 and 3/8" gradings 1/2" and 3/4" gradings	LP-4		 0.9 – 2.0 0.6 – 1.3	 0.9 – 2.0 0.6 – 1.3	Report only	--
Smoothness	Section 39-1.12	--	12-foot straightedge, must-grind, and PI_0	12-foot straightedge, must-grind, and PI_0	12-foot straightedge, must-grind, and PI_0	12-foot straightedge and must-grind
Asphalt rubber binder viscosity @ 350 °F, centipoises	Section 39-1.02D	Section 39-1.04C	--	--	1,500 – 4,000	1,500 – 4,000
Asphalt modifier	Section 39-1.02D	Section 39-1.04C	--	--	Section 39-1.02D	Section 39-1.02D
Crumb rubber modifier	Section 39-1.02D	Section 39-1.04C	--	--	Section 39-1.02D	Section 39-1.02D

Notes:
[a] Determine combined aggregate gradation containing RAP under Laboratory Procedure LP-9.
[b] The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."
[c] Report the average of 3 tests from a single split sample.
[d] Required for HMA Type A, Type B, and RHMA-G if the specified paved thickness is at least 0.15 foot.
[e] Determine maximum theoretical density (California Test 309) at the frequency specified for Test Maximum Density under California Test 375, Part 5.D.
[f] Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F ± 5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."
[g] Determine the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.
[h] For adjusting the plant controller at the HMA plant.
[i] Report only if the adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC.
[j] Voids in mineral aggregate for RHMA-G must be within this range.

For any single quality characteristic except smoothness, if 2 consecutive quality control test results do not comply with the action limits or specifications:

1. Stop production.
2. Notify the Engineer in writing.
3. Take corrective action.
4. Demonstrate compliance with the specifications before resuming production and placement on the State highway.

39-2.03 ENGINEER'S ACCEPTANCE

39-2.03A Testing

The Engineer samples for acceptance testing and tests for:

HMA Acceptance - Standard

Quality Characteristic	Test Method	HMA Type			
		A	B	RHMA-G	OGFC
Aggregate gradation [a]	CT 202	JMF ± Tolerance [c]	JMF ± Tolerance [c]	JMF ± Tolerance [c]	JMF ± Tolerance [c]
Sieve / 3/4" / 1/2" / 3/8"					
1/2" / X [b]					
3/8" / X					
No. 4 / X					
No. 8 / X / X / X					
No. 200 / X / X / X					
Sand equivalent (min.) [d]	CT 217	47	42	47	--
Asphalt binder content (%)	CT 379 or 382	JMF ± 0.45	JMF ± 0.45	JMF ± 0.50	JMF ± 0.50
HMA moisture content (%, max.)	CT 226 or CT 370	1.0	1.0	1.0	1.0
Percent of maximum theoretical density (%) [e, f]	CT 375	91 – 97	91 – 97	91 – 97	--
Stabilometer value (min.) [d, g]	CT 366				
No. 4 and 3/8" gradings		30	30	--	--
1/2" and 3/4" gradings		37	35	23	--
Air voids content (%) [d, h]	CT 367	4 ± 2	4 ± 2	Specification ± 2	--
Percent of crushed particles Coarse aggregate (%, min.)	CT 205				
One fractured face		90	25	--	90
Two fractured faces		75	--	90	75
Fine aggregate (%, min) (Passing No. 4 sieve and retained on No. 8 sieve.) One fractured face		70	20	70	90
Percent of crushed particles Coarse aggregate (%, min.)	CT 205				
One fractured face		90	25	--	90
Two fractured faces		75	--	90	75
Los Angeles Rattler (%, max.)	CT 211				
Loss at 100 rev.		12	--	12	12
Loss at 500 rev.		45	50	40	40
Fine aggregate angularity (%, min.)	AASHTO T 304, Method A	45	45	45	--
Flat and elongated particles (%, max. by weight @ 5:1)	ASTM D 4791	Report only	Report only	Report only	Report only
Voids filled with asphalt (%) [i]	LP-3				
No. 4 grading		76.0 – 80.0	76.0 – 80.0	Report only	--
3/8" grading		73.0 – 76.0	73.0 – 76.0		
1/2" grading		65.0 – 75.0	65.0 – 75.0		
3/4" grading		65.0 – 75.0	65.0 – 75.0		
Voids in mineral aggregate (% min.) [i]	LP-2				
No. 4 grading		17.0	17.0	--	--
3/8" grading		15.0	15.0	--	
1/2" grading		14.0	14.0	18.0 – 23.0 [j]	
3/4" grading		13.0	13.0	18.0 – 23.0 [j]	
Dust proportion [i]	LP-4				
No. 4 and 3/8" gradings		0.9 – 2.0	0.9 – 2.0	Report only	--
1/2" and 3/4" gradings		0.6 – 1.3	0.6 – 1.3		

Smoothness	Section 39-1.12	12-foot straightedge, must-grind, and PI_0	12-foot straightedge, must-grind, and PI_0	12-foot straightedge, must-grind, and PI_0	12-foot straightedge and must-grind
Asphalt binder	Various	Section 92	Section 92	Section 92	Section 92
Asphalt rubber binder	Various	--	--	Section 92-1.02(C) and Section 39-1.02D	Section 92-1.02(C) and Section 39-1.02D
Asphalt modifier	Various	--	--	Section 39-1.02D	Section 39-1.02D
Crumb rubber modifier	Various	--	--	Section 39-1.02D	Section 39-1.02D

[a] The Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.
[b] "X" denotes the sieves the Engineer considers for the specified aggregate gradation.
[c] The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."
[d] The Engineer reports the average of 3 tests from a single split sample.
[e] The Engineer determines percent of maximum theoretical density if the specified paved thickness is at least 0.15 foot under California Test 375 except the Engineer uses:

1. California Test 308, Method A, to determine in-place density of each density core instead of using the nuclear gauge in Part 4, "Determining In-Place Density By The Nuclear Density Device."
2. California Test 309 to determine maximum theoretical density instead of calculating test maximum density in Part 5, "Determining Test Maximum Density."

[f] The Engineer determines maximum theoretical density (California Test 309) at the frequency specified for Test Maximum Density under California Test 375, Part 5.D.
[g] Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F ±5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."
[h] The Engineer determines the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.
[i] Report only if the adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC.
[j] Voids in mineral aggregate for RHMA-G must be within this range.

No single test result may represent more than the smaller of 750 tons or 1 day's production.

For any single quality characteristic except smoothness, if 2 consecutive acceptance test results do not comply with the specifications:

1. Stop production.
2. Take corrective action.
3. In the Engineer's presence, take samples and split each sample into 4 parts. Test 1 part for compliance with the specifications and submit 3 parts to the Engineer. The Engineer tests 1 part for compliance with the specifications and reserves and stores 2 parts.
4. Demonstrate compliance with the specifications before resuming production and placement on the State highway.

The Engineer tests the density core you take from each 250 tons of HMA production. The Engineer determines the percent of maximum theoretical density for each density core by determining the density core's density and dividing by the maximum theoretical density.

If the specified total paved thickness is at least 0.15 foot and any layer is less than 0.15 foot, the Engineer determines the percent of maximum theoretical density from density cores taken from the final layer measured the full depth of the total paved HMA thickness.

For percent of maximum theoretical density, the Engineer determines a deduction for each test result outside the specifications in compliance with:

Reduced Payment Factors for Percent of Maximum Theoretical Density

HMA Type A and B and RHMA-G Percent of Maximum Theoretical Density	Reduced Payment Factor	HMA Type A and B and RHMA-G Percent of Maximum Theoretical Density	Reduced Payment Factor
91.0	0.0000	97.0	0.0000
90.9	0.0125	97.1	0.0125
90.8	0.0250	97.2	0.0250
90.7	0.0375	97.3	0.0375
90.6	0.0500	97.4	0.0500
90.5	0.0625	97.5	0.0625
90.4	0.0750	97.6	0.0750
90.3	0.0875	97.7	0.0875
90.2	0.1000	97.8	0.1000
90.1	0.1125	97.9	0.1125
90.0	0.1250	98.0	0.1250
89.9	0.1375	98.1	0.1375
89.8	0.1500	98.2	0.1500
89.7	0.1625	98.3	0.1625
89.6	0.1750	98.4	0.1750
89.5	0.1875	98.5	0.1875
89.4	0.2000	98.6	0.2000
89.3	0.2125	98.7	0.2125
89.2	0.2250	98.8	0.2250
89.1	0.2375	98.9	0.2375
89.0	0.2500	99.0	0.2500
< 89.0	Remove and Replace	> 99.0	Remove and Replace

39-2.04 TRANSPORTING, SPREADING, AND COMPACTING

Determine the number of rollers needed to obtain the specified density and surface finish.

39-3 METHOD

39-3.01 DESCRIPTION

If HMA is specified as Method, construct it under Section 39-1, "General," this Section 39-3, "Method," and Section 39-5, "Measurement and Payment."

39-3.02 ENGINEER'S ACCEPTANCE

39-3.02A Testing

The Engineer samples for acceptance testing and tests for:

HMA Acceptance - Method

Quality Characteristic	Test Method	HMA Type			
		A	B	RHMA-G	OGFC
Aggregate gradation [a]	CT 202	JMF ± Tolerance [b]	JMF ± Tolerance [b]	JMF ± Tolerance [b]	JMF ± Tolerance [b]
Sand equivalent (min.) [c]	CT 217	47	42	47	--
Asphalt binder content (%)	CT 379 or 382	JMF ± 0.45	JMF ± 0.45	JMF ± 0.50	JMF ± 0.50
HMA moisture content (%, max.)	CT 226 or CT 370	1.0	1.0	1.0	1.0
Stabilometer value (min.) [c, d]	CT 366				
No. 4 and 3/8" gradings		30	30	--	--
1/2" and 3/4" gradings		37	35	23	--
Percent of crushed particles	CT 205				
Coarse aggregate (% min.)					
One fractured face		90	25	--	90
Two fractured faces		75	--	90	75
Fine aggregate (% min) (Passing No. 4 sieve and retained on No. 8 sieve.)					
One fractured face		70	20	70	90
Los Angeles Rattler (% max.)	CT 211				
Loss at 100 rev.		12	--	12	12
Loss at 500 rev.		45	50	40	40
Air voids content (%) [c, e]	CT 367	4 ± 2	4 ± 2	Specification ± 2	--
Fine aggregate angularity (% min.)	AASHTO T 304, Method A	45	45	45	--
Flat and elongated particles (% max. by weight @ 5:1)	ASTM D 4791	Report only	Report only	Report only	Report only
Voids filled with asphalt (%) [f]	LP-3			Report only	
No. 4 grading		76.0 – 80.0	76.0 – 80.0		--
3/8" grading		73.0 – 76.0	73.0 – 76.0		
1/2" grading		65.0 – 75.0	65.0 – 75.0		
3/4" grading		65.0 – 75.0	65.0 – 75.0		
Voids in mineral aggregate (% min.) [f]	LP-2				
No. 4 grading		17.0	17.0	--	--
3/8" grading		15.0	15.0	--	
1/2" grading		14.0	14.0	18.0 – 23.0 [g]	
3/4" grading		13.0	13.0	18.0 – 23.0 [g]	
Dust proportion [f]	LP-4				
No. 4 and 3/8" gradings		0.9 – 2.0	0.9 – 2.0	Report only	--
1/2" and 3/4" gradings		0.6 – 1.3	0.6 – 1.3		
Smoothness	Section 39-1.12	12-foot straightedge and must-grind	12-foot straightedge and must-grind	12-foot straightedge and must-grind	12-foot straightedge and must-grind
Asphalt binder	Various	Section 92	Section 92	Section 92	Section 92
Asphalt rubber binder	Various	--	--	Section 92-1.02(C) and	Section 92-1.02(C) and

				Section 39-1.02D	Section 39-1.02D
Asphalt modifier	Various	--	--	Section 39-1.02D	Section 39-1.02D
Crumb rubber modifier	Various	--	--	Section 39-1.02D	Section 39-1.02D

[a] The Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.
[b] The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."
[c] The Engineer reports the average of 3 tests from a single split sample.
[d] Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F ±5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."
[e] The Engineer determines the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.
[f] Report only if the adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC.
[g] Voids in mineral aggregate for RHMA-G must be within this range.

No single test result may represent more than the smaller of 750 tons or 1 day's production.

For any single quality characteristic except smoothness, if 2 consecutive acceptance test results do not comply with the specifications:

1. Stop production.
2. Take corrective action.
3. In the Engineer's presence, take samples and split each sample into 4 parts. Test 1 part for compliance with the specifications and submit 3 parts to the Engineer. The Engineer tests 1 part for compliance with the specifications and reserves and stores 2 parts.
4. Demonstrate compliance with the specifications before resuming production and placement on the State highway.

39-3.03 SPREADING AND COMPACTING EQUIPMENT

Each paver spreading HMA Type A and Type B must be followed by 3 rollers:

1. One vibratory roller specifically designed to compact HMA. The roller must be capable of at least 2,500 vibrations per minute and must be equipped with amplitude and frequency controls. The roller's gross static weight must be at least 7.5 tons.
2. One oscillating type pneumatic-tired roller at least 4 feet wide. Pneumatic tires must be of equal size, diameter, type, and ply. The tires must be inflated to 60 psi minimum and maintained so that the air pressure does not vary more than 5 psi.
3. One steel-tired, 2-axle tandem roller. The roller's gross static weight must be at least 7.5 tons.

Each roller must have a separate operator. Rollers must be self-propelled and reversible.

Compact RHMA-G under the specifications for compacting HMA Type A and Type B except do not use pneumatic-tired rollers.

Compact OGFC with steel-tired, 2-axle tandem rollers. If placing over 300 tons of OGFC per hour, use at least 3 rollers for each paver. If placing less than 300 tons of OGFC per hour, use at least 2 rollers for each paver. Each roller must weigh between 126 pounds to 172 pounds per linear inch of drum width. Turn the vibrator off.

39-3.04 TRANSPORTING, SPREADING, AND COMPACTING

Pave HMA in maximum 0.25-foot thick compacted layers.

If the surface to be paved is both in sunlight and shade, pavement surface temperatures are taken in the shade.

Spread HMA Type A and Type B only if atmospheric and surface temperatures are:

Minimum Atmospheric and Surface Temperatures

Compacted Layer Thickness, feet	Atmospheric,° F		Surface,° F	
	Unmodified Asphalt Binder	Modified Asphalt Binder[a]	Unmodified Asphalt Binder	Modified Asphalt Binder [a]
< 0.15	55	50	60	55
0.15 – 0.25	45	45	50	50

Note:
[a] Except asphalt rubber binder.

If the asphalt binder for HMA Type A and Type B is:

1. Unmodified asphalt binder, complete:

   1.1. First coverage of breakdown compaction before the surface temperature drops below 250 °F
   1.2. Breakdown and intermediate compaction before the surface temperature drops below 200 °F
   1.3. Finish compaction before the surface temperature drops below 150 °F

2. Modified asphalt binder, complete:

   2.1. First coverage of breakdown compaction before the surface temperature drops below 240 °F
   2.2. Breakdown and intermediate compaction before the surface temperature drops below 180 °F
   2.3. Finish compaction before the surface temperature drops below 140 °F

For RHMA-G:

1. Only spread and compact if the atmospheric temperature is at least 55 °F and the surface temperature is at least 60 °F.
2. Complete the first coverage of breakdown compaction before the surface temperature drops below 280 °F.
3. Complete breakdown and intermediate compaction before the surface temperature drops below 250 °F.
4. Complete finish compaction before the surface temperature drops below 200 °F.
5. If the atmospheric temperature is below 70 °F, cover loads in trucks with tarpaulins. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or to the pavement surface.

For OGFC with unmodified asphalt binder:

1. Only spread and compact if the atmospheric temperature is at least 55 °F and the surface temperature is at least 60 °F.
2. Complete first coverage using 2 rollers before the surface temperature drops below 240 °F.
3. Complete all compaction before the surface temperature drops below 200 °F.
4. If the atmospheric temperature is below 70 °F, cover loads in trucks with tarpaulins. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or to the pavement surface.

For OGFC with modified asphalt binder except asphalt rubber binder:

1. Only spread and compact if the atmospheric temperature is at least 50 °F and the surface temperature is at least 50 °F.
2. Complete first coverage using 2 rollers before the surface temperature drops below 240 °F.
3. Complete all compaction before the surface temperature drops below 180 °F.
4. If the atmospheric temperature is below 70 °F, cover loads in trucks with tarpaulins. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or to the pavement surface.

For RHMA-O and RHMA-O-HB:

1. Only spread and compact if the atmospheric temperature is at least 55 °F and surface temperature is at least 60 °F.
2 Complete the 1st coverage using 2 rollers before the surface temperature drops below 280 °F.
3. Complete compaction before the surface temperature drops below 250 °F.
4. If the atmospheric temperature is below 70 °F, cover loads in trucks with tarpaulins. The tarpaulins must completely cover the exposed load until the mixture is transferred to the paver's hopper or to the pavement surface.

For RHMA-G and OGFC, tarpaulins are not required if the time from discharge to truck until transfer to the paver's hopper or the pavement surface is less than 30 minutes.

HMA compaction coverage is the number of passes needed to cover the paving width. A pass is 1 roller's movement parallel to the paving in either direction. Overlapping passes are part of the coverage being made and are not a subsequent coverage. Do not start a coverage until completing the prior coverage.

Start rolling at the lower edge and progress toward the highest part.

Perform breakdown compaction of each layer of HMA Type A, Type B, and RHMA-G with 3 coverages using a vibratory roller. The speed of the vibratory roller in miles per hour must not exceed the vibrations per minute divided by 1,000. If the HMA layer thickness is less than 0.08 foot, turn the vibrator off. The Engineer may order fewer coverages if the HMA layer thickness is less than 0.15 foot.

Perform intermediate compaction of each layer of HMA Type A and Type B with 3 coverages using a pneumatic-tired roller at a speed not to exceed 5 mph.

Perform finish compaction of HMA Type A, Type B, and RHMA-G with 1 coverage using a steel-tired roller.

Compact OGFC with 2 coverages using steel-tired rollers.

39-4 QUALITY CONTROL / QUALITY ASSURANCE

39-4.01 DESCRIPTION

If HMA is specified as Quality Control / Quality Assurance, construct it under Section 39-1, "General," this Section 39-4, "Quality Control / Quality Assurance," and Section 39-5, "Measurement and Payment."

39-4.02 GENERAL

The QC / QA construction process consists of:

1. Establishing, maintaining, and changing if needed a quality control system providing assurance the HMA complies with the specifications
2. Sampling and testing at specified intervals, or sublots, to demonstrate compliance and to control process
3. The Engineer sampling and testing at specified intervals to verify testing process and HMA quality
4. The Engineer using test results, statistical evaluation of verified quality control tests, and inspection to accept HMA for payment

A lot is a quantity of HMA. The Engineer designates a new lot when:

1. 20 sublots are complete
2. The JMF changes
3. Production stops for more than 30 days

Each lot consists of no more than 20 sublots. A sublot is 750 tons except HMA paved at day's end greater than 250 tons is a sublot. If HMA paved at day's end is less than 250 tons, you may either make this quantity a sublot or include it in the previous sublot's test results for statistical evaluation.

39-4.03 CONTRACTOR QUALITY CONTROL

39-4.03A General

Use a composite quality factor, QF_C, and individual quality factors, QF_{QCi}, to control your process and evaluate your quality control program. For quality characteristics without quality factors, use your quality control plan's action limits to control process.

Control HMA quality including:

1. Materials
2. Proportioning
3. Spreading and compacting
4. Finished roadway surface

Develop, implement, and maintain a quality control program that includes:

1. Inspection
2. Sampling
3. Testing

39-4.03B Quality Control Plan

With the JMF submittal, submit a written Quality Control Plan (QCP). The QCP must comply with the Department's Quality Control Manual for Hot Mix Asphalt Production and Placement. Discuss the QCP with the Engineer during the prepaving conference.

The Engineer reviews each QCP within 5 business days from the submittal. Hold HMA production until the Engineer accepts the QCP in writing. The Engineer's QCP acceptance does not mean your compliance with the QCP will result in acceptable HMA. Section 39-1.05, "Engineer's Acceptance," specifies HMA acceptance.

The QCP must include the name and qualifications of a Quality Control Manager. The Quality Control Manager administers the QCP and during paving must be at the job site within 3 hours of receiving notice. The Quality Control Manager must not be any of the following on the project:

1. Foreman
2. Production or paving crewmember
3. Inspector
4. Tester

The QCP must include action limits and details of corrective action you will take if a test result for any quality characteristic falls outside an action limit.

As work progresses, you must submit a written QCP supplement to change quality control procedures, personnel, tester qualification status, or laboratory accreditation status.

39-4.03C Quality Control Inspection, Sampling, And Testing

Sample, test, inspect, and manage HMA quality control.

Provide a roadway inspector while HMA paving activities are in progress. Provide a plant inspector during HMA production.

Inspectors must comply with the Department's Quality Control Manual for Hot Mix Asphalt Production and Placement.

Provide a testing laboratory and personnel for quality control testing. Provide the Engineer unrestricted access to the quality control activities. Before providing services for the project, the Engineer reviews, accredits, and qualifies the testing laboratory and personnel under the Department's Independent Assurance Program.

The minimum random sampling and testing for quality control is:

Minimum Quality Control – QC / QA

Quality Characteristic	Test Method	Minimum Sampling and Testing Frequency	HMA Type			Location of Sampling	Max. Reporting Time Allowance
			A	B	RHMA-G		
Aggregate gradation [a]	CT 202	1 per 750 tons	JMF ± Tolerance [b]	JMF ± Tolerance [b]	JMF ± Tolerance [b]	CT 125	24 hours
Asphalt binder content (%)	CT 379 or 382		JMF ±0.45	JMF ±0.45	JMF ±0.5	Loose Mix Behind Paver See CT 125	
Percent of maximum theoretical density (%) [c, d]	QC Plan		92 - 96	92 - 96	91 - 96	QC Plan	
Aggregate moisture content at continuous mixing plants and RAP moisture content at continuous mixing plants and batch mixing plants [e]	CT 226 or CT 370	2 per day during production	--	--	--	Stockpiles or cold feed belts	--
Sand equivalent (min.) [f]	CT 217	1 per 750 tons	47	42	47	CT 125	24 hours
HMA moisture content (%,max.)	CT 226 or CT 370	1 per 2,500 tons but not less than 1 per paving day	1.0	1.0	1.0	Loose Mix Behind Paver See CT 125	24 hours
Stabilometer Value (min.) [f, g] No. 4 and 3/8" gradings 1/2" and 3/4" gradings	CT 366	1 per 4,000 tons or 2 per 5 business days, whichever is more	30 37	30 35	-- 23		48 hours
Air voids content (%)[f, h]	CT 367		4 ± 2	4 ± 2	Specification ± 2		

Percent of crushed particles coarse aggregate (% min.) One fractured face Two fractured faces Fine aggregate (% min) (Passing No. 4 sieve and retained on No. 8 sieve.) One fractured face	CT 205	As neces-sary and designat-ed in QCP. At least once per project.	90 75 70	25 -- 20	-- 90 70	CT 125	48 hours
Los Angeles Rattler (% max.) Loss at 100 rev. Loss at 500 rev.	CT 211		12 45	-- 50	12 40	CT 125	
Fine aggregate angularity (% min.)	AASHTO T 304, Method A		45	45	45	CT 125	
Flat and elongated particle (% max. by weight @ 5:1)	ASTM D 4791		Report only	Report only	Report only	CT 125	
Voids filled with asphalt (%) [i] No. 4 grading 3/8" grading 1/2" grading 3/4" grading	LP-3		76.0 – 80.0 73.0 – 76.0 65.0 – 75.0 65.0 – 75.0	76.0 – 80.0 73.0 – 76.0 65.0 – 75.0 65.0 – 75.0	Report only	LP-3	
Voids in mineral aggregate (% min.) [i] No. 4 grading 3/8" grading 1/2" grading 3/4" grading	LP-2		17.0 15.0 14.0 13.0	17.0 15.0 14.0 13.0	-- -- 18.0 – 23.0 [j] 18.0 – 23.0 [j]	LP-2	
Dust proportion [i] No. 4 and 3/8" gradings 1/2" and 3/4" gradings	LP-4		0.9 – 2.0 0.6 – 1.3	0.9 – 2.0 0.6 – 1.3	Report only	LP-4	
Smoothness	Section 39-1.12	--	12-foot straight-edge, must-grind, and PI_0	12-foot straight-edge, must-grind, and PI_0	12-foot straight-edge, must-grind, and PI_0	--	
Asphalt rubber binder viscosity @ 350 °F, centipoises	Section 39-1.02D	--	--	--	1,500 – 4,000	Section 39-1.02D	24 hours
Crumb rubber modifier	Section 39-1.02D	--	--	--	Section 39-1.02D	Section 39-1.02D	48 hours

Notes:
[a] Determine combined aggregate gradation containing RAP under Laboratory Procedure LP-9.
[b] The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."
[c] Required for HMA Type A, Type B, and RHMA-G if the specified paved thickness is at least 0.15 foot.
[d] Determine maximum theoretical density (California Test 309) at the frequency specified for test maximum density under California Test 375, Part 5 D.

[e] For adjusting the plant controller at the HMA plant.
[f] Report the average of 3 tests from a single split sample.
[g] Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F ± 5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."
[h] Determine the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.
[i] Report only if the adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC.
[j] Voids in mineral aggregate for RHMA-G must be within this range.

Within the specified reporting time, submit written test results including:

1. Sampling location, quantity, and time
2. Testing results
3. Supporting data and calculations

If test results for any quality characteristic are beyond the action limits in the QCP, take corrective actions. Document the corrective actions taken in the inspection records under Section 39-4.03E, "Records of Inspection and Testing."

Stop production, notify the Engineer in writing, take corrective action, and demonstrate compliance with the specifications before resuming production and placement on the State highway if:

1. A lot's composite quality factor, Q_{FC}, or an individual quality factor, QF_{QCi} for i = 3, 4, or 5, is below 0.90 determined under Section 39-4.03F, "Statistical Evaluation"
2. An individual quality factor, QF_{QCi} for i = 1 or 2, is below 0.75
3. Quality characteristics for which a quality factor, QF_{QCi}, is not determined has 2 consecutive acceptance or quality control tests not in compliance with the specifications

39-4.03D Charts And Records

Record sampling and testing results for quality control on forms provided in the "Quality Control Manual for Hot Mix Asphalt," or on forms you submit with the QCP. The QCP must also include form posting locations and submittal times.

Submit quality control test results using the Department's statistical evaluation program, HMAPay, available at

www.dot.ca.gov/hq/construc/hma/index.htm

39-4.03E Records Of Inspection And Testing

During HMA production, submit in writing a daily:

1. HMA Construction Daily Record of Inspection. Also make this record available at the HMA plant and job site each day.
2. HMA Inspection and Testing Summary. Include in the summary:

    2.1. Test forms with the testers' signatures and Quality Control Manager's initials.
    2.2. Inspection forms with the inspectors' signatures and Quality Control Manager's initials.
    2.3. A list and explanation of deviations from the specifications or regular practices.
    2.4. A signed statement by the Quality Control Manager that says:

    "It is hereby certified that the information contained in this record is accurate, and that information, tests, or calculations documented herein comply with the specifications of the contract and the standards set forth in the testing procedures. Exceptions to this certification are documented as part of this record."

Retain for inspection the records generated as part of quality control including inspection, sampling, and testing for at least 3 years after final acceptance.

39-4.03F Statistical Evaluation

General

Determine a lot's composite quality factor, QF_C, and the individual quality factors, QF_{QCi}. Perform statistical evaluation calculations to determine these quality factors based on quality control test results for:

1. Aggregate gradation
2. Asphalt binder content
3. Percent of maximum theoretical density

The Engineer grants a waiver and you must use 1.0 as the individual quality factor for percent of maximum theoretical density, QF_{QC5}, for HMA paved in:

1. Areas where the specified paved thickness is less than 0.15 foot
2. Areas where the specified paved thickness is less than 0.20 foot and a 3/4-inch grading is specified and used
3. Dig outs
4. Leveling courses
5. Areas where, in the opinion of the Engineer, compaction or compaction measurement by conventional methods is impeded

Statistical Evaluation Calculations

Use the Variability-Unknown / Standard Deviation Method to determine the percentage of a lot not in compliance with the specifications. The number of significant figures used in the calculations must comply with AASHTO R-11, Absolute Method.

Determine the percentage of work not in compliance with the specification limits for each quality characteristic as follows:

1. Calculate the arithmetic mean ($\overline{X}$) of the test values

$$\overline{X} = \frac{\Sigma x}{n}$$

where:

x = individual test values
n = number of test values

2. Calculate the standard deviation

$$s = \sqrt{\frac{n\,(\Sigma x^2)-(\Sigma x)^2}{n(n-1)}}$$

where:

$\sum(x^2)$ = sum of the squares of individual test values
$(\sum x)^2$ = sum of the individual test values squared
n = number of test values

3. Calculate the upper quality index (Qu)

$$Q_u = \frac{USL - \overline{X}}{s}$$

where:

USL = target value plus the production tolerance or upper specification limit
s = standard deviation
$\overline{X}$ = arithmetic mean

4. Calculate the lower quality index (QL);

$$Q_L = \frac{\overline{X} - LSL}{s}$$

where:

LSL = target value minus production tolerance or lower specification limit
s = standard deviation
$\overline{X}$ = arithmetic mean

5. From the table, Upper Quality Index Q_U or Lower Quality Index Q_L, of this Section 39-4.03F, "Statistical Evaluation", determine P_U ;

where:

P_U = the estimated percentage of work outside the USL.
$P_U = 0$, when USL is not specified.

6. From the table, Upper Quality Index Q_U or Lower Quality Index Q_L, of this Section 39-4.03F, "Statistical Evaluation," determine P_L;

where:

P_L = the estimated percentage of work outside the LSL.
$P_L = 0$, when LSL is not specified.

7. Calculate the total estimated percentage of work outside the USL and LSL, percent defective

Percent defective = $P_U + P_L$

P_U and P_L are determined from:

P_U or P_L	**Upper Quality Index Q_U or Lower Quality Index Q_L**												
	Sample Size (n)												
	5	6	7	8	9	10-11	12-14	15-17	18-22	23-29	30-42	43-66	>66
0	1.72	1.88	1.99	2.07	2.13	2.20	2.28	2.34	2.39	2.44	2.48	2.51	2.56
1	1.64	1.75	1.82	1.88	1.91	1.96	2.01	2.04	2.07	2.09	2.12	2.14	2.16
2	1.58	1.66	1.72	1.75	1.78	1.81	1.84	1.87	1.89	1.91	1.93	1.94	1.95
3	1.52	1.59	1.63	1.66	1.68	1.71	1.73	1.75	1.76	1.78	1.79	1.80	1.81
4	1.47	1.52	1.56	1.58	1.60	1.62	1.64	1.65	1.66	1.67	1.68	1.69	1.70
5	1.42	1.47	1.49	1.51	1.52	1.54	1.55	1.56	1.57	1.58	1.59	1.59	1.60
6	1.38	1.41	1.43	1.45	1.46	1.47	1.48	1.49	1.50	1.50	1.51	1.51	1.52
7	1.33	1.36	1.38	1.39	1.40	1.41	1.41	1.42	1.43	1.43	1.44	1.44	1.44
8	1.29	1.31	1.33	1.33	1.34	1.35	1.35	1.36	1.36	1.37	1.37	1.37	1.38
9	1.25	1.27	1.28	1.28	1.29	1.29	1.30	1.30	1.30	1.31	1.31	1.31	1.31
10	1.21	1.23	1.23	1.24	1.24	1.24	1.25	1.25	1.25	1.25	1.25	1.26	1.26
11	1.18	1.18	1.19	1.19	1.19	1.19	1.20	1.20	1.20	1.20	1.20	1.20	1.20
12	1.14	1.14	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
13	1.10	1.10	1.10	1.10	1.10	1.10	1.11	1.11	1.11	1.11	1.11	1.11	1.11
14	1.07	1.07	1.07	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
15	1.03	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
16	1.00	0.99	0.99	0.99	0.99	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
17	0.97	0.96	0.95	0.95	0.95	0.95	0.94	0.94	0.94	0.94	0.94	0.94	0.94
18	0.93	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90
19	0.90	0.89	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
20	0.87	0.86	0.85	0.85	0.84	0.84	0.84	0.83	0.83	0.83	0.83	0.83	0.83
21	0.84	0.82	0.82	0.81	0.81	0.81	0.80	0.80	0.80	0.80	0.80	0.80	0.79
22	0.81	0.79	0.79	0.78	0.78	0.77	0.77	0.77	0.76	0.76	0.76	0.76	0.76
23	0.77	0.76	0.75	0.75	0.74	0.74	0.74	0.73	0.73	0.73	0.73	0.73	0.73
24	0.74	0.73	0.72	0.72	0.71	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70
25	0.71	0.70	0.69	0.69	0.68	0.68	0.67	0.67	0.67	0.67	0.67	0.67	0.66
26	0.68	0.67	0.67	0.65	0.65	0.65	0.64	0.64	0.64	0.64	0.64	0.64	0.63
27	0.65	0.64	0.63	0.62	0.62	0.62	0.61	0.61	0.61	0.61	0.61	0.61	0.60
28	0.62	0.61	0.60	0.59	0.59	0.59	0.58	0.58	0.58	0.58	0.58	0.58	0.57
29	0.59	0.58	0.57	0.57	0.56	0.56	0.55	0.55	0.55	0.55	0.55	0.55	0.54
30	0.56	0.55	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52
31	0.53	0.52	0.51	0.51	0.50	0.50	0.50	0.49	0.49	0.49	0.49	0.49	0.49
32	0.50	0.49	0.48	0.48	0.48	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.46
33	0.47	0.48	0.45	0.45	0.45	0.44	0.44	0.44	0.44	0.43	0.43	0.43	0.43
34	0.45	0.43	0.43	0.42	0.42	0.42	0.41	0.41	0.41	0.41	0.41	0.41	0.40
35	0.42	0.40	0.40	0.39	0.39	0.39	0.38	0.38	0.38	0.38	0.38	0.38	0.38
36	0.39	0.38	0.37	0.37	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
37	0.36	0.35	0.34	0.34	0.34	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.32
38	0.33	0.32	0.32	0.31	0.31	0.31	0.30	0.30	0.30	0.30	0.30	0.30	0.30
39	0.30	0.30	0.29	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
40	0.28	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
41	0.25	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
42	0.23	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
43	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
44	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
45	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
46	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
47	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
48	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
49	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1. If the value of Q_U or Q_L does not correspond to a value in the table, use the next lower value.
2. If Q_U or Q_L are negative values, P_U or P_L is equal to 100 minus the table value for P_U or P_L.

Quality Factor Determination

Determine individual quality factors, QF_{QCi}, using percent defective = $P_U + P_L$ and:

Quality Factors

Quality Factor	Maximum Allowable Percent Defective ($P_U + P_L$)												
	Sample Size (n)												
	5	6	7	8	9	10-11	12-14	15-17	18-22	23-29	30-42	43-66	>66
1.05				0	0	0	0	0	0	0	0	0	0
1.04			0	1	3	5	4	4	4	3	3	3	3
1.03		0	2	4	6	8	7	7	6	5	5	4	4
1.02		1	3	6	9	11	10	9	8	7	7	6	6
1.01	0	2	5	8	11	13	12	11	10	9	8	8	7
1.00	22	20	18	17	16	15	14	13	12	11	10	9	8
0.99	24	22	20	19	18	17	16	15	14	13	11	10	9
0.98	26	24	22	21	20	19	18	16	15	14	13	12	10
0.97	28	26	24	23	22	21	19	18	17	16	14	13	12
0.96	30	28	26	25	24	22	21	19	18	17	16	14	13
0.95	32	29	28	26	25	24	22	21	20	18	17	16	14
0.94	33	31	29	28	27	25	24	22	21	20	18	17	15
0.93	35	33	31	29	28	27	25	24	22	21	20	18	16
0.92	37	34	32	31	30	28	27	25	24	22	21	19	18
0.91	38	36	34	32	31	30	28	26	25	24	22	21	19
0.90	39	37	35	34	33	31	29	28	26	25	23	22	20
0.89	41	38	37	35	34	32	31	29	28	26	25	23	21
0.88	42	40	38	36	35	34	32	30	29	27	26	24	22
0.87	43	41	39	38	37	35	33	32	30	29	27	25	23
0.86	45	42	41	39	38	36	34	33	31	30	28	26	24
0.85	46	44	42	40	39	38	36	34	33	31	29	28	25
0.84	47	45	43	42	40	39	37	35	34	32	30	29	27
0.83	49	46	44	43	42	40	38	36	35	33	31	30	28
0.82	50	47	46	44	43	41	39	38	36	34	33	31	29
0.81	51	49	47	45	44	42	41	39	37	36	34	32	30
0.80	52	50	48	46	45	44	42	40	38	37	35	33	31
0.79	54	51	49	48	46	45	43	41	39	38	36	34	32
0.78	55	52	50	49	48	46	44	42	41	39	37	35	33
0.77	56	54	52	50	49	47	45	43	42	40	38	36	34
0.76	57	55	53	51	50	48	46	44	43	41	39	37	35
0.75	58	56	54	52	51	49	47	46	44	42	40	38	36
	60	57	55	53	52	51	48	47	45	43	41	40	37
	61	58	56	55	53	52	50	48	46	44	43	41	38
Reject	62	59	57	56	54	53	51	49	47	45	44	42	39
	63	61	58	57	55	54	52	50	48	47	45	43	40
	64	62	60	58	57	55	53	51	49	48	46	44	41
Reject Values Greater Than Those Shown Above													

Notes:

1. To obtain a quality factor when the estimated percent outside specification limits from table, "Upper Quality Index Q_U or Lower Quality Index Q_L," does not correspond to a value in the table, use the next larger value.

Compute the composite of single quality factors, QF_C, for a lot using:

$$QF_C = \sum_{i=1}^{5} w_i \, QF_{QC_i}$$

where:

QF_C =	the composite quality factor for the lot rounded to 2 decimal places.
QF_{QCi} =	the quality factor for the individual quality characteristic.
w =	the weighting factor listed in the table HMA Acceptance – QC / QA.
i =	the quality characteristic index number in the table HMA Acceptance – QC / QA.

39-4.04 ENGINEER'S QUALITY ASSURANCE

39-4.04A General

The Engineer assures quality by:

1. Reviewing mix designs and proposed JMF
2. Inspecting procedures
3. Conducting oversight of quality control inspection and records
4. Verification sampling and testing during production and paving

39-4.04B Verification Sampling And Testing

General

The Engineer samples:

1. Aggregate to verify gradation
2. HMA to verify asphalt binder content

Verification

For aggregate gradation and asphalt binder content, the ratio of verification testing frequency to the minimum quality control testing frequency is 1:5. The Engineer performs at least 3 verification tests per lot.

Using the t-test, the Engineer compares quality control tests results for aggregate gradation and asphalt binder content with corresponding verification test results. The Engineer uses the average and standard deviation of up to 20 sequential sublots for the comparison. The Engineer uses production start-up evaluation tests to represent the first sublot. When there are less than 20 sequential sublots, the Engineer uses the maximum number of sequential sublots available. The 21st sublot becomes the 1st sublot (n = 1) in the next lot.

The t-value for a group of test data is computed as follows:

$$t = \frac{\left|\overline{X}_c - \overline{X}_v\right|}{S_p\sqrt{\frac{1}{n_c} + \frac{1}{n_v}}} \qquad \text{and} \qquad S_p^2 = \frac{S_c^2(n_c - 1) + S_v^2(n_v - 1)}{n_c + n_v - 2}$$

where:

n_c =	Number of quality control tests (2 minimum, 20 maximum).
n_v =	Number of verification tests (minimum of 1 required).
$\overline{X}_c$ =	Mean of quality control tests.
$\overline{X}_v$ =	Mean of verification tests.
S_p =	Pooled standard deviation (When $n_v = 1$, $S_p = S_c$).
S_c =	Standard deviation of quality control tests.
S_v =	Standard deviation of verification tests (when $n_v > 1$).

The comparison of quality control test results and the verification test results is at a level of significance of $\alpha = 0.025$. The Engineer computes t and compares it to the critical t-value, t_{crit}, from:

Critical T-Value

Degrees of freedom (n_c+n_v-2)	t_{crit} (for α = 0.025)	Degrees of freedom (n_c+n_v-2)	t_{crit} (for α = 0.025)
1	24.452	18	2.445
2	6.205	19	2.433
3	4.177	20	2.423
4	3.495	21	2.414
5	3.163	22	2.405
6	2.969	23	2.398
7	2.841	24	2.391
8	2.752	25	2.385
9	2.685	26	2.379
10	2.634	27	2.373
11	2.593	28	2.368
12	2.560	29	2.364
13	2.533	30	2.360
14	2.510	40	2.329
15	2.490	60	2.299
16	2.473	120	2.270
17	2.458	∞	2.241

If the t-value computed is less than or equal to t_{crit}, quality control test results are verified.

If the t-value computed is greater than t_{crit} and both $\overline{X}_v$ and $\overline{X}_c$ comply with acceptance specifications, the quality control tests are verified. You may continue to produce and place HMA with the following allowable differences:

1. $\left|\overline{X}_v - \overline{X}_c\right| \leq 1.0$ percent for any grading
2. $\left|\overline{X}_v - \overline{X}_c\right| \leq 0.1$ percent for asphalt binder content

If the t-value computed is greater than t_{crit} and the $\left|\overline{X}_v - \overline{X}_c\right|$ for grading and asphalt binder content are greater than the allowable differences, quality control test results are not verified and:

1. The Engineer notifies you in writing.
2. You and the Engineer must investigate why the difference exist.
3. If the reason for the difference cannot be found and corrected, the Engineer's test results are used for acceptance and pay.

39-4.05 ENGINEER'S ACCEPTANCE

39-4.05A Testing

The Engineer samples for acceptance testing and tests for:

HMA Acceptance – QC / QA

Index (i)	Quality Characteristic				Weight-ing Factor (w)	Test Method	HMA Type		
							A	B	RHMA-G
		Aggregate gradation [a]							
	Sieve	3/4"	1/2"	3/8"					
1	1/2"	X [b]	--	--	0.05	CT 202	JMF ± Tolerance [c]		
1	3/8"	--	X	--	0.05				
1	No. 4	--	--	X	0.05				
2	No. 8	X	X	X	0.10				
3	No. 200	X	X	X	0.15				
4	Asphalt binder content (%)				0.30	CT 379 or 382	JMF ± 0.45	JMF ± 0.45	JMF ± 0.5
5	Percent of maximum theoretical density (%) [d, e]				0.40	CT 375	92 – 96	92 – 96	91 – 96
	Sand equivalent (min.) [f]					CT 217	47	42	47
	Stabilometer value (min.) [f,, g] No. 4 and 3/8" gradings 1/2" and 3/4" gradings					CT 366	 30 37	 30 35	 -- 23
	Air voids content (%) [f, h]					CT 367	4 ± 2	4 ± 2	Specifica-tion ± 2
	Percent of crushed particles coarse aggregate (% min.) One fractured face Two fractured faces Fine aggregate (% min) (Passing No. 4 sieve and retained on No. 8 sieve.) One fractured face					CT 205	 90 70 70	 25 -- 20	 -- 90 70
	HMA moisture content (%, max.)					CT 226 or CT 370	1.0	1.0	1.0
	Los Angeles Rattler (% max.) Loss at 100 rev. Loss at 500 rev.					CT 211	 12 45	 -- 50	 12 45
	Fine aggregate angularity (% min.)					AASHTO T 304, Method A	45	45	45
	Flat and elongated particle (% max. by weight @ 5:1)					ASTM D 4791	Report only	Report only	Report only
	Voids in mineral aggregate (% min.) [i] No. 4 grading 3/8" grading 1/2" grading 3/4" grading					LP-2	 17.0 15.0 14.0 13.0	 17.0 15.0 14.0 13.0	(Note j) -- -- 18.0 - 23.0 18.0 - 23.0
	Voids filled with asphalt (%) [i] No. 4 grading 3/8" grading 1/2" grading 3/4" grading					LP-3	 76.0 - 80.0 73.0 - 76.0 65.0 - 75.0 65.0 - 75.0	 76.0 - 80.0 73.0 - 76.0 65.0 - 75.0 65.0 - 75.0	Report only
	Dust proportion [i] No. 4 and 3/8" gradings 1/2" and 3/4" gradings					LP-4	 0.9 - 2.0 0.6 - 1.3	 0.9 – 2.0 0.6 – 1.3	Report only

	Smoothness		Section 39-1.12	12-foot straight-edge, must-grind, and PI_0	12-foot straight-edge, must-grind, and PI_0	12-foot straight-edge, must-grind, and PI_0
	Asphalt binder		Various	Section 92	Section 92	Section 92
	Asphalt rubber binder		Various	--	--	Section 92-1.02(C) and Section 39-1.02D
	Asphalt modifier		Various	--	--	Section 39-1.02D
	Crumb rubber modifier		Various	--	--	Section 39-1.02D

Notes:
[a] The Engineer determines combined aggregate gradations containing RAP under Laboratory Procedure LP-9.
[b] "X" denotes the sieves the Engineer considers for the specified aggregate gradation.
[c] The tolerances must comply with the allowable tolerances in Section 39-1.02E, "Aggregate."
[d] The Engineer determines percent of maximum theoretical density if the specified paved thickness is at least 0.15 foot under California Test 375 except the Engineer uses:

1. California Test 308, Method A, to determine in-place density of each density core instead of using the nuclear gauge in Part 4, "Determining In-Place Density By The Nuclear Density Device."
2. California Test 309 to determine maximum theoretical density instead of calculating test maximum density in Part 5, "Determining Test Maximum Density."

[e] The Engineer determines maximum theoretical density (California Test 309) at the frequency specified for Test Maximum Density under California Test 375, Part 5.D.
[f] The Engineer reports the average of 3 tests from a single split sample.
[g] Modify California Test 304, Part 2.B.2.c: "After compaction in the mechanical compactor, cool to 140 °F ± 5 °F by allowing the briquettes to cool at room temperature for 0.5 hour, then place the briquettes in the oven at 140 °F for a minimum of 2 hours and not more than 3 hours."
[h] The Engineer determines the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.
[i] Report only if the adjustment for asphalt binder content target value is less than or equal to ± 0.3 percent from OBC.
[j] Voids in mineral aggregate for RHMA-G must be within this range.

The Engineer determines the percent of maximum theoretical density from the average density of 3 density cores you take from every 750 tons of production or part thereof divided by the maximum theoretical density.

If the specified total paved thickness is at least 0.15 foot and any layer is less than 0.15 foot, the Engineer determines the percent of maximum theoretical density from density cores taken from the final layer measured the full depth of the total paved HMA thickness.

The Engineer stops production and terminates a lot if:

1. The lot's composite quality factor, Q_{FC}, or an individual quality factor, QF_{QCi} for i = 3, 4, or 5, is below 0.90 determined under Section 39-4.03F, "Statistical Evaluation"
2. An individual quality factor, QF_{QCi} for i = 1 or 2, is below 0.75
3. Quality characteristics for which a quality factor, QF_{QCi}, is not determined has 2 consecutive acceptance or quality control tests not in compliance with the specifications

For any single quality characteristic for which a quality factor, QF_{QCi}, is not determined, except smoothness, if 2 consecutive acceptance test results do not comply with specifications:

1. Stop production.
2. Take corrective action.

3. In the Engineer's presence, take samples and split each sample into 4 parts. Test 1 part for compliance with the specifications and submit 3 parts to the Engineer. The Engineer tests 1 part for compliance with the specifications and reserves and stores 2 parts.
4. Demonstrate compliance with the specifications before resuming production and placement on the State highway.

39-4.05B Statistical Evaluation, Determination Of Quality Factors And Acceptance

Statistical Evaluation and Determination of Quality Factors

To determine the individual quality factor, $QF_{QCi,}$ for any quality factor i = 1 through 5 or a lot's composite quality factor, QF_C, for acceptance and payment adjustment, the Engineer uses the evaluation specifications under Section 39-4.03F, "Statistical Evaluation," and:

1. Verified quality control test results for aggregate gradation
2. Verified quality control test results for asphalt binder content
3. The Engineer's test results for percent of maximum theoretical density

Lot Acceptance Based on Quality Factors

The Engineer accepts a lot based on the quality factors determined for aggregate gradation and asphalt binder content, QF_{QCi} for i = 1 through 4, using the total number of verified quality control test result values and the total percent defective ($P_U + P_L$).

The Engineer accepts a lot based on the quality factor determined for maximum theoretical density, QF_{QC5}, using the total number of test result values from density cores and the total percent defective ($P_U + P_L$).

The Engineer calculates the quality factor for the lot, QF_C, which is a composite of weighted individual quality factors, QF_{QCi}, determined for each quality characteristic in the HMA Acceptance – QC / QA table in Section 39-4.05A, "Testing."

The Engineer accepts a lot based on quality factors if:

1. The current composite quality factor, QF_C, is 0.90 or greater
2. Each individual quality factor, QF_{QCi} for i = 3, 4, and 5, is 0.90 or greater
3. Each individual quality factor, QF_{QCi} for i = 1 and 2, is 0.75 or greater

No single quality characteristic test may represent more than the smaller of 750 tons or 1 day's production.

Payment Adjustment

If a lot is accepted, the Engineer adjusts payment with the following formula:

$$PA = \sum_{i=1}^{n} HMACP * wi * \left[QFQCi * (HMATT - WHMATTi) + WHMATTi\right] - (HMACP * HMATT)$$

where:

PA =	Payment adjustment rounded to 2 decimal places.
HMACP =	HMA contract price.
HMATT =	HMA total tons represented in the lot.
$WHMATT_i$ =	Total tons of waived quality characteristic HMA.
QF_{QCi} =	Running quality factor for the individual quality characteristic. QF_{QCi} for i = 1 through 4 must be from verified Contractor's QC results. QF_{QC5} must be determined from the Engineer's results on density cores taken for percent of maximum theoretical density determination.
w =	Weighting factor listed in the HMA acceptance table.
i =	Quality characteristic index number in the HMA acceptance table.

If the payment adjustment is a negative value, the Engineer deducts this amount from payment. If the payment adjustment is a positive value, the Engineer adds this amount to payment.

The 21st sublot becomes the 1st sublot (n = 1) in the next lot. When the 21st sequential sublot becomes the 1st sublot, the previous 20 sequential sublots become a lot for which the Engineer determines a quality factor. The Engineer uses this quality factor to pay for the HMA in the lot. If the next lot consists of less than 8 sublots, these sublots must be added to the previous lot for quality factor determination using 21 to 27 sublots.

39-4.05C Dispute Resolution

For a lot, if you or the Engineer dispute any quality factor, QF_{QCi}, or verification test result, every sublot in that lot must be retested.

Referee tests must be performed under the specifications for acceptance testing.

Any quality factor, QF_{QCi}, must be determined using the referee tests.

For any quality factor, QF_{QCi}, for i = 1 through 5, dispute resolution:

1. If the difference between the quality factors for QF_{QCi} using the referee test result and the disputed test result is less than or equal to 0.01, the original test result is correct.
2. If the difference between the quality factor for QF_{QCi} using the referee test result and the disputed test result is more than 0.01, the quality factor determined from the referee tests supersedes the previously determined quality factor.

39-5 MEASUREMENT AND PAYMENT

39-5.01 MEASUREMENT

The contract item for HMA is measured by weight. The weight of each HMA mixture designated in the Engineer's Estimate must be the combined mixture weight.

If tack coat, asphalt binder, and asphaltic emulsion are paid with separate contract items, their contract items are measured under Section 92, "Asphalts," or Section 94, "Asphaltic Emulsions," as the case may be.

If recorded batch weights are printed automatically, the contract item for HMA is measured by using the printed batch weights, provided:

1. Total aggregate and supplemental fine aggregate weight per batch is printed. If supplemental fine aggregate is weighed cumulatively with the aggregate, the total aggregate batch weight must include the supplemental fine aggregate weight.
2. Total asphalt binder weight per batch is printed.
3. Each truckload's zero tolerance weight is printed before weighing the first batch and after weighing the last batch.
4. Time, date, mix number, load number and truck identification is correlated with a load slip.
5. A copy of the recorded batch weights is certified by a licensed weighmaster and submitted to the Engineer.

The contract item for placing HMA dike is measured by the linear foot along the completed length. The contract item for placing HMA in miscellaneous areas is measured as the in-place compacted area in square yards. In addition to the quantities measured on a linear foot or square yard basis, the HMA for dike and miscellaneous areas are measured by weight.

The contract item for geosynthetic pavement interlayer is measured by the square yard for the actual pavement area covered.

39-5.02 PAYMENT

The contract prices paid per ton for hot mix asphalt as designated in the Engineer's Estimate include full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all the work involved in constructing hot mix asphalt, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

If HMA is specified to comply with Section 39-4, "Quality Control / Quality Assurance," the Engineer adjusts payment under that section.

Full compensation for the Quality Control Plan and prepaving conference is included in the contract prices paid per ton for hot mix asphalt as designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

Full compensation for performing and submitting mix designs and for Contractor sampling, testing, inspection, testing facilities, and preparation and submittal of results is included in the contract prices paid per ton for HMA as designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

Full compensation for reclaimed asphalt pavement is included in the contract prices paid per ton for HMA as designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

The contract price paid per ton for hot mix asphalt (leveling) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all the work involved in hot mix asphalt (leveling), complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The State pays for HMA dike at the contract price per linear foot for place HMA dike and by the ton for HMA. The contract prices paid per linear foot for place hot mix asphalt dike as designated in the Engineer's Estimate include full compensation for furnishing all labor, tools, equipment, and incidentals, and for doing all the work involved in placing HMA dike, complete in place, including excavation, backfill, and preparation of the area to receive the dike, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The State pays for HMA specified to be a miscellaneous area at the contract price per square yard for place hot mix asphalt (miscellaneous area) and per ton for hot mix asphalt. The contract price paid per square yard for place hot mix asphalt (miscellaneous area) includes full compensation for furnishing all labor, tools, equipment, and incidentals, and for doing all the work involved in placing HMA (miscellaneous area) complete in place, including excavation, backfill, and preparation of the area to receive HMA (miscellaneous area), as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

If the Quality Control / Quality Assurance construction process is specified, HMA placed in dikes and miscellaneous areas is paid for at the contract price per ton for hot mix asphalt under Section 39-4, "Quality Control / Quality Assurance." Section 39-4.05B, "Statistical Evaluation, Determination of Quality Factors and Acceptance," does not apply to HMA placed in dikes and miscellaneous areas.

If there are no contract items for place hot mix asphalt dike and place hot mix asphalt (miscellaneous area) and the work is specified, full compensation for constructing HMA dikes and HMA (miscellaneous areas) including excavation, backfill, and preparation of the area to receive HMA dike or HMA (miscellaneous area) is included in the contract price paid per ton for the hot mix asphalt designated in the Engineer's Estimate and no separate payment will be made therefor.

The contract price paid per square yard for geosynthetic pavement interlayer includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in placing geosynthetic pavement interlayer, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The contract price paid per ton for paving asphalt (binder, geosynthetic pavement interlayer) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in applying paving asphalt (binder, geosynthetic pavement interlayer), complete in place, including spreading sand to cover exposed binder material, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

Full compensation for small quantities of HMA placed on geosynthetic pavement interlayer to prevent displacement during construction is included in the contract price paid per ton for the HMA being paved over the interlayer and no separate payment will be made therefor.

The contract price paid per ton for tack coat includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in applying tack coat, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The Engineer does not adjust payment for increases or decreases in the quantities for tack coat, regardless of the reason for the increase or decrease. Section 4-1.03B, "Increased or Decreased Quantities," does not apply to the items for tack coat.

Full compensation for performing smoothness testing, submitting written and electronic copies of tests, and performing corrective work including applying fog seal coat is included in the contract price paid per ton for the HMA designated in the Engineer's Estimate and no separate payment will be made therefor.

Full compensation for spreading sand on RHMA-G, RHMA-O, and RHMA-O-HB surfaces and for sweeping and removing excess sand is included in the contract price paid per ton for rubberized hot mix asphalt as designated in the Engineer's Estimate and no separate payment will be made therefor.

If the Engineer fails to comply with a specification within a specified time, and if, in the opinion of the Engineer, work completion is delayed because of the failure, the Engineer adjusts payment and contract time under Section 8-1.09, "Right of Way Delays."

If the dispute resolution ITP determines the Engineer's test results are correct, the Engineer deducts the ITP's testing costs from payments. If the ITP determines your test results are correct, the State pays the ITP's testing costs. If, in the Engineer's opinion, work completion is delayed because of incorrect Engineer test results, the Engineer adjusts payment and contract time under Section 8-1.09, "Right of Way Delays."

^^

SECTION 40 PORTLAND CEMENT CONCRETE PAVEMENT
(Issued 06-05-09)

Replace Section 40 with:
SECTION 40 CONCRETE PAVEMENT

40-1 GENERAL

40-1.01 SUMMARY

Section 40 includes specifications for constructing concrete pavement on a prepared subgrade.

40-1.02 SUBMITTALS

40-1.02A Certificates of Compliance

Submit Certificates of Compliance under Section 6-1.07, "Certificates of Compliance." Include a test result report for any specified test with certification that test was performed within 12 months before the tested material's use.

Submit Certificates of Compliance for:

1. Tie bars
2. Threaded tie bar splice couplers
3. Dowel bars
4. Tie bar baskets
5. Dowel bar baskets
6. Chemical adhesive (drill and bond)
7. Silicone joint sealant
8. Asphalt rubber joint sealant
9. Preformed compression seal
10. Backer rods. Include the manufacturer's statement of compatibility with the sealant to be used.
11. Joint filler material
12. Curing compound. For each delivery to the job site, submit a copy of the Certificate of Compliance to the Engineer and the Transportation Laboratory. Each Certificate of Compliance must not represent more than 10,000 gallons and must include a test result report for:

    12.1. Moisture loss at 24 hours under California Test 534
    12.2. Reflectance under ASTM E 1347
    12.3. Viscosity under ASTM D 2196
    12.4. Nonvolatile content under ASTM D 3723
    12.5. Pigment content under ASTM D 3723

13. Epoxy powder coating

40-1.02B Curing Compound Samples

Submit split curing compound samples to the Transportation Laboratory.

40-1.02C Drilled Corings

Submit each core taken for Engineer's acceptance in a plastic bag. Mark each core with a location description.

40-1.02D Independent Third Party Air Content Testing Laboratory

Before testing, submit for the Engineer's approval the name of a laboratory that will test drilled core specimens for air content in cases of dispute.

40-1.02E Dowel Bars

Before placing dowel bars, submit a procedure for identifying transverse contraction joint locations relative to the dowel bars' longitudinal center and a procedure for consolidating concrete around the dowel bars.

40-1.02F Concrete Field Qualification

Submit field qualification data and test reports including:

1. Mixing date
2. Mixing equipment and procedures used
3. Batch volume in cubic yards
4. Type and source of ingredients used
5. Penetration of the concrete
6. Air content of the plastic concrete
7. Age and strength at time of concrete beam testing

Field qualification test reports must be certified with a signature by an official in responsible charge of the laboratory performing the tests.

40-1.02G Frequency Measuring Device (Tachometer)

Submit calibration documentation and operational guidelines for frequency measuring devices for concrete consolidation vibrators.

40-1.02H Manufacturer's Recommendations and Instructions

If used and at least 15 days before delivery to the job site, submit manufacturer's recommendations and instructions for storage and installation of:

1. Threaded tie bar splice couplers
2. Chemical adhesive (drill and bond)
3. Silicone liquid sealant
4. Asphalt rubber liquid sealant
5. Preformed compression seals
6. Joint filler material

40-1.02I Mix Proportions

At least 15 days before starting testing for mix proportions under California Test 559, submit a copy of the AASHTO accreditation for your laboratory determining the mix proportions. At least 30 days before starting field qualification, submit under California Test 559 the proposed concrete mix proportions, the corresponding mix identifications, and laboratory test reports including the modulus of rupture for each trial mixture at 10, 21, 28, and 42 days.

40-1.02J Preformed Compression Seal

Submit the manufacturer's data sheet used to develop the recommended preformed compression seal based on the joint dimensions.

40-1.02K Concrete Pavement Early Age Crack Mitigation System

At least 24 hours before each paving shift, submit:

1. Early age stress and strength predictions
2. Scheduled sawing and curing activities
3. Contingency plan if volunteer cracking occurs

At least 24 hours before paving, meet with the Engineer to review the submittals for the early age crack mitigation system.

During paving, update the system with current weather data obtained from a portable weather station. Before paving concrete pavement with these updates, submit new stress and strength predictions and curing and sawing activity schedules.

40-1.02L Profilograms

Submit profilograms within 5 business days of initial profiling and within 2 business days of profiling corrected sections.

Submit 1 electronic copy of profile information in ".erd" format or other ProVAL compatible format to the Engineer and to:

Smoothness@dot.ca.gov

Submit the original of final profilograms before the Engineer accepts the contract.

Submitted profilograms become the Department's property.

40-1.02M Protecting Concrete Pavement During Cold Weather

Submit a plan for protecting concrete pavement when the average ambient daily temperature is below 40 °F and daytime ambient temperature is less than 50 °F during the initial 72 hours after paving.

40-1.02N Quality Control Charts

Submit updated quality control charts each paving day.

40-1.02O Quality Control Plan

At least 30 days before the start of field qualification, submit a concrete pavement quality control plan (QCP).

40-1.03 QUALITY CONTROL AND ASSURANCE

40-1.03A Contractor Quality Control Plan

Establish, implement, and maintain a QCP for concrete pavement. The QCP must describe the organization and procedures you use to:

1. Control the production process
2. Determine if changes to the production process are needed
3. Implement changes

The QCP must address the elements affecting concrete pavement quality including:

1. Mix proportions
2. Aggregate gradation
3. Materials quality
4. Stockpile management
5. Line and grade control
6. Proportioning
7. Mixing and transportation
8. Placing and consolidation
9. Contraction and construction joints
10. Dowel bar placement, alignment, and anchorage
11. Tie bar placement
12. Modulus of rupture
13. Finishing and curing
14. Surface smoothness
15. Joint sealant and compression seal installation

The QCP must include details of corrective action to be taken if any process is out of control. As a minimum, a process is out of control if any of the following occurs:

1. For fine and coarse aggregate gradation, 2 consecutive running averages of 4 tests are outside the specification limits
2. For fine and coarse aggregates, the moisture content of either aggregate changes by more than 0.5 percentage point from any reading
3. For individual penetration or air content measurements:

    3.1. One point falls outside the suspension limit line
    3.2. Two points in a row fall outside the action limit line

Stop production and take corrective action for out of control processes except fine and coarse aggregate moisture content or the Engineer rejects subsequent material.

40-1.03B Quality Control Testing

Select random locations and perform sampling and testing in compliance with:

Quality Control Testing

Test	Frequency	Test Method
Cleanness value	2 per day	CT 227
Sand equivalent	2 per day	CT 217
Aggregate gradation	2 per day	CT 202
Air content (freeze thaw) [a]	1 per hour	CT 504
Air content (non-freeze thaw)	1 per 4 hours	CT 504
Density	1 per 4 hours	CT 518
Penetration	1 per 4 hours	CT 533
Calibration of moisture meter [b, c]	1 per day	CT 223 or CT 226

Notes:
[a] If air entrainment is specified, make at least 1 air content measurement per hour. If air entrainment is not specified, make at least 1 air content measurement per 4 hours.
[b] Make at least 1 measurement of moisture content per week to check the calibration of an electronically actuated moisture meter.
[c] Random location sampling and testing is not applicable.

If air entrainment is specified, the testing laboratory and tester must be qualified under the Department's Independent Assurance Manual. The manual is available from the Transportation Laboratory.

40-1.03C Control Charts

Maintain control charts to identify potential problems and assignable causes. Post a copy of each control chart at a location determined by the Engineer.

Individual measurement control charts must use the target values in the mix proportions as indicators of central tendency. Develop linear control charts for:

1. Cleanness value
2. Sand equivalent
3. Fine and coarse aggregate gradation
4. Air content
5. Penetration

Control charts must include:

1. Contract number
2. Mix proportions
3. Test number
4. Each test parameter
5. Action and suspension limits
6. Specification limits
7. Quality control test results

For fine and coarse aggregate gradation control charts, record the running average of the previous 4 consecutive gradation tests for each sieve and superimpose the specification limits.

For penetration and air content control charts, record the individual measurements and superimpose the following action and suspension limits:

Penetration and Air Content Action and Suspension Limits

Control Parameter	Individual Measurements	
	Action Limit	Suspension Limit
Penetration, CT 533	1 inch	1-1/2 inch
Air content, CT 504	±1.0 percent	±1.5 percent

40-1.03D Contractor's Laboratory

Use a laboratory that complies with ASTM C 1077 to determine the mix proportions for concrete pavement. The laboratory must have a current AASHTO accreditation for:

1. AASHTO T 97 or ASTM C 78
2. ASTM C 192/C 192M

40-1.03E Joint Sealant and Compression Seal Installation Training

Before installing joint sealant or compression seals, arrange for a representative from the joint sealant or compression seal manufacturer to provide training on the cleaning and preparation of the joint and installing the sealant or seal. Until your personnel and the Department's personnel have been trained, do not install joint sealant or compression seals.

40-1.03F Frequency Measuring Device (Tachometer)

Before each day's concrete pavement placement and at intervals not to exceed 4 hours of production, test and record vibration frequency and amplitude for concrete consolidation vibrators.

40-1.03G Early Age Concrete Pavement Crack Mitigation System

Develop and implement a system for predicting concrete pavement stresses and strength during the initial 72 hours after paving. The system must include:

1. Subscribing to a weather service to obtain forecasts for wind speed, ambient temperatures, humidity, and cloud cover
2. Portable weather station with anemometer, temperature and humidity sensors, located at the paving site
3. Early age concrete pavement stress and strength prediction computer program
4. Analyzing, monitoring, updating, and reporting the system's predictions

40-1.03H Curing Compound

Sample curing compound from shipping containers at the manufacturer's source of supply. Split the samples.

40-1.03I Concrete Pavement Smoothness

Within 10 days after paving, measure the Profile Index (PI_0) of the concrete pavement surface using a zero (null) blanking band under California Test 526.

For the following concrete pavement areas, the Engineer does not require a profilograph and you must test and correct high points determined by a 12-foot straightedge placed parallel with and perpendicular to the centerline:

1. Horizontal curves with a centerline radius of curvature less than 1,000 feet including concrete pavement within the superelevation transitions of those curves.
2. Exit ramp termini, truck weigh stations, and weigh-in-motion areas
3. Where steep grades and superelevation rates greater than 6 percent are present on:

    3.1. Ramps
    3.2. Connectors

4. Turn lanes and areas around manholes or drainage transitions
5. Acceleration and deceleration lanes for at-grade intersections
6. Shoulders and miscellaneous gore areas

Use a California Profilograph or equivalent to determine the concrete pavement profile. If the profilograph uses a mechanical recorder, use an electronic scanner to reduce the profilogram.

The profilograph operator must be qualified under the Department's Independent Assurance Manual. The manual is available from the Transportation Laboratory.

40-1.03J Profilograph Test Procedure

Notify the Engineer at least 2 business days before performing profilograph testing. Each day before performing profilograph testing, notify the Engineer of the start location. Perform profilograph testing in the Engineer's presence.

Before starting profilograph testing, remove foreign objects from the concrete pavement surface.

Before starting profilograph testing, calibrate the profilograph in the Engineer's presence. If the Engineer chooses not to be present during profilograph testing, you may perform the testing with the Engineer's written approval. Note the Engineer's absence on the profilogram.

Determine PI_0 values for the final concrete pavement surface of each 0.1-mile section of a traffic lane. Take 2 profiles within each traffic lane, 3 feet from and parallel with the edge of each lane. Each section's PI_0 is the average of the PI_0 values for the measurements within that traffic lane. A section that is less than 0.01 mile and is the result of an interruption to continuous concrete pavement surface must comply with the PI_0 specifications for a full section. Adjust the PI_0 for a partial section to reflect a full section.

Use stationing to locate vertical deviations greater than 0.3 inches. The profilogram stationing must be the same as the project stationing. Note 0.1-mile segments on the profilogram.

Label the profilogram with:

1. Contract number
2. County and route number
3. Stationing
4. Operator's name
5. Test date
6. Test number
7. Traffic direction
8. Traffic lane (numbered from left to right in direction of travel)
9. Test wheel path (left or right in direction of travel)
10. Test direction
11. Paving direction

40-1.03K Smoothness Corrective Action

Correct concrete pavement not complying with the Engineer's acceptance specifications for smoothness by grinding under Section 42-2, "Grinding."

Do not grind before:

1. Ten days after concrete pavement placement
2. The concrete has developed a modulus of rupture of at least 550 psi

Grind the entire lane width. When completed, the lane width must be uniform in texture and appearance. Square the corrected area's start and end normal to the paved surface's centerline.

Retest sections where corrections were made.

40-1.03L Engineer's Acceptance

General

The Engineer accepts concrete pavement based on the Department's testing for the following concrete pavement quality characteristics. A single test represents no more than the quantity specified:

Concrete Pavement Acceptance

Quality Characteristic	Quantity	Test
28-day modulus of rupture	1,000 cubic yards	CT 523
Thickness	1,200 square yards for primary area measurements	CT 531
Dowel bar placement	700 square yards	Measurement
Tie bar placement	4,000 square yards	Measurement
Coefficient of friction	One day's paving	CT 342
Air content (freeze-thaw) [a]	One day's paving	CT 504

Note:
[a] Air content tests must be performed under California Test 504 if air entrainment is specified.

At the Department's option, the Engineer also accepts concrete pavement based on your or the Department's testing for smoothness. A single test represents no more than 0.1 mile.

The Engineer considers other concrete pavement quality characteristics in determining final acceptance. The Engineer's acceptance of modulus of rupture, thickness, dowel bar and tie bar placement, coefficient of friction, smoothness, and air content does not constitute final concrete pavement acceptance.

Modulus of Rupture

The Engineer accepts concrete pavement for modulus of rupture on a lot basis. The minimum modulus of rupture for each lot is 570 psi at 28 days.

For each lot of concrete for concrete pavement:

1. Quantity must not exceed 1,000 cubic yards.
2. Department determines the modulus of rupture of test beams aged 10 days and 28 days.
3. Department calculates the modulus of rupture by averaging the individual test results of 2 beams aged for 28 days.
4. Difference in the individual test results of beams aged 28 days must not exceed 12 percent when tested by Method 1, or 16 percent when tested by Method 2. The Engineer calculates the difference relative to the average of the 2 test results.

The Department provides molds and machines for modulus of rupture acceptance testing. Provide material and labor the Engineer may require.

Concrete Pavement Smoothness

If the Department tests for smoothness, the tests are performed under Section 40-1.03I, "Concrete Pavement Smoothness."

The Engineer accepts concrete pavement for smoothness in compliance with the following:

1. For tangents and horizontal curves having a centerline radius of curvature 2,000 feet or more, the PI_0 must be at most 3 inches per 0.1-mile section.
2. For horizontal curves having a centerline radius of curvature from 1,000 to 2,000 feet including concrete pavement within the superelevation transitions of those curves, the PI_0 must be at most 6 inches per 0.1-mile section.
3. If using a profilograph to measure smoothness, the surface must not have individual high points greater than 0.3 inch.
4. If using a straightedge to measure smoothness, the surface must be within 0.02 foot of the straightedge's lower edge.

Profile index specifications apply to existing pavement within 50 feet of the transverse joint separating new concrete pavement and the existing pavement.

If the Department's profilograph test results do not match yours, the Engineer may order you to recalibrate your profilograph equipment and perform a retest. If your test results are inaccurate due to operator error, the Engineer may disqualify your profilograph operator. If the Engineer determines your test results are inaccurate, the Engineer does not make adjustments to payment or contract time for recalibrating, retesting, and delays.

Concrete Pavement Thickness

The Engineer accepts concrete pavement for thickness based on coring in the primary area, which is the area placed in 1 day for each thickness. Concrete pavement thickness must not be deficient by more than 0.05 foot.

After corrective grinding has been completed, core concrete pavement in the primary area under Section 40-3.16, "Obtaining Drilled Cores," at locations determined by the Engineer and in the Engineer's presence. The core specimen diameter must be 4 inches. To identify the limits of concrete pavement deficient in thickness by more than 0.05 foot, you may divide primary areas into secondary areas. Specifications that may affect concrete pavement thickness such as allowable tolerances for subgrade construction do not change the thickness specified for concrete pavement.

In each primary area, the Engineer measures concrete pavement thickness every 1,200 square yards and any remaining area. The Engineer measures cores under California Test 531 to the nearest 0.01 foot. Core at least 1 foot from existing, contiguous, and parallel concrete pavement not constructed as part of this contract.

You may request the Engineer make additional thickness measurements and use them to determine the average thickness variation. The Engineer determines the locations with random sampling methods.

If each thickness measurement in a primary area is less than 0.05 foot deficient, the Engineer calculates the average thickness deficiency in that primary area. The Engineer uses 0.02 foot for a thickness difference more than 0.02 foot over the specified thickness.

For each thickness measurement in a primary area deficient by more than 0.05 foot, the Engineer determines a secondary area where the thickness deficiency is more than 0.05 foot. The Engineer determines this secondary area by measuring the thickness of each concrete pavement slab adjacent to the measurement found to be more than 0.05 foot deficient. The Engineer continues to measure the thickness until an area that is bound by slabs with thickness deficient by 0.05 foot or less is determined.

Slabs without bar reinforcement are defined as the areas bound by longitudinal and transverse joints and concrete pavement edges. Slabs with bar reinforcement are defined as the areas bound by longitudinal joints and concrete pavement edges and 15-foot lengths. Secondary area thickness measurements in a slab determine that entire slab's thickness.

The Engineer measures the remaining primary area thickness after removing the secondary areas from consideration for determining the average thickness deficiency.

The Engineer determines the slabs to remove and replace.

Required Use of Air-Entraining Admixtures

If air-entraining admixtures are specified, the Engineer may choose to accept concrete pavement for air content based on your air content quality control tests. The Engineer decides to use your air content quality control tests based on a *t*-test that determines the difference in the means of your test and the Engineer's verification tests. The Engineer calculates the t-value of the test data as follows:

$$t = \frac{\left|\overline{X}_c - \overline{X}_v\right|}{S_p\sqrt{\frac{1}{n_c} + \frac{1}{n_v}}} \qquad \text{and} \qquad S_p^2 = \frac{S_c^2(n_c - 1) + S_v^2(n_v - 1)}{n_c + n_v - 2}$$

where:

n_c = Number of your quality control tests (minimum of 2 required)
n_v = Number of verification tests (minimum of 1 required)
$\overline{X}_c$ = Mean of your quality control tests
$\overline{X}_v$ = Mean of the verification tests
S_p = Pooled standard deviation
(When $n_v = 1$, $S_p = S_c$)
S_c = Standard deviation of your quality control tests
S_v = Standard deviation of the verification tests (when $n_v > 1$)

The Engineer compares your quality control test results with the Department's verification test results at a level of significance of $\alpha = 0.01$. The Engineer compares the *t*-value to t_{crit}, determined from:

t_{crit}

degrees of freedom (n_c+n_v-2)	t_{crit} (for $\alpha = 0.01$)
1	63.657
2	9.925
3	5.841
4	4.604
5	4.032
6	3.707
7	3.499
8	3.355
9	3.250
10	3.169

If the *t*-value calculated is less than or equal to t_{crit}, your quality control test results are verified. If the *t*-value calculated is greater than t_{crit}, quality control test results are not verified.

If your quality control test results are not verified, core at least 3 specimens from concrete pavement under Section 40-3.16, "Obtaining Drilled Cores." The Engineer selects the core locations. Your approved third party independent testing laboratory must test these specimens for air content under ASTM C 457. The Engineer compares these test results with your quality control test results using the *t*-test method. If your quality control test results are verified based on this comparison, the Engineer uses the quality control test results for acceptance of concrete pavement for air content. If your quality control test results are not verified based on this comparison, the Engineer uses the air content of core specimens determined under ASTM C 457 for acceptance.

Dowel Bar and Tie Bar Placement

The Engineer uses core specimens to evaluate and accept concrete pavement for:

1. Dowel bar placement
2. Tie bar placement
3. Concrete consolidation

Obtain cores under Section 40-3.16, "Obtaining Drilled Cores." The Engineer determines the core locations. Each core must have a nominal diameter of 4 inches. Core each day's paving within 2 business days in compliance with:

1. One test for every 700 square yards of doweled concrete pavement or remaining fraction of that area. Each dowel bar test consists of 2 cores, 1 on each dowel bar end to expose both ends and allow measurement.
2. One test for every 4,000 square yards of concrete pavement with tie bars or remaining fraction of that area

If the tests indicate dowel or tie bars are not placed within the specified tolerances or if there are air voids around the dowel or tie bars, core additional specimens to determine the limits of unacceptable work.

The Engineer determines the slabs to remove and replace.

If the Engineer approves your request, slabs may remain in place with an adjustment in payment for:

1. Dowel bars with centers from ±2 inches to ±3 inches from the saw cut of a transverse contraction joint or with deficient concrete consolidation around the dowel bars
2. Tie bars placed outside their specified placement and position or with deficient concrete consolidation around the tie bars

Bar Reinforcing Steel

The Engineer accepts concrete pavement for bar reinforcing steel based on inspection before concrete placement.

Curing Compound

The Engineer accepts curing compound based on test results submitted with the Certificate of Compliance for moisture loss, reflectance, viscosity, nonvolatile content, and pigment content. Curing compound sampled from shipping containers from the manufacturer's supply source or from the job site must match these test results within the specified tolerances listed in the precision and bias statements for the test methods.

40-2 MATERIALS

40-2.01 CONCRETE

40-2.01A General

Concrete must comply with Section 90, "Portland Cement Concrete."

40-2.01B Aggregate

The specifications for reduction in Operating Range and Contract Compliance for cleanness value and sand equivalent specified under Section 90-2.02A, "Coarse Aggregate," and Section 90-2.02B, "Fine Aggregate," do not apply to concrete pavement.

Combined aggregate gradings must comply with Section 90-3, "Aggregate Gradings," and the difference between the percent passing the 3/8-inch sieve and the percent passing the No. 8 sieve must not be less than 16 percent of the total aggregate.

40-2.01C Cementitious Material

Concrete for concrete pavement must contain from 505 pounds to 675 pounds cementitious material per cubic yard. The specifications for reducing cementitious material content in Section 90-4.05, "Optional Use of Chemical Admixtures," do not apply to concrete pavement.

40-2.01D Mix Proportions

Your laboratory determining mix proportions must determine the minimum cementitious materials content or the maximum water to cementitious materials ratio under California Test 559 and:

1. You must make trial mixtures no more than 24 months before field qualification.
2. Modulus of rupture used to determine the minimum cementitious materials content or maximum water to cementitious materials ratio must be 570 psi at 28 days age and 650 psi at 42 days age.
3. Your laboratory must determine an increase in the cementitious materials content or a decrease in the water to cementitious materials ratio from the trial mixtures to ensure concrete pavement complies with the specifications.

If changing an aggregate supply source or the mix proportions, produce a trial batch and field-qualify the new concrete. The Engineer does not adjust contract time for performing sampling, testing, and qualifying new mix proportions or changing an aggregate supply source.

40-2.01E Field Qualification

Proposed mix proportions must be field qualified before you place concrete pavement. Use an American Concrete Institute (ACI) certified "Concrete Laboratory Technician, Grade I" to perform field qualification tests and calculations.

The Engineer accepts field qualification if five beams made and tested under California Test 523 comply with the following:

1. At a minimum, beams are tested at 10, 21, and 28 days of age
2. At your choice of age not later than 28 days, no single beam's modulus of rupture is less than 550 psi and the average modulus of rupture is at least 570 psi

40-2.02 TIE BARS

Unless specified as smooth, tie bars must be deformed.

Deformed tie bars must be:

1. Deformed steel reinforcing bars under any of the following:

    1.1. ASTM A 615/A 615M, Grade 40 or 60
    1.2. ASTM A 996/A 996M
    1.3. ASTM A 706/A 706M

2. Epoxy-coated under Section 52-1.02B, "Epoxy-coated Reinforcement," and the following:

    2.1. Epoxy-coated tie bars must comply with either ASTM A 775/ A 775M or ASTM A 934/ A 934 M.
    2.2. Epoxy coating under ASTM A 934/ A 934M must be purple or gray.

Smooth tie bars must be:

1. Plain, round, and smooth steel under ASTM A 615/A 615M, Grade 40 or 60
2. Epoxy-coated under Section 52-1.02B, "Epoxy-coated Reinforcement," and the following:

    2.1. Epoxy-coated smooth tie bars must comply with ASTM A 884/A 884M, Class A, Type 1 or Type 2.
    2.2. Epoxy coating under ASTM A 884/A 884 M, Class A, Type 2 must be purple or gray.
    2.3. Bend test does not apply.

Fabricate, sample, and handle epoxy-coated smooth and deformed tie bars at the job site under ASTM D 3963/D 3963M and Section 52-1.02B, "Epoxy-coated Reinforcement."

Do not bend epoxy-coated tie bars.

40-2.03 DOWEL BARS

40-2.03A General

Dowel bars must be:

1. Plain, round, and smooth steel under ASTM A 615/A 615M, Grade 40 or 60
2. Epoxy-coated under Section 52-1.02B, "Epoxy-coated Reinforcement," and the following:

2.1 Epoxy-coated dowel bars must comply with ASTM A 884/A 884M, Class A, Type 1 or Type 2.
2.2. Epoxy coating under ASTM A 884/ A 884M, Class A, Type 2 must be purple or gray.
2.3. Specifications for bend test do not apply.

Fabricate, sample, and handle epoxy-coated dowel bars at the job site under ASTM D 3963/D 3963M and Section 52-1.02B, "Epoxy-coated Reinforcement," except each sample must be 18 inches long. Sample each load delivered to the job site.

40-2.03B Dowel Bar Lubricant

Dowel bar lubricant must be petroleum paraffin-based or curing compound. Paraffin-based lubricant must be Dayton Superior DSC BB-Coat or Valvoline Tectyl 506 or an approved equal and must be factory-applied. Curing compound must be curing compound (3) under Section 90-7.01B, "Curing Compound Method," of the Standard Specifications.

40-2.04 CURING COMPOUND

Curing compound must be curing compound (1) or (2) with white pigment under Section 90-7.01B, "Curing Compound Method."

Reflectance must be at least 60 percent when tested under ASTM E 1347.

40-2.05 CHEMICAL ADHESIVE (DRILL AND BOND)

Chemical adhesive for drilling and bonding dowels and tie bars must be prequalified. A list of prequalified chemical adhesives is available on the Department's Materials Engineering and Testing Services website. The prequalified list indicates the appropriate chemical adhesive system for the concrete temperature and installation conditions.

Each chemical adhesive system must clearly and permanently show the manufacturer's name, model number of the system, manufacturing date, lot number, shelf life or expiration date, and current International Conference of Building Officials (ICBO) Evaluation Report number. Each chemical adhesive carton must include the manufacturer's recommended installation procedures and warning or precautions required by State or Federal laws and regulations.

40-2.06 DOWEL AND TIE BAR BASKETS

Dowel and tie bar baskets must be:

1. Minimum W10 wire size number under ASTM A 82/A 82M
2. Either U-frame or A-frame shape
3. Welded under Section 7.4 of ASTM A 185/A 185M

You may epoxy-coat dowel and tie bar baskets under Section 52-1.02B, "Epoxy-coated Reinforcement," and the following:

1. Epoxy-coated dowel and tie bar baskets must comply with ASTM A 884/A 884M, Class A, Type 1 or Type 2.
2. Epoxy-coating under ASTM A 884/ A 884M, Class A, Type 2 must be purple or gray.

Handle epoxy-coated dowel and tie-bar baskets at the manufacturing plant and job site under ASTM D 3963/D 3963M and Section 52-1.02B, "Epoxy-coated Reinforcement."

Fasteners must be driven fasteners under ASTM F 1667. Fasteners on lean concrete base or asphalt concrete must have a minimum shank diameter of 3/16 inch and a minimum shank length of 2 1/2 inches. For asphalt treated permeable base or cement treated permeable base, the shank diameter must be at least 3/16 inch and the shank length must be at least 5 inches.

Fasteners, clips, and washers must have a minimum 0.2-mil thick zinc coating applied either by electroplating or galvanizing.

40-2.07 BACKER RODS

Backer rods must be Type 1 under ASTM D 5249. Backer rod diameter must be at least 25 percent greater than the sawcut joint width. Backer rod material must be expanded, crosslinked, closed-cell polyethylene foam. No bond or adverse reaction may occur between the backer rod and sealant.

40-2.08 JOINT FILLER MATERIAL

Joint filler for isolation joints must be preformed expansion joint filler for concrete (bituminous type) under ASTM D 994.

40-2.09 HYDRAULIC CEMENT GROUT (NON-SHRINK)

Hydraulic cement grout (non-shrink) must comply with ASTM C 1107/ C 1107M. Use clean, uniform, rounded aggregate filler to extend the grout. Aggregate filler must not exceed 60 percent of the grout mass or the maximum recommended by the manufacturer, whichever is less. Aggregate filler moisture content must not exceed 0.5 percent. Aggregate filler must comply with:

Aggregate Filler Grading

Sieve Size	Percentage Passing
1/2-inch	100
3/8-inch	85 - 100
No. 4	10 - 30
No. 8	0 - 10
No. 16	0 - 5

40-2.10 BAR REINFORCEMENT

Bar reinforcement must comply with Section 52, "Reinforcement."

40-2.11 JOINT SEALANT

40-2.11A General

Do not use hot-pour sealant that will melt the backer rod.

40-2.11B Silicone Joint Sealant

Silicone joint sealant must be low modulus furnished in a one-part silicone formulation. Do not use acid cure sealant. Silicone joint sealant must be compatible with the surface it is applied to and comply with:

Silicone Joint Sealant

Property	Test Method	Specification
Tensile stress, 150% elongation, 7-day cure at 77 °F ± 2 °F and 45% to 55% R.H. [e]	ASTM D 412 (Die C)	45 psi max.
Flow at 77 °F ± °F	ASTM C 639 [a]	Must not flow from channel
Extrusion Rate at 77 °F ± 2 °F	ASTM C 603 [b]	3 to 9 oz/min.
Specific Gravity	ASTM D 792 Method A	1.01 to 1.51
Durometer Hardness, at 0 °F, Shore A, cured 7 days at 77 °F ±2 °F	ASTM C 661	10 to 25
Ozone and Ultraviolet Resistance, after 5,000 hours	ASTM C 793	No chalking, cracking or bond loss
Tack-free at 77 °F ±2 °F and 45% to 55% R.H.[e]	ASTM C 679	Less than 75 minutes
Elongation, 7 day cure at 77 °F ±2 °F and 45% to 55% R.H. [e]	ASTM D 412 (Die C)	500 percent min.
Set to Touch, at 77 °F ±2 °F and 45% to 55% R.H. [e]	ASTM D 1640	Less than 75 minutes
Shelf Life, from date of shipment	—	6 months min.
Bond, to concrete mortar-concrete briquettes, air cured 7 days at 77 °F ±2 °F	AASHTO T 132 [c]	50 psi min.
Movement Capability and Adhesion, 100% extension at 0 °F after, air cured 7 days at 77 °F ±2 °F , and followed by 7 days in water at 77 °F ±2 °F	ASTM C 719[d]	No adhesive or cohesive failure after 5 cycles

Notes:
[a] ASTM C 639 Modified (15 percent slope channel A).
[b] ASTM C 603, through 0.12-inch opening at 50 psi.
[c] Mold briquettes under AASHTO T 132, saw in half and bond with a 0.60-inch maximum thickness of sealant and test under AASHTO T 132. Briquettes must be dried to constant mass at 212 °F ±10 °F.
[d] Prepare 12" x 1" x 3" concrete blocks under ASTM C 719. Use a sawed face for bond surface. Seal 2 inches of block leaving 0.50 inch on each end of specimen unsealed. The depth of sealant must be 0.40 inch and the width 0.50 inch.
[e] R.H. equals relative humidity.

After application, silicone joint sealant must not flow on grades up to 15 percent.

40-2.11C Asphalt Rubber Joint Sealant

Asphalt rubber joint sealant must:

1. Be a mixture of paving asphalt and ground rubber containing not less than 22 percent ground rubber by weight. One hundred percent of ground rubber must pass a No. 8 sieve. Ground rubber must be vulcanized or a combination of vulcanized and devulcanized materials.
2. Comply with ASTM D 6690, Type II except:

    2.1. The cone penetration requirement must not exceed 120 at 77 F, 5 ounces, 5 seconds.
    2.2. The resilience requirement must be a minimum 50 percent recovery when tested at 77 F.

3. Have a Ring and Ball softening point of 135 °F minimum when tested under AASHTO T 53.
4. Be capable of being melted and applied to cracks and joints at temperatures below 400 °F.
5. Not be applied when the concrete pavement surface temperature is below 50 °F.

40-2.11D Preformed Compression Joint Seals

Preformed compression joint seals must comply with ASTM D 2628. Lubricant adhesive used with the seals must comply with ASTM D 2835. Preformed compression joint seals must have 5 or 6 cells, except seals for Type A2 and Type B joints may have 4 cells. Install preformed compression joint seals in compliance with the manufacturer's recommendations. Show evidence that the seals are compressed from 40 to 50 percent for the joint width and depth.

40-2.12 WATER

Water for core drilling must be from a local domestic water supply. Water must not contain:

1. More than 1,000 parts per million of chlorides as CL
2. More than 1,300 parts per million of sulfates as $S0_4$
3. Impurities in a quantity to cause concrete discoloration or surface etching

40-3 CONSTRUCTION

40-3.01 WATER SUPPLY

Before placing concrete pavement, develop enough water supply for the work.

40-3.02 SUBGRADE PREPARATION

Immediately before placing concrete, the subgrade to receive concrete pavement must be:

1. In compliance with the specified compaction and elevation tolerances
2. Free of loose and extraneous material
3. Uniformly moist, but free of standing or flowing water
4. Excavated for thickened parts of concrete pavement end anchors with no disturbed compaction outside the end anchor dimensions

If cement treated permeable base is specified, cover the base surface with asphaltic emulsion before placing concrete pavement. Apply the asphaltic emulsion uniformly at a rate of 0.1 gallons per square yard. Asphaltic emulsion must comply with anionic slow-setting type, SS1h grade in Section 94, "Asphaltic Emulsions." Repair damaged asphaltic emulsion before placing concrete pavement.

40-3.03 PROPORTIONING

Proportion aggregate and bulk cementitious materials under Section 90-5, "Proportioning."

40-3.04 PLACING CONCRETE

40-3.04A General

Place concrete pavement with stationary side forms or slip-form paving equipment.

Place consecutive concrete loads within 30 minutes of each other. Construct a transverse construction joint when concrete placement is interrupted by more than 30 minutes. The transverse construction joint must coincide with the next contraction joint location, or you must remove fresh concrete pavement to the preceding transverse joint location.

Place concrete pavement in full slab widths separated by construction joints or monolithically in multiples of full lane widths with a longitudinal contraction joint at each traffic lane line.

Do not retemper concrete.

If the concrete pavement surface width is constructed as specified, you may construct concrete pavement sides on a batter not flatter than 6:1 (vertical:horizontal).

40-3.04B Concrete Pavement Widening

If concrete pavement is placed adjacent to existing pavement not constructed as part of the contract, grind the existing concrete pavement lane or shoulder adjacent to the new concrete pavement. Perform the grinding before new concrete pavement is placed. The new concrete pavement must match the elevation of the existing concrete pavement after grinding. Grind existing concrete pavement under Section 42-2, "Grinding," except profile index must comply with the pavement smoothness specifications in Section 40-1.03, "Quality Control and Assurance."

Use paving equipment with padded crawler tracks or rubber-tired wheels on the existing concrete pavement with enough offset to avoid breaking or cracking the existing concrete pavement's edge.

40-3.04C Concrete Pavement Transition Panel

For concrete pavement placed in a transition panel, texture the surface with a drag strip of burlap, a broom, or a spring steel tine device that produces scoring in the finished surface. The scoring must be either parallel with or transverse to the centerline. For the method you choose, texture at the time that produces the coarsest texture.

40-3.04D Stationary Side Form Construction

Stationary side forms must be straight and without defects including warps, bends, and indentations. Side forms must be metal except at end closures and transverse construction joints where other materials may be used.

You may build up side forms by attaching a section to the top or bottom. If attached to the top of metal forms, the attached section must be metal.

The side form's base width must be at least 80 percent of the specified concrete pavement thickness.

Side forms including interlocking connections with adjoining forms must be rigid enough to prevent springing from subgrading and paving equipment and concrete pressure.

Construct subgrade to final grade before placing side forms. Side forms must bear fully on the foundation throughout their length and base width. Place side forms to the specified grade and alignment of the finished concrete pavement's edge. Support side forms during concrete placing, compacting, and finishing.

After subgrade work is complete and immediately before placing concrete, true side forms and set to line and grade for a distance that avoids delays due to form adjustment.

Clean and oil side forms before each use.

Side forms must remain in place for at least 1 day after placing concrete and until the concrete pavement edge no longer requires protection from the forms.

Spread, screed, shape, and consolidate concrete with 1 or more machines. The machine must uniformly distribute and consolidate the concrete. The machines must operate to place the concrete pavement to the specified cross section with minimal hand work.

Consolidate the concrete without segregation. If vibrators are used:

1. The vibration rate must be at least 3,500 cycles per minute for surface vibrators and 5,000 cycles per minute for internal vibrators
2. Amplitude of vibration must cause perceptible concrete surface movement at least 1 foot from the vibrating element
3. Use a calibrated tachometer for measuring frequency of vibration
4. Vibrators must not rest on side forms or new concrete pavement
5. Power to vibrators must automatically cease when forward or backward motion of the paving machine is stopped

Use high-frequency internal vibrators within 15 minutes of depositing concrete on the subgrade to uniformly consolidate the concrete across the paving width including adjacent to forms. Do not use vibrators to shift the mass of concrete.

40-3.04E Slip-Form Construction

If slip-form construction is used, spread, screed, shape, and consolidate concrete to the specified cross section with slip-form machines and minimal hand work. Slip-form paving machines must be equipped with traveling side forms and must not segregate the concrete.

Do not deviate from the specified concrete pavement alignment by more than 0.1 foot.

Slip-form paving machines must use high frequency internal vibrators to consolidate concrete. You may mount vibrators with their axes parallel or normal to the concrete pavement alignment. If mounted with axes parallel to the concrete pavement alignment, space vibrators no more than 2.5 feet measured center to center. If mounted with axes normal to the concrete pavement alignment, space the vibrators with a maximum 0.5-foot lateral clearance between individual vibrators.

Each vibrator must have a vibration rate from 5,000 cycles per minute to 8,000 cycles per minute. The amplitude of vibration must cause perceptible concrete surface movement at least 1 foot from the vibrating element. Use a calibrated tachometer to measure frequency of vibration.

40-3.05 TIE BAR PLACEMENT

Place tie bars:

1. Perpendicular to the longitudinal concrete pavement joint
2. Parallel with the concrete pavement surface at mid-slab depth
3. Not less than 1/2-inch below the saw cut depth of joints
4. With not less than 2 inches clearance from the concrete pavement's surface and bottom
5. With embedment length tolerance of ±2 inches
6. For smooth tie bars, with horizontal and vertical skew not more than 1/2 inch per foot of bar length

Install tie bars at longitudinal joints by 1 of the following methods:

1. Drill concrete and bond tie bars with chemical adhesive in compliance with the manufacturer's instructions. Clean and dry drilled holes before placing chemical adhesive and tie bars. After inserting tie bars into chemical adhesive, support the bars to prevent movement during curing. If the Engineer rejects a tie bar installation, cut the tie bar flush with the joint face and coat the exposed end of the tie bar with chemical adhesive under Section 40-2, "Materials." Offset new holes 3 inches horizontally from the rejected hole's center.
2. Insert tie bars into plastic slip-formed concrete before finishing. Inserted tie bars must have full contact between the bar and the concrete. If tie bars are inserted through the plastic concrete surface, eliminate evidence of the insertion by reworking the concrete over the tie bars.
3. Use threaded tie bar splice couplers fabricated from deformed bar reinforcement free of external welding or machining.
4. Use tie bar baskets. Anchor baskets at least 200 feet in advance of the concrete placement activity. If you request a waiver, describe the construction limitations or restricted access preventing the advanced anchoring. After the baskets are anchored and before the concrete is placed, cut and remove temporary spacer wires and demonstrate the tie bars do not move from their specified depth and alignment during concrete placement. Use fasteners to anchor tie bar baskets.

If tie bars are not placed correctly, stop paving activities until you demonstrate to the Engineer correction of the cause.

40-3.06 DOWEL BAR PLACEMENT

Center dowel bars within 2 inches in the longitudinal direction on transverse contraction joints or construction joints.

If using curing compound as lubricant, apply the curing compound to dowels in 2 separate applications. Lubricate each dowel bar entirely with bond breaker before placement. The last application must be applied not more than 8 hours before placing the dowel bars. Apply each curing compound application at a rate of 1 gallon per 150 square feet.

If dowel bars are placed by mechanical insertion, eliminate evidence of the insertion by reworking the concrete over the dowel bars. If drilling and bonding dowel bars at construction joints, use a grout retention ring.

If using dowel bar baskets, anchor them with fasteners.

Use at least 10 fasteners for basket sections greater than 12 feet and less than or equal to 16 feet. Baskets must be anchored at least 200 feet in advance of the concrete placement activity unless the Engineer approves your waiver request. If requesting a waiver, describe the construction limitations or restricted access preventing the advanced anchoring. After the baskets are anchored and before the concrete is placed, cut and remove temporary spacer wires and demonstrate the dowel bars do not move from their specified depth and alignment during concrete placement.

Place dowel bars in compliance with:

Dowel Bar Tolerances

Dimension	Tolerance
Horizontal offset	±1 inch
Longitudinal translation	±2 inches
Horizontal skew	3/8 inch, max
Vertical skew	3/8 inch, max
Vertical depth	The minimum distance below the concrete pavement surface must be: DB = d/3 + 1/2 inch where: DB = vertical distance in inches, measured from concrete pavement surface to any point along the top of dowel bar d = concrete pavement thickness in inches The maximum distance below the depth shown on the plans must be 0.05 foot.

If dowel bars are not placed correctly, stop paving activities until you demonstrate to the Engineer correction of the cause.

Remove and replace the concrete pavement 3 feet on either side of a joint with a rejected dowel bar.

40-3.07 BAR REINFORCEMENT

Place bar reinforcement under Section 52, "Reinforcement." Bar reinforcement must be more than 1/2 inch below the saw cut depth at concrete pavement joints.

40-3.08 JOINTS

40-3.08A General

Concrete pavement joints consist of:

1. Longitudinal and transverse construction joints
2. Longitudinal and transverse contraction joints
3. Isolation joints

Construction joints must be normal to the concrete pavement surface.

Until contract acceptance and except for joint filler material, keep joints free of foreign material including soil, gravel, concrete, or asphalt mix.

Volunteer cracks are cracks not coincident with constructed joints.

Repair concrete pavement damaged during joint construction under Section 40-3.17B, "Repair of Spalls, Raveling, and Tearing."

Do not bend tie bars or reinforcement in existing concrete pavement joints.

40-3.08B Construction Joints

Construction joints form where fresh concrete is placed against hardened concrete, existing pavements, or structures.

Before placing concrete at construction joints, apply a curing compound under Section 90-7.01B, "Curing Compound Method," to the vertical surface of existing or hardened concrete and allow it to dry.

Use a metal or wooden bulkhead to form transverse construction joints. If dowel bars are specified, the bulkhead must allow dowel bar installation.

40-3.08C Contraction Joints

In multilane monolithic concrete pavement, use the sawing method to construct longitudinal contraction joints. Construct transverse contraction joints by the sawing method.

Construct transverse contraction joints within 1 foot of their specified spacing. If a slab length of less than 5 feet would be formed, adjust the transverse contraction joint spacing.

Construct transverse contraction joints across the full concrete pavement width regardless of the number or types of longitudinal joints crossed. In areas of converging and diverging pavements, space transverse contraction joints so their alignment is continuous across the full width where converging and diverging pavements are contiguous. Longitudinal contraction joints must be parallel with the concrete pavement centerline. Transverse and longitudinal contraction joints must not deviate by more than 0.1 foot from either side of a 12-foot straight line, except for longitudinal joints parallel to a curving centerline.

40-3.08D Isolation Joints

Construct isolation joints by saw cutting a minimum 1/8-inch width to full concrete pavement depth at the existing concrete pavement's edge and removing the concrete to expose a flat vertical surface. Before placing concrete, secure joint filler material that prevents new concrete from adhering to the existing concrete face.

Dispose of concrete saw cutting residue under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way."

40-3.08E Sawing Method

The sawing method is cutting a groove in the concrete pavement with a power driven concrete saw. Grooves for longitudinal and transverse contraction joints must be the minimum width possible for the type of saw used. If necessary, the top of the joint must be sawn wider to provide space for joint sealant. Immediately wash slurry from the joint with water under 100 psi maximum pressure.

Saw longitudinal and transverse contraction joints before volunteer cracking occurs and after the concrete is hard enough to saw without spalling, raveling, or tearing.

To keep foreign material out of grooves before joint sealant or compression seal installation, you may use joint filler in sawed contraction joints. Joint filler must not react adversely with the concrete or cause concrete pavement damage. After sawing and washing a joint, install joint filler material that keeps moisture in the adjacent concrete during the 72 hours after paving. If you install joint filler material, the specifications for spraying the sawed joint with additional curing compound under Section 40-3.13, "Curing," do not apply. If using absorptive filler material, moisten the filler immediately before or after installation.

40-3.09 JOINT SEALANT AND COMPRESSION SEAL INSTALLATION

40-3.09A General

At least 7 days after concrete pavement placement and not more than 4 hours before installing joint sealant or compression seal materials, use dry sand blasting and other methods to clean the joint walls of objectionable material such as soil, asphalt, curing compound, paint, and rust. The maximum sand blasting nozzle diameter must be 1/4 inch. The minimum pressure must be 90 psi. Sand blast each side of the joint at least once, in at least 2 separate passes. Hold the nozzle at an angle to the joint from 1 to 2 inches from the concrete pavement. Using a vacuum, collect sand, dust, and loose material at least 2 inches on each side of the joint. Remove surface moisture and dampness at the joints with compressed air that may be moderately hot.

Before you install joint sealant or compression seal, the joint wall must be free of moisture, residue, or film.

If grinding or grooving over or adjacent to sealed joints, remove joint sealant or compression seal materials and dispose of them under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way." After grinding or grooving, replace the joint sealant or compression seal materials.

40-3.09B Liquid Sealant

Do not install liquid sealant in construction joints.

Install backer rods when the concrete pavement temperature is above the air dew point and when the air temperature is at least 40 °F.

Install liquid sealant immediately after installing the backer rod. Install sealant using a mechanical device with a nozzle shaped to introduce the sealant from inside the joint. Extrude sealant evenly and with continuous contact with the joint walls. Recess the sealant surface after placement. Remove excess sealant from the concrete pavement surface.

Do not allow traffic over sealed joints until the sealant is set.

40-3.09C Preformed Compression Seal

Do not install preformed compression seal in construction or isolation joints.

Install longitudinal seals before transverse seals. Longitudinal seals must be continuous except at intersections with transverse seals. Install transverse seals in 1 continuous piece for the entire transverse length of concrete pavement. With a sharp instrument, cut across the longitudinal seal at the intersection with transverse construction joints. If the longitudinal seal does not relax enough to properly install the transverse seal, trim the longitudinal seal to form a tight seal between the 2 joints.

Use a machine specifically designed for preformed compression seal installation. The machine must install the seal:

1. To the specified depth
2. To make continuous contact with the joint walls
3. Without cutting, nicking, or twisting the seal
4. With less than 4 percent stretch

Lay a length of preformed compression seal material cut to the exact length of the pavement joint to be sealed. The Engineer measures this length. After you install the length of preformed compression joint sealant, the Engineer measures the excess amount of material at the joint end. The Engineer divides the excess amount length by the original measured length to determine the percentage of stretch.

40-3.10 SHOULDER RUMBLE STRIP

If specified, construct shoulder rumble strips by rolling or grinding indentations in new concrete pavement.

Select the method and equipment for constructing ground-in indentations.

Do not construct shoulder rumble strips on structures or approach slabs.

Construct rumble strips within 2 inches of the specified alignment. Roller or grinding equipment must be equipped with a sighting device enabling the operator to maintain the rumble strip alignment.

Indentations must not vary from the specified dimensions by more than 1/16 inch in depth or more than 10 percent in length and width.

The Engineer orders grinding or removal and replacement of noncompliant rumble strips to bring them within specified tolerances. Ground surface areas must be neat and uniform in appearance.

The grinding equipment must be equipped with a vacuum attachment to remove residue.

Dispose of removed material under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way."

40-3.11 PRELIMINARY FINISHING

40-3.11A General

Preliminary finishing must produce a smooth and true-to-grade finish. After preliminary finishing, mark each day's concrete pavement with a stamp. The stamp must be approved by the Engineer before paving starts. The stamp must be approximately 1' x 2' in size. The stamp must form a uniform mark from 1/8 to 1/4 inch deep. Locate the mark 20 feet ± 5 feet from the transverse construction joint formed at each day's start of paving and 1 foot ± 0.25 foot from the concrete pavement's outside edge. The stamp mark must show the month, day, and year of placement and the station of the transverse construction joint. Orient the stamp mark so it can be read from the concrete pavement's outside edge.

Do not apply more water to the concrete pavement surface than can evaporate before float finishing and texturing are completed.

Allow enough time to complete finishing activities during daylight. Work may continue after daylight if the Engineer approves lighting you provide.

40-3.11B Stationary Side Form Finishing

If stationary side form construction is used, give the concrete a preliminary finish by the machine float method or the hand method.

If using the machine float method:

1. Use self-propelled machine floats.
2. Determine the number of machine floats required to perform the work at a rate equal to the concrete delivery rate. When the time from concrete placement to machine float finishing exceeds 30 minutes, stop concrete delivery . When machine floats are in proper position, you may resume concrete delivery and paving.
3. Machine floats must run on side forms or adjacent concrete pavement lanes. If running on adjacent concrete pavement, protect the adjacent concrete pavement surface under Section 40-3.15, "Protecting Concrete Pavement."
4. Floats must be hardwood, steel, or steel-shod wood. Floats must be equipped with devices that adjust the under side to a true flat surface.

If using the hand method, finish concrete smooth and true to grade with manually operated floats or powered finishing machines.

40-3.11C Slip-Form Finishing

If slip-form construction is used, the slip-form paver must give the concrete pavement a preliminary finish. You may supplement the slip-form paver with machine floats.

Before the concrete hardens, correct concrete pavement edge slump in excess of 0.02 foot exclusive of edge rounding.

40-3.12 FINAL FINISHING

After completing preliminary finishing, round the edges of the initial paving widths to a 0.04-foot radius. Round transverse and longitudinal construction joints to a 0.02-foot radius.

Before curing, texture the pavement. Perform initial texturing with a burlap drag or broom device that produces striations parallel to the centerline. Perform final texturing with a steel-tined device that produces grooves parallel with the centerline.

Construct longitudinal grooves with a self-propelled machine designed specifically for grooving and texturing concrete pavement. The machine must have tracks to maintain constant speed, provide traction, and maintain accurate tracking along the pavement surface. The machine must have a single row of rectangular spring steel tines. The tines must be from 3/32 to 1/8 inch wide, on 3/4-inch centers, and must have enough length, thickness, and resilience to form grooves approximately 3/16 inch wide. The machine must have horizontal and vertical controls. The machine must apply constant down pressure on the pavement surface during texturing. The machines must not cause ravels.

Construct grooves over the entire pavement width in a single pass except do not construct grooves 3 inches from the concrete pavement edges and longitudinal joints. Final texture must be uniform and smooth. Use a guide to properly align the grooves. Grooves must be parallel and aligned to the pavement edge across the pavement width. Grooves must be from 1/8 to 3/16 inch deep and 3/16 inch wide after concrete has hardened.

For irregular areas and areas inaccessible to the grooving machine, you may hand-construct grooves in compliance with the hand method under Section 40-3.11B, "Stationary Side Form Finishing." Hand-constructed grooves must comply with the specifications for machine-constructed grooves.

Initial and final texturing must produce a coefficient of friction of at least 0.30 when tested under California Test 342. Notify the Engineer when the concrete pavement is scheduled to be opened to traffic. Allow at least 25 days for the Department to test for coefficient of friction from the later of:

1. Seven days after concrete placement
2. When the concrete pavement has attained a modulus of rupture of 550 psi

Do not open the concrete pavement to traffic unless the coefficient of friction is at least 0.30.

Correct concrete pavement not complying with the Engineer's acceptance criteria for coefficient of friction by grooving or grinding under Section 42, "Groove and Grind Pavement."

Do not grind before:

1. Ten days after concrete pavement placement
2. Concrete has developed a modulus of rupture of at least 550 psi

Before opening to traffic, allow at least 25 days for the Department to retest sections for coefficient of friction after corrections are made.

40-3.13 CURING

Cure the concrete pavement's exposed area with waterproof membrane or curing compound (1) or (2) under Section 90-7.01, "Methods of Curing." When side forms are removed within 72 hours of the start of curing, also cure the concrete pavement edges.

If curing compound is used, apply it with mechanical sprayers. Reapply curing compound to sawcuts and disturbed areas.

40-3.14 EARLY USE OF CONCRETE PAVEMENT

If requesting early use of concrete pavement:

1. Furnish molds and machines for modulus of rupture testing
2. Sample concrete
3. Fabricate beam specimens
4. Test for modulus of rupture under California Test 523

When you request early use, concrete pavement must have a modulus of rupture of at least 350 psi. Protect concrete pavement under Section 40-3.15, "Protecting Concrete Pavement."

40-3.15 PROTECTING CONCRETE PAVEMENT

Protect concrete pavement under Section 90-8, "Protecting Concrete."

Maintain the concrete pavement temperature at not less than 40 °F for the initial 72 hours.

Protect the concrete pavement surface from activities that cause damage and reduce texture and coefficient of friction. Do not allow soil, gravel, petroleum products, concrete, or asphalt mixes on the concrete pavement surface.

Construct crossings for traffic convenience. If the Engineer approves your request, you may use Type III portland cement in the concrete for crossings. Do not open crossings until the Department determines by California Test 523 the concrete pavement's modulus of rupture is at least 550 psi.

Do not open concrete pavement to traffic or use equipment on the concrete pavement for 10 days after paving or before the concrete has attained a modulus of rupture of 550 psi except:

1. If the equipment is for sawing contraction joints
2. If the Engineer approves your request, one side of paving equipment's tracks may be on the concrete pavement after a modulus of rupture of 350 psi has been attained, provided:

    2.1. Unit pressure exerted on the concrete pavement by the paver does not exceed 20 psi
    2.2. You change the paving equipment tracks to prevent damage or the paving equipment tracks travel on protective material such as planks
    2.3. No part of the track is closer than 1 foot from the concrete pavement's edge

If concrete pavement damage including visible cracking occurs, stop operating paving equipment on the concrete pavement and repair the damage.

40-3.16 OBTAINING DRILLED CORES

Drill concrete pavement cores under ASTM C 42/ C 42M. Core drilling equipment must use diamond impregnated bits.

Clean, dry, and fill core holes with hydraulic cement grout (non-shrink) or pavement concrete. Coat the core hole walls with epoxy under the specifications for epoxy adhesive for bonding new concrete to old concrete in Section 95, "Epoxy." The backfill must match the adjacent concrete pavement surface elevation and texture.

Do not allow residue from core drilling to fall on traffic, flow across shoulders or lanes occupied by traffic, or flow into drainage facilities including gutters.

40-3.17 REPAIR, REMOVAL, AND REPLACEMENT

40-3.17A General

Working cracks are full-depth cracks essentially parallel to a planned contraction joint beneath which a contraction crack has not formed. If the Engineer orders, take 4-inch nominal diameter cores on designated cracks under Section 40-3.16, "Obtaining Drilled Cores."

40-3.17B Repair of Spalls, Raveling, and Tearing

Before concrete pavement is open to traffic, repair spalls, raveling, and tearing in sawed joints.Make repairs in compliance with the following:

1. Saw a rectangular area with a diamond-impregnated blade at least 2 inches deep.
2. Remove unsound and damaged concrete between the saw cut and the joint and to the saw cut's depth. Do not use a pneumatic hammer heavier than 15 pounds. Do not damage concrete pavement to remain in place.
3. Dispose of removed concrete pavement under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way."
4. Clean the repair area's exposed surfaces with high pressure abrasive water blasting. Further clean and dry the exposed surfaces with compressed air free of moisture and oil.
5. Apply epoxy as specified for epoxy resin adhesive for bonding new concrete to old concrete under Section 95, "Epoxy." Apply the epoxy with a stiff bristle brush.
6. Apply a portland cement concrete or mortar patch immediately following the epoxy application. Install an insert to prevent bonding of the sides of planned joints.

Repair spalls if they are:

1. Deeper than 0.05 foot
2. Wider than 0.04 foot
3. Longer than 0.3 foot

40-3.17C Route and Seal Working Cracks

Treat working cracks within 0.5 foot of either side of a planned contraction joint in compliance with the following:

1. Route and seal the crack with epoxy resin in compliance with the following:

    1.1. Use a powered rotary router mounted on wheels, with a vertical shaft and a routing spindle that casters as it moves along the crack
    1.2. Form a reservoir 3/4 inch deep by 3/8 inch wide in the crack
    1.3. Use equipment that does not cause raveling or spalling
    1.4. Place liquid sealant

2. Treat the contraction joint adjacent to the working crack in compliance with the following:

    2.1. Use epoxy resin under ASTM C 881/C 881M, Type IV, Grade 2 for Type B joints and secondary saw cuts for Type A1 and Type A2 joints
    2.2. Pressure inject epoxy resin under ASTM C 881/C881M, Type IV, Grade 1 for narrow saw cuts including initial saw cuts for Type A1 and Type A2 joints

If a working crack intersects a contraction joint, route and seal the working crack and seal the contraction joint as specified for installing liquid sealant under Section 40-3.09, "Joint Seal and Joint Sealant Installation."

40-3.17D Removal and Replacement of Slabs

As specified, remove and replace slabs or partial slabs for:

1. Insufficient thickness
2. Dowel bar misalignment
3. Working cracks more than 0.5 foot from a planned contraction joint

40-4 MEASUREMENT AND PAYMENT

40-4.01 MEASUREMENT

The contract item for concrete pavement as designated in the Verified Bid Item List is measured by the cubic yard. The Engineer calculates the pay quantity volume based on the plan dimensions. The Engineer does not measure concrete pavement placed outside those dimensions unless it was ordered by the Engineer.

The contract items for sealing joints as designated in the Verified Bid Item List are measured by the linear foot.

The contract item for shoulder rumble strips is measured by the station along each shoulder on which the rumble strips are constructed without deductions for gaps between indentations.

40-4.02 PAYMENT

The contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the concrete pavement, complete in place including bar reinforcement, tie bars, dowel bars, anchors, and fasteners, as shown on the plans and as specified in these specifications and the special provisions, and as directed by the Engineer.

The Engineer adjusts payment for each primary area deficient in average thickness in compliance with the following:

Pay Adjustments for Deficient Thickness

Average Thickness Deficiency (foot)	Deficiency Adjustment ($/yd^2)
0.01	0.90
0.02	2.30
0.03	4.10
0.04	6.40
0.05	9.11

If the average thickness deficiency is less than 0.01 foot, the Engineer does not adjust payment for thickness deficiency. If the average thickness deficiency is more than 0.01 foot, the Engineer rounds to the nearest 0.01 foot and uses the adjustment table.

Full compensation for core drilling and backfilling the cores ordered by the Engineer for measuring concrete pavement thickness and determining full-depth cracks is included in the contract price paid per cubic yard for concrete pavement as designated in the Engineer's Estimate and no additional compensation will be allowed therefor. The Department does not pay for additional concrete pavement thickness measurements requested by the Contractor.

The Department does not pay for the portion of concrete that penetrates treated permeable base.

Full compensation for the quality control plan is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for furnishing and applying asphaltic emulsion on cement treated permeable base is included in the contract price paid per cubic yard for concrete pavement as designated in the Engineer's Estimate and no separate payment will be made therefor.

Full compensation for repairing joints is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for furnishing, calibrating, and operating profilograph equipment for Profile Index, for submitting profilograms, and for performing corrective work is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for grooving and grinding for final finishing is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for removing and replacing joint material for grooving and grinding is included in the contract price per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for removing and replacing slabs is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

Full compensation for drilling holes and bonding tie bars with chemical adhesive is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no additional compensation will be allowed therefor.

Full compensation for repairing damage caused by operating paving equipment on new concrete pavement is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no separate payment will be made therefor.

The material and work necessary for the construction of crossings for public convenience, and their subsequent removal and disposal, will be paid for at the contract prices for the items of work involved and if there are no contract items for the work involved, payment for concrete pavement crossings will be made by extra work as specified in Section 4-1.03D, "Extra Work."

The Department will reduce payments to the Contractor by $56.12 per square yard for concrete pavement slabs allowed to remain in place represented by cores indicating dowel bars placed with their centers from ±2 inches to ±3 inches from the saw cut of a transverse contraction joint

The Engineer will calculate the reduced payment using the slab dimensions adjacent to and inclusive of the joints with misplaced dowel bars. This reduced payment is in addition to other specified payment reductions.

The Department will reduce payments to the Contractor by $59.56 per square yard for concrete pavement allowed to remain in place represented by cores indicating either of the following:

1. Tie bars placed outside their specified placement and position tolerances
2. Bar reinforcement placed outside their specified placement and position tolerances

The Engineer will calculate the reduced payment using the slab dimensions adjacent to and inclusive of the joints with misplaced tie bars. This reduced payment is in addition to other specified payment reductions.

Full compensation for core drilling for checking dowel or tie bar alignment and backfilling the cores is included in the contract price paid per cubic yard for concrete pavement as designated in the Engineer's Estimate and no additional compensation will be allowed therefor.

If the initial cores show that dowel bars or tie bars are out of tolerance for alignment and the Engineer orders additional dowel or tie bar coring, full compensation for drilling the additional cores is included in the contract price paid per cubic yard for concrete pavement as designated in the Verified Bid Item List and no additional compensation will be allowed therefor.

If the initial cores show that dowel bars or tie bars are within alignment tolerances and the Engineer orders more dowel or tie bar coring, the additional cores will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

The Department will not pay for additional coring to check dowel or tie bar alignment you request.

Full compensation for performing profilograph tests, furnishing the profilograms and electronic files to the Engineer, and for performing corrective work is included in the contract price paid per cubic yard for the type of concrete pavement as designated in the Verified Bid Item List and no additional compensation will be allowed therefor.

The contract prices paid per linear foot for seal pavement joint, seal isolation joint, and seal longitudinal isolation joint include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in sealing pavement joints and sealing isolation joints, complete in place, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

The contract price paid per station for shoulder rumble strip includes full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in constructing the rumble strip complete in place, as shown on the plans, as specified in these Standard Specifications and as directed by the Engineer.

^^

SECTION 41 PAVEMENT SUBSEALING AND JACKING
(Issued 01-05-07)

In Section 41-1.02 replace the 2nd and 3rd paragraphs with:

Cement for grout shall be Type II portland cement conforming to the provisions in Section 90-2.01A, "Cement."

Fly ash shall conform to the requirements in AASHTO Designation: M 295 for either Class C or for Class F. The brand of fly ash used in the work shall conform to the provisions for approval of admixture brands in Section 90-4.03, "Admixture Approval."

In Section 41-1.02 replace the 5th paragraph with:

Chemical admixtures and calcium chloride may be used. Chemical admixtures in the grout mix shall conform to the provisions in Section 90-4, "Admixtures." Calcium chloride shall conform to ASTM Designation: D 98.

^^

SECTION 42 GROOVE AND GRIND PAVEMENT
(Issued 05-15-09)

In Section 42-2.02 replace the 3rd paragraph with:

Existing portland cement concrete pavement not constructed as part of the project shall be ground as follows:

> Grinding shall be performed so that the pavement surface on both sides of all transverse joints and cracks has essentially the same depth of texture and does not vary from a true plane enough to permit a 0.006-foot thick shim 0.25-foot wide to pass under a 3-foot straightedge adjacent to either side of the joint or crack when the straightedge is laid on the pavement parallel to centerline with its midpoint at the joint or crack. After grinding has been completed, the pavement shall conform to the straightedge and profile requirements specified in Section 40-1.03, "Quality Control and Assurance."
>
> Abnormally depressed areas due to subsidence or other localized causes will be excluded from testing with the profilograph and 12-foot straightedge specified in Section 40-1.03. The accumulated total of the excluded areas shall not exceed 5 percent of the total area to be ground. Profilograph testing shall end 25 feet prior to excluded areas and shall resume 25 feet following the excluded areas.

In Section 42-2.03 replace the 2nd paragraph with:

Replacement concrete paving shall conform to the provisions in Section 40, "Concrete Pavement." Replacement pavement may be spread and shaped by any suitable powered finishing machines, supplemented by handwork as necessary. Consolidation of the concrete shall be by means of high-frequency internal vibrators within 15 minutes after the concrete is deposited on the subgrade. Vibrating shall be done with care and in such manner to assure adequate consolidation adjacent to forms and uniformly across the full paving width. Use of vibrators for extensive shifting of the mass of concrete will not be permitted. Methods of spreading, shaping and compacting that result in segregation, voids or rock pockets shall be discontinued, and the Contractor shall adopt methods which will produce dense homogeneous pavement conforming to the required cross section. Finishing may be performed by hand method, as specified in Section 40-3.11B, "Stationary Side Form Finishing."

^^

SECTION 49 PILING
(Issued 12-19-08)

In Section 49-1.03 replace the 4th paragraph with:

Modification to the specified installation methods and specified pile tip elevation will not be considered at locations where settlement, tension demands, or lateral load demands control design pile tip elevations or when the plans state that specified pile tip elevation shall not be revised.

In Section 49-1.03 in the 6th paragraph, replace the 1st sentence with:

Indicator compression pile load testing shall conform to the requirements in ASTM Designation: D 1143-81.

In Section 49-1.03 in the 7th paragraph, replace the 1st sentence with:

Indicator tension pile load testing shall conform to the requirements in ASTM Designation: D 3689-90.

In Section 49-1.03 replace the 9th paragraph with:

The Contractor shall furnish piling of sufficient length to obtain the specified tip elevation shown on the plans or specified in the special provisions.

In Section 49-1.04 replace the 6th paragraph with:

The Contractor may use additional cementitious material in the concrete for the load test and anchor piles.

In Section 49-6.01 replace the 1st paragraph with:

The length of timber, steel, and precast prestressed concrete piles, and of cast-in-place concrete piles consisting of driven shells filled with concrete, shall be measured along the longest side, from the tip elevation shown on the plans to the plane of pile cut-off.

In Section 49-6.02 add:

When pile tips are revised by the Engineer for timber, steel, and precast prestressed concrete piles, and for cast-in-place concrete piles consisting of driven shells filled with concrete, the additional length required, including all materials, equipment, and labor for furnishing, splicing, and installing the piling, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work."

^^

SECTION 50 PRESTRESSING CONCRETE
(Issued 06-05-09)

In Section 50-1.05 replace the 1st paragraph with:

Prestressing steel shall be high-tensile wire conforming to the requirements in ASTM Designation: A 421, including Supplement I; high-tensile seven-wire strand conforming to the requirements in ASTM Designation: A 416; or uncoated deformed (Type II) high-strength steel bars conforming to the requirements in ASTM Designation: A 722, including all supplementary requirements. The maximum weight requirement of ASTM Designation: A 722 will not apply.

In Section 50-1.05 in the 3rd paragraph, delete item A.

In Section 50-1.07 replace the 2nd paragraph with:

Ducts shall be fabricated with either welded or interlocked seams. Galvanizing of the welded seam will not be required. Ducts shall have sufficient strength to maintain their correct alignment during placing of concrete. Joints between sections of duct shall be positive metallic connections which do not result in angle changes at the joints. Waterproof tape shall be used at the connections. Ducts shall be bent without crimping or flattening. Transition couplings connecting the ducts to anchoring devices shall be either ferrous metal or polyolefin. Ferrous metal transition couplings need not be galvanized.

In Section 50-1.07 replace the 7th paragraph with:

All ducts with a total length of 400 feet or more shall be vented. Vents shall be placed at intervals of not more than 400 feet and shall be located within 6 feet of every high point in the duct profile. Vents shall be 1/2 inch minimum diameter standard pipe or suitable plastic pipe. Connections to ducts shall be made with metallic or plastic structural fasteners. Plastic components, if selected, shall not react with the concrete or enhance corrosion of the prestressing steel and shall be free of water soluble chlorides. The vents shall be mortar tight, taped as necessary, and shall provide means for injection of grout through the vents and for sealing the vents. Ends of vents shall be removed one inch below the roadway surface after grouting has been completed.

In Section 50-1.08 in the 11th paragraph, replace item B with:

B. When the concrete is designated by class or cementitious material content, either the concrete compressive strength shall have reached the strength shown on the plans at the time of stressing or at least 28 days shall have elapsed since the last concrete to be prestressed has been placed, whichever occurs first.

In Section 50-1.09 replace the 2nd and 3rd paragraphs with:

Grout shall consist of cement and water and may contain an admixture if approved by the Engineer.

Cement shall conform to the provisions in Section 90-2.01A, "Cement."

In Section 50-1.11 replace the 1st paragraph with:

No separate payment will be made for pretensioning precast concrete members. Payment for pretensioning precast concrete members shall be considered as included in the contract price paid for furnish precast members as provided for in Section 51, "Concrete Structures."

^^

SECTION 51 CONCRETE STRUCTURES
(Issued 06-05-09)

In Section 51-1.05 in the 11th paragraph, replace the 1st sentence with:

Form panels for exposed surfaces shall be furnished and placed in uniform widths of not less than 3 feet and in uniform lengths of not less than 6 feet, except at the end of continuously formed surfaces where the final panel length required is less than 6 feet.

In Section 51-1.06C in the 11th paragraph, replace the 1st sentence with:

Falsework for box culverts and other structures with decks lower than the roadway pavement and with span lengths of 14 feet or less shall not be released until the last placed concrete has attained a compressive strength of 1,600 psi, provided that curing of the concrete is not interrupted.

In Section 51-1.11 replace the 6th paragraph with:

Construction methods and equipment employed by the Contractor shall conform to the provisions in Section 7-1.02, "Load Limitations."

In Section 51-1.12D replace the 4th paragraph with:

Expanded polystyrene shall be a commercially available polystyrene board. Expanded polystyrene shall have a minimum flexural strength of 35 psi determined in conformance with the requirements in ASTM Designation: C 203 and a compressive yield strength of between 16 and 40 psi at 5 percent compression. Surfaces of expanded polystyrene against which concrete is placed shall be faced with hardboard. Hardboard shall be 1/8 inch minimum thickness, conforming to ANSI A135.4, any class. Other facing materials may be used provided they furnish equivalent protection. Boards shall be held in place by nails, waterproof adhesive, or other means approved by the Engineer.

In Section 51-1.12F replace the 3rd paragraph with:

Type A and AL joint seals shall consist of a groove in the concrete that is filled with field-mixed silicone sealant.

In Section 51-1.12F in the 6th paragraph, replace the table with:

Movement Rating (MR)	Seal Type
MR ≤ 1 inch	Type A or Type B
1 inch < MR ≤ 2 inches	Type B
2 inches < MR ≤ 4 inches	Joint Seal Assembly (Strip Seal)
MR > 4 inches	Joint Seal Assembly (Modular Unit) or Seismic Joint

In Section 51-1.12F(3)(a) replace the 1st and 2nd paragraphs with:

The sealant must consist of a 2-component silicone sealant that will withstand up to ±50 percent movement. Silicone sealants must be tested under California Test 435 and must comply with the following:

Specification	Requirement
Modulus at 150 percent elongation	8-75 psi
Recovery	21/32 inch max.
Notch Test	Notched or loss of bond 1/4 inch, max.
Water Resistance	Notched or loss of bond 1/4 inch, max.
Ultraviolet Exposure ASTM Designation: G 154, Table X2.1,Cycle 2.	No more than slight checking or cracking.
Cone Penetration	4.5-12.0 mm

In Section 51-1.12F(3)(a) delete the 3rd and 8th paragraphs.

In Section 51-1.12F(3)(a) replace the 10th paragraph with:

A Certificate of Compliance accompanied by a certified test report must be furnished for each batch of silicone sealant in conformance with the provisions in Section 6-1.07, "Certificates of Compliance."

In Section 51-1.12F(3)(b) replace the 2nd paragraph with:

The preformed elastomeric joint seal must conform to the requirements in ASTM D 2628 and the following:

1. The seal must consist of a multichannel, nonporous, homogeneous material furnished in a finished extruded form.
2. The minimum depth of the seal measured at the contact surface must be at least 95 percent of the minimum uncompressed width of the seal as designated by the manufacturer.
3. When tested in conformance with the requirements in California Test 673 for Type B seals, joint seals must provide a movement rating (MR) of not less than that shown on the plans.
4. The top and bottom edges of the joint seal must maintain continuous contact with the sides of the groove over the entire range of joint movement.
5. The seal must be furnished full length for each joint with no more than 1 shop splice in any 60-foot length of seal.
6. The Contractor must demonstrate the adequacy of the procedures to be used in the work before installing seals in the joints.
7. One field splice per joint may be made at locations and by methods approved by the Engineer. The seals are to be manufactured full length for the intended joint, then cut at the approved splice section and rematched before splicing. The Contractor must submit splicing details prepared by the joint seal manufacturer for approval before beginning splicing work.
8. Shop splices and field splices must have no visible offset of exterior surfaces and must show no evidence of bond failure.
9. At all open ends of the seal that would admit water or debris, each cell must be filled to a depth of 3 inches with commercial quality open cell polyurethane foam or closed by other means subject to approval by the Engineer.

In Section 51-1.12F(3)(b) replace the 7th paragraph with:

The joint seal must be installed full length for each joint with equipment that does not twist or distort the seal, elongate the seal longitudinally, or otherwise cause damage to the seal or to the concrete forming the groove.

In Section 51-1.12F(3)(b) in the 11th paragraph, replace the 1st sentence with:

Samples of the prefabricated joint seals, not less than 3 feet in length, will be taken by the Engineer from each lot of material.

In Section 51-1.12H(1) in the 6th paragraph, replace the 4th and 5th sentences with:

Each ply of fabric shall have a breaking strength of not less than 800 pounds per inch of width in each thread direction when 3" x 36" samples are tested on split drum grips. The bond between double plies shall have a minimum peel strength of 20 pounds per inch.

In Section 51-1.12H(1) in the 8th paragraph in the table, replace the hardness (Type A) requirements with:

Hardness (Type A)	D 2240 with 2kg mass.	55 ±5

In Section 51-1.12H(2) in the 1st paragraph in item A, replace the 1st and 2nd sentences with:

The bearings shall consist of alternating steel laminates and internal elastomer laminates with top and bottom elastomer covers. Steel laminates shall have a nominal thickness of 0.075 inch (14 gage).

In Section 51-1.135 replace the 1st paragraph with:

Mortar shall be composed of cementitious material, sand, and water proportioned and mixed as specified in this Section 51-1.135.

In Section 51-1.135 replace the 3rd paragraph with:

The proportion of cementitious material to sand, measured by volume, shall be 1 to 2 unless otherwise specified.

In Section 51-1.17 in 4th paragraph, replace the 3rd sentence with:

The surfaces shall have a profile trace showing no high points in excess of 0.25 inch, and the portions of the surfaces within the traveled way shall have a profile count of 5 or less in any 100 foot section.

Add:

51-1.17A Deck Crack Treatment

The Contractor shall use all means necessary to minimize the development of shrinkage cracks.

The Contractor shall remove all equipment and materials from the deck and clean the surface as necessary for the Engineer to measure the surface crack intensity. Surface crack intensity will be determined by the Engineer after completion of concrete cure, before prestressing, and before the release of falsework. In any 500 square foot portion of deck within the limits of the new concrete deck, should the intensity of cracking be such that there are more than 50 feet of cracks whose width at any location exceeds 0.02 inch, the deck shall be treated with a high molecular weight methacrylate (HMWM) resin system. The area of deck to be treated shall have a width that extends for the entire width of new deck inside the concrete barriers and a length that extends at least 5 feet beyond the furthest single continuous crack outside the 500 square foot portion, measured from where that crack exceeds 0.02 inch in width, as determined by the Engineer.

Deck crack treatment shall include furnishing, testing, and applying the HMWM resin system, with sand and absorbent material. If grinding is required, deck crack treatment shall take place before grinding.

51-1.17A(1) Submittals

Submit a HMWM resin system placement plan. When HMWM resin is to be applied within 100 feet of a residence, business, or public space including sidewalks under a structure, also submit a public safety plan. Submit plans under Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The review time is 15 days.

The HMWM resin system placement plan must include:

1. Schedule of work and testing for each bridge
2. Description of equipment for applying HMWM resin
3. Range of gel time and final cure time for HMWM resin
4. Absorbent material to be used
5. Description of equipment for applying and removing excess sand and absorbent material
6. Procedure for removing HMWM resin from the deck, including equipment
7. Storage and handling of HMWM resin components and absorbent material
8. Disposal of excess HMWM resin and containers

The public safety plan must include:

1. A public notification letter with a list of delivery and posting addresses. The letter must state HMWM resin work locations, dates, times, and what to expect. Deliver the letter to residences and businesses within 100 feet of HMWM resin work locations and to local fire and police officials at least 7 days before starting work. Post the letter at the job site.
2. An airborne emissions monitoring plan prepared and executed by a certified industrial hygienist (CIH) certified in comprehensive practice by the American Board of Industrial Hygiene. The plan must have at least 4 monitoring points including the mixing point, application point, and point of nearest public contact. Monitor airborne emissions during HMWM resin work and submit emissions monitoring results after completing the work.
3. An action plan for protection of the public when airborne emissions levels exceed permissible levels.
4. A copy of the CIH's certification.

If the measures proposed in the safety plan are inadequate to provide for public safety associated with the use of HMWM resin, the Engineer will reject the plan and direct the Contractor to revise the plan. Directions for revisions will be in writing and include detailed comments. The Engineer will notify the Contractor of the approval or rejection of a submitted or revised plan within 15 days of receipt of that plan.

51-1.17A(2) Quality Control and Assurance

Submit samples of HMWM resin components 15 days before use under Section 6-3, "Testing," of the Standard Specifications. Notify the Engineer 15 days before delivery of HMWM resin components in containers over 55 gallons to the job site.

Complete a test area before starting work. Results from airborne emissions monitoring of the test area must be submitted to the Engineer before starting production work.

The test area must:

1. Be approximately 500 square feet
2. Be placed within the project limits outside the traveled way at an approved location
3. Be constructed using the same equipment as the production work
4. Replicate field conditions for the production work
5. Demonstrate proposed means and methods meet the acceptance criteria
6. Demonstrate production work will be completed within the time allowed
7. Demonstrate suitability of the airborne emissions monitoring plan

The test area will be acceptable if:

1. The treated deck surface is tack free and non-oily
2. The sand cover adheres and resists brushing by hand
3. Excess sand and absorbent material has been removed
4. The coefficient of friction is at least 0.35 when tested under California Test 342

51-1.17A(3) Materials

HMWM resin system consists of a resin, promoter, and initiator. HMWM resin must be low odor and comply with the following:

HMWM Resin

Property	Requirement	Test Method
Volatile Content*	30 percent, maximum	ASTM D 2369
Viscosity*	25 cP, maximum, (Brookfield RVT with UL adaptor, 50 RPM at 77°F)	ASTM D 2196
Specific Gravity*	0.90 minimum, at 77°F	ASTM D 1475
Flash Point*	180°F, minimum	ASTM D 3278
Vapor Pressure*	1.0 mm Hg, maximum, at 77°F	ASTM D 323
Tack-free Time	400 minutes, maximum, at 25°C	Specimens prepared per California Test 551
PCC Saturated Surface-Dry Bond Strength	3.5 MPa, minimum at 24 hours and 21 ± 1°C	California Test 551

* Test must be performed before adding initiator.

Sand for abrasive sand finish must:

1. Be commercial quality dry blast sand
2. Have at least 95 percent pass the No. 8 sieve and at least 95 percent retained on the No. 20 sieve when tested under California Test 205

Absorbent material must be diatomaceous earth, abrasive blast dust, or substitute recommended by the HMWM resin supplier and approved by the Engineer.

51-1.17A(4) Construction

HMWM resin system applied by machine must be:

1. Combined in volumetric streams of promoted resin to initiated resin by static in-line mixers
2. Applied without atomization

HMWM resin system may be applied manually. Limit the quantity of resin mixed for manual application to 5 gallons at a time.

Prepare the area to be treated by abrasive blasting. Curing compound, surface contaminants, and foreign material must be removed from the bridge deck surface. Sweep the deck surface clean after abrasive blasting and blow loose material from cracks using high-pressure air.

The deck surface must be dry when abrasive blast cleaning is performed. When abrasive blast cleaning within 10 feet of public traffic, remove dust and residue from abrasive blast cleaning using a vacuum attachment operating concurrently with blasting equipment . If the deck surface becomes contaminated before placing HMWM, abrasive blast clean the contaminated area and sweep the deck clean.

The deck must be dry before applying HMWM resin. The concrete surface must be at least 50 degrees F and at most 100 degrees F. Relative humidity must be expected to be at most 85 percent during the work shift.

Thoroughly mix all components of the HMWM resin system. Apply HMWM resin to the deck surface within 5 minutes of mixing at approximately 90 sq ft per gallon. The Engineer determines the exact application rate. The resin gel time must be between 40 and 90 minutes. HMWM resin that thickens during application is rejected.

Spread the HMWM resin system uniformly. Completely cover surfaces to be treated and fill all cracks. Redistribute excess resin using squeegees or brooms within 10 minutes of application. For textured or grooved deck surfaces, excess resin must be removed from the texture indentations.

Apply the abrasive sand finish of at least 2 pounds per square yard or until saturation as determined by the Engineer no sooner than 20 minutes after applying resin. Apply absorbent material before opening lane to traffic. Remove excess sand and absorbent material by vacuuming or power sweeping.

Traffic or equipment will be allowed on the overlay after the Engineer has determined:

1. The treated deck surface is tack free and non-oily
2. The sand cover adheres and resists brushing by hand

3. Excess sand and absorbent material has been removed
4. No material will be tracked beyond limits of treatment by traffic

In Section 51-1.18C replace the 2nd paragraph with:

When Class 2 surface finish (gun finish) is specified, ordinary surface finish shall first be completed. The concrete surfaces shall then be abrasive blasted to a rough texture and thoroughly washed down with water. While the washed surfaces are damp, but not wet, a finish coating of machine applied mortar, approximately 1/4 inch thick, shall be applied in not less than 2 passes. The coating shall be pneumatically applied and shall consist of either (1) sand, cementitious material, and water mechanically mixed prior to its introduction to the nozzle, or (2) premixed sand and cementitious material to which water is added prior to its expulsion from the nozzle. The use of admixtures shall be subject to the approval of the Engineer as provided in Section 90, "Portland Cement Concrete." Unless otherwise specified, supplementary cementitious materials will not be required. The proportion of cementitious material to sand shall be not less than one to 4, unless otherwise directed by the Engineer. Sand shall be of a grading suitable for the purpose intended. The machines shall be operated and the coating shall be applied in conformance with standard practice. The coating shall be firmly bonded to the concrete surfaces on which it is applied.

In Section 51-1.18C replace the 5th paragraph with:

When surfaces to be finished are in pedestrian undercrossings, the sand shall be silica sand and the cementitious material shall be standard white portland cement.

In Section 51-1.23, add:

Full compensation for deck crack treatment, including the public safety plan, shall be considered as included in the contract price paid per cubic yard for structural concrete, bridge, and no additional compensation will be allowed therefor.

^^

SECTION 52 REINFORCEMENT
(Issued 06-05-09)

In Section 52-1.02(B) between the 3rd and 4th paragraphs, add:

The epoxy powder coating shall be selected from the Department's Pre-Qualified Products List.

In Section 52-1.02(B) replace the 14th paragraph with:

Except for lap splices, splices for epoxy-coated reinforcement shall be coated with a corrosion protection covering that is selected from the Department's Pre-Qualified Products List. The covering shall be installed in accordance with the manufacturer's recommendations.

In Section 52-1.07 in the 11th paragraph, replace the table with:

Height Zone (H) (Feet above ground)	Wind Pressure Value (psf)
$H \leq 30$	20
$30 < H \leq 50$	25
$50 < H \leq 100$	30
$H > 100$	35

In Section 52-1.08B(1) replace the 1st paragraph with:

Mechanical splices to be used in the work shall be selected from the Department's Pre-Qualified Products List.

In Section 52-1.08B(1) in the 2nd paragraph, replace the table with:

Reinforcing Bar Number	Total Slip
4	0.020-inch
5	0.020-inch
6	0.020-inch
7	0.028-inch
8	0.028-inch
9	0.028-inch
10	0.036-inch
11	0.036-inch
14	0.048-inch
18	0.060-inch

In Section 52-1.08B(1), in the 6th paragraph, delete item C.

In Section 52-1.08B(2) in the 6th paragraph, replace the subparagraph with:

The minimum preheat and interpass temperatures shall be 400º F for Grade 40 bars and 600º F for Grade 60 bars. Immediately after completing the welding, at least 6 inches of the bar on each side of the splice shall be covered by an insulated wrapping to control the rate of cooling. The insulated wrapping shall remain in place until the bar has cooled below 200º F.

Replace Section 52-1.08B(3) with:

52-1.08B(3) Resistance Butt Welds

Shop produced resistance butt welds shall be produced by a fabricator who is selected from the Department's Pre-Qualified Products List.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," shall be furnished for each shipment of splice material. The Certificate of Compliance shall include heat number, lot number and mill certificates.

In Section 52-1.08C replace the 3rd paragraph with:

Testing on prequalification and production sample splices shall be performed at an approved independent testing laboratory. The laboratory shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors who will provide other services or materials for the project.

The independent testing laboratory shall be selected from the Department's Pre-Qualified Products List.

In Section 52-1.08C replace the 5th paragraph with:

Prequalification and production sample splices and testing shall conform to California Test 670 and these specifications.

In Section 52-1.08C delete the 6th paragraph.

In Section 52-1.08C replace the 8th paragraph with:

Each sample splice, as defined herein, shall be identified as representing either a prequalification or production test sample splice.

In Section 52-1.08C in the 10th paragraph, delete the last sentence.

Replace Section 52-1.08C(1) with:

52-1.08C(1) Splice Prequalification Report

Before using any service splices or ultimate butt splices in the work, the Contractor shall submit a Splice Prequalification Report. The report shall include the following:

A. A copy of the manufacturer's product literature giving complete data on the splice material and installation procedures.
B. Names of the operators who will be performing the splicing.

C. Descriptions of the positions, locations, equipment, and procedures that will be used in the work.
D. Certifications from the fabricator for prequalification of operators and procedures based on sample tests performed no more than 2 years before submitting the report. Each operator shall be certified by performing 2 sample splices for each bar size of each splice type that the operator will be performing in the work. For deformation-dependent types of splice devices, each operator shall be certified by performing 2 additional samples for each bar size and deformation pattern that will be used in the work.

Prequalification sample splices shall be tested by an approved independent testing laboratory and shall conform to the appropriate production test criteria and slip requirements specified herein. When epoxy-coated reinforcement is required, resistance butt welded sample splices shall have the weld flash removed by the same procedure as will be used in the work, before coating and testing. The Splice Prequalification Report shall include the certified test results for all prequalification sample splices.

The QCM shall review and approve the Splice Prequalification Report before submitting it to the Engineer for approval. The Contractor shall allow 2 weeks for the review and approval of a complete report before performing any service splicing or ultimate butt splicing in the work.

In Section 52-1.08C(2)(a) replace the 1st, 2nd, 3rd, 4th, and 5th paragraphs with:

Production tests shall be performed by an approved independent testing laboratory for all service splices used in the work. A production test shall consist of testing 4 sample splices prepared for each lot of completed splices. The samples shall be prepared by the Contractor using the same splice material, position, operators, location, and equipment, and following the same procedure as used in the work.

At least one week before testing, the Contractor shall notify the Engineer in writing of the date and location where the testing of the samples will be performed.

The 4 samples from each production test shall be securely bundled together and identified with a completed sample identification card before shipment to the approved independent testing laboratory. The card will be furnished by the Engineer. Bundles of samples containing fewer than 4 samples of splices shall not be tested.

Before performing any tensile tests on production test sample splices, one of the 4 samples shall be tested for, and shall conform to, the requirements for total slip in Section 52-1.08B(1), "Mechanical Splices." Should this sample not meet the total slip requirements, one retest, in which the 3 remaining samples are tested for total slip, will be allowed. Should any of the 3 remaining samples not conform to the total slip requirements, all splices in the lot represented by this production test will be rejected.

If 3 or more sample splices from a production test conform to the provisions in this Section 52-1.08C(2), "Service Splice Test Criteria," all splices in the lot represented by this production test will be considered acceptable.

Replace Section 52-1.08C(2)(b) with:

52-1.08C(2)(b) Quality Assurance Test Requirements for Service Splices

In addition to the required production tests, the Contractor shall concurrently prepare 4 service quality assurance sample splices for:

A. The first production test performed.
B. One of every 5 subsequent production tests, or fraction thereof, randomly selected by the Engineer.

These service quality assurance sample splices shall be prepared in the same manner as specified herein for service production sample splices.

The service quality assurance sample splices shall be shipped to the Transportation Laboratory for quality assurance testing. Each set of 4 sample splices shall be securely bundled together and identified by location and contract number with weatherproof markings before shipment. Bundles containing fewer than 4 samples of splices will not be tested. Sample splices not accompanied by the supporting documentation required in Section 52-1.08B(1), "Mechanical Splices," for mechanical splices, or in Section 52-1.08B(3), "Resistance Butt Welds," for resistance butt welds, will not be tested.

Quality assurance testing will be performed in conformance with the requirements for service production sample splices in Section 52-1.08C(2)(a), "Production Test Requirements for Service Splices."

Replace Section 52-1.08C(3) with:

52-1.08C(3) Ultimate Butt Splice Test Criteria

Ultimate production and quality assurance sample splices shall be tensile tested in conformance with the requirements described in ASTM Designation: A 370 and California Test 670.

Each sample splice shall be identified as representing a prequalification, production, or quality assurance sample splice.

The portion of hoop reinforcing bar, removed to obtain a sample splice, shall be replaced using a prequalified ultimate mechanical butt splice, or the hoop shall be replaced in kind.

Reinforcing bars, other than hoops, from which sample splices are removed, shall be repaired using ultimate mechanical butt splices conforming to the provisions in Section 52-1.08C(1), "Splice Prequalification Report," or the bars shall be replaced in kind. These bars shall be repaired or replaced such that no splices are located in any "No Splice Zone" shown on the plans.

Ultimate production and quality assurance sample splices shall rupture either: 1) in the reinforcing bar but outside of the affected zone, provided that the sample splice has visible necking or 2) anywhere, provided that the sample splice has achieved the strain requirement for necking.

When tested in conformance with the requirements in California Test 670, "Necking (Option I)," the visible necking shall be such that there is a visible decrease in the sample's cross-sectional area at the point of rupture.

When tested in conformance with the requirements in California Test 670, "Necking (Option II)," the strain requirement for necking shall be such that the largest measured strain is not less than 6 percent for No. 11 and larger bars, or not less than 9 percent for No. 10 and smaller bars.

The affected zone is the portion of the reinforcing bar where any properties of the bar, including the physical, metallurgical, or material characteristics, have been altered by fabrication or installation of the splice. The weld and one inch adjacent to the weld will be considered part of the affected zone.

In Section 52-1.08C(3)(a) replace the 1st paragraph with:

Production tests shall be performed for all ultimate butt splices used in the work. A production test shall consist of testing 4 sample splices removed from each lot of completed splices.

In Section 52-1.08C(3)(a) replace the 3rd paragraph with:

After notification has been received, the Engineer will randomly select the 4 sample splices to be removed from the lot and place tamper-proof markings or seals on them. These ultimate production sample splices shall be removed by the Contractor, and tested by an approved independent testing laboratory.

In Section 52-1.08(C)(3)(a) replace the 5th, 6th, and 7th paragraphs with:

A sample splice will be rejected if a tamper-proof marking or seal is disturbed before testing.

The 4 sample splices from each production test shall be securely bundled together and identified with a completed sample identification card before shipment to the approved independent testing laboratory. The card will be furnished by the Engineer. Bundles of samples containing fewer than 4 sample splices shall not be tested.

Before performing any tensile tests on production test sample splices, one of the 4 sample splices shall be tested for, and shall conform to, the requirements for total slip in Section 52-1.08B(1), "Mechanical Splices." Should this sample splice not meet these requirements, one retest, in which the 3 remaining sample splices are tested for total slip, will be allowed. Should any of the 3 remaining sample splices not conform to these requirements, all splices in the lot represented by this production test will be rejected.

Replace Section 52-1.08C(3)(b) with:

52-1.08C(3)(b) Quality Assurance Test Requirements for Ultimate Butt Splices

In addition to the required production tests, the Contractor shall concurrently prepare 4 ultimate quality assurance sample splices for:

A. The first production test performed.
B. One of every 5 subsequent production tests, or fraction thereof, randomly selected by the Engineer.

These ultimate quality assurance sample splices shall be prepared in the same manner as specified herein for ultimate production sample splices.

The ultimate quality assurance sample splices shall be shipped to the Transportation Laboratory for quality assurance testing. Each set of 4 sample splices shall be securely bundled together and identified by location and contract number with weatherproof markings before shipment. Bundles containing fewer than 4 samples of splices will not be tested. Sample splices not accompanied by the supporting documentation required in Section 52-1.08B(1), "Mechanical Splices," for mechanical splices, or in Section 52-1.08B(3), "Resistance Butt Welds," for resistance butt welds, will not be tested.

Quality assurance testing will be performed in conformance with the requirements for ultimate production sample splices in Section 52-1.08C(3)(a), "Production Test Requirements for Ultimate Butt Splices."

Replace Section 52-1.08D with:

A Production Test Report for all testing performed on each lot shall be prepared by the approved independent testing laboratory performing the testing and submitted to the QCM for review and approval. The report shall be signed by an engineer who represents the laboratory and is registered as a Civil Engineer in the State of California. The report shall include, as a minimum, the following information for each test: contract number, bridge number, lot number and location, bar size, type of splice, length of mechanical splice, length of test specimen, physical condition of test sample splice, any notable defects, total measured slip, and ultimate tensile strength of each splice. In addition, the report shall include location of visible necking area and largest measured strain for ultimate butt splices.

The QCM must review, approve, and forward each Production Test Report to the Engineer for review before the splices represented by the report are encased in concrete. The Engineer will have 3 working days to review each Production Test Report and respond in writing after a complete report has been received. Should the Contractor elect to encase any splices before receiving notification from the Engineer, it is expressly understood that the Contractor will not be relieved of the responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection.

Quality assurance test results for each bundle of 4 samples of splices will be reported in writing to the Contractor within 3 working days after receipt of the bundle by the Transportation Laboratory. In the event that more than one bundle is received on the same day, 2 additional working days shall be allowed for providing test results for each additional bundle received. A test report will be made for each bundle received. Should the Contractor elect to encase splices before receiving notification from the Engineer, it is expressly understood that the Contractor will not be relieved of the responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection.

^^

SECTION 53 SHOTCRETE
(Issued 11-02-07)

In Section 53-1.01 replace the 3rd paragraph with:

The dry-mix process shall consist of delivering dry mixed aggregate and cementitious material pneumatically or mechanically to the nozzle body and adding water and mixing the materials in the nozzle body. The wet-mix process shall consist of delivering mixed aggregate, cement, and water pneumatically to the nozzle and adding any admixture at the nozzle.

In Section 53-1.02 replace the 1st through 4th paragraphs with:

Cementitious material, fine aggregate, and mixing water shall conform to the provisions in Section 90, "Portland Cement Concrete."

Shotcrete to be mixed and applied by the dry-mix process shall consist of one part cementitious material to not more than 4.5 parts fine aggregate, thoroughly mixed in a dry state before being charged into the machine. Measurement may be either by volume or by weight. The fine aggregate shall contain not more than 6 percent moisture by weight.

Shotcrete to be mixed and applied by the wet-mix process shall consist of cementitious material, fine aggregate, and water and shall contain not less than 632 pounds of cementitious material per cubic yard. A maximum of 30 percent pea gravel may be substituted for fine aggregate. The maximum size of pea gravel shall be such that 100 percent passes the 1/2 inch screen and at least 90 percent passes the 3/8 inch screen.

Admixtures may be added to shotcrete and shall conform to the provisions in Section 90-4, "Admixtures."

In Section 53-1.04 in the 3rd paragraph, replace item C with:

C. Aggregate and cementitious material that have been mixed for more than 45 minutes shall not be used unless otherwise permitted by the Engineer.

Replace Section 53-1.07 with:

53-1.07 MEASUREMENT

Quantities of shotcrete will be measured by the cubic yard computed from measurements, along the slope, of actual areas placed and the theoretical thickness shown on the plans. The Department does not pay for shotcrete placed outside the dimensions shown on the plans or to fill low foundation.

Replace Section 53-1.08 with:

53-1.08 PAYMENT

The contract price paid per cubic yard for shotcrete shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in placing shotcrete, including preparing the foundation, wire reinforcement, structure backfill, joint filling material, and if required by the plans, drains with sacked pervious backfill material, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

^^

SECTION 55 STEEL STRUCTURES
(Issued 05-02-08

In Section 55-1.05 replace the 3rd paragraph with:

Construction methods and equipment employed by the Contractor shall conform to the provisions in Section 7-1.02, "Load Limitations."

In Section 55-2.01 in the 5th paragraph in the table, replace the CVN impact value for Grade HPS 50W with:

Grade HPS 50W* (4 inches and under in thickness)	20 at 10 ºF

In Section 55-3.05 replace the 1st paragraph with:

Surfaces of bearing and base plates and other metal surfaces that are to come in contact with each other or with ground concrete surfaces or with asbestos sheet packing shall be flat to within 1/32-inch tolerance in 12 inches and to within 1/16-inch tolerance overall. Surfaces of bearing and base plates and other metal bearing surfaces that are to come in contact with preformed fabric pads, elastomeric bearing pads, or mortar shall be flat to within 1/8-inch tolerance in 12 inches and to within 3/16-inch tolerance overall.

In Section 55-3.10 in the 1st paragraph, replace item B with:

B. Internal threads shall conform to the requirements in ASTM Designation: A 563.

In Section 55-3.19 replace the 3rd paragraph with:

Immediately before setting bearing assemblies or masonry plates directly on ground concrete surfaces, the Contractor shall thoroughly clean the surfaces of the concrete and the metal to be in contact and shall apply a coating of nonsag polysulfide or polyurethane caulking conforming to the requirements in ASTM Designation: C 920 to contact areas to provide full bedding.

In Section 55-3.19 replace the 5th paragraph with:

Mortar to be placed below masonry plates or bearing plates of the bearing assemblies and in anchor bolt sleeves or canisters shall conform to the provisions in Section 51-1.135, "Mortar," except that the proportion of cementitious material to sand shall be 1:3.

In Section 55-4.01 in the 1st paragraph, replace item D with:

D. To determine the pay quantities of galvanized metal, the weight to be added to the calculated weight of the base metal for the galvanizing will be determined from the table of weights of zinc coatings specified in ASTM Designation: A 153/A 153M.

^^

SECTION 56 SIGNS
(Issued 03-16-07)

In Section 56-1.03 replace the 5th paragraph with:

Clips, eyes, or removable brackets shall be affixed to all signs and all posts and shall be used to secure the sign during shipping and for lifting and moving during erection as necessary to prevent damage to the finished galvanized or painted surfaces. Brackets on tubular sign structures shall be removed after erection. Details of the devices shall be shown on the working drawings.

In Section 56-1.10 replace the 4th paragraph with:

The contract price paid per pound for install sign structure of the type or types designated in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in installing sign structures, complete in place, including installing anchor bolt assemblies, removable sign panel frames, and sign panels and performing any welding, painting or galvanizing required during installation, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

In Section 56-2.03 replace the 4th paragraph with:

Backfill material for metal posts shall consist of minor concrete conforming to the provisions in Section 90-10, "Minor Concrete," and shall contain not less than 463 pounds of cementitious material per cubic yard.

^^

SECTION 59 PAINTING
(Issued 06-05-09)

In Section 59-1.03 replace the 3rd paragraph with:

Painting shall be done in a neat and workmanlike manner. Unless otherwise specified, paint shall be applied by brush, or spray, or roller, or any combination of these methods. Gun extensions shall not be used.

In Section 59-2.01 replace the 2nd paragraph with:

Unless otherwise specified, no painting Contractors or subcontractors will be permitted to perform work without having the following current "SSPC: The Society for Protective Coatings" (formerly the Steel Structures Painting Council) certifications in good standing throughout the duration of the contract:

A. For cleaning and painting structural steel in the field, certification in conformance with the requirements in Qualification Procedure No. 1, "Standard Procedure For Evaluating Painting Contractors (Field Application to Complex Industrial Structures)" (SSPC-QP 1).
B. For removing paint from structural steel, certification in conformance with the requirements in Qualification Procedure No. 2, "Standard Procedure for the Qualification of Painting Contractors (Field Removal of Hazardous Coatings from Complex Structures)" (SSPC-QP 2, Category A).
C. For cleaning and painting structural steel in a permanent painting facility, certification in conformance with the requirements in Qualification Procedure No. 3, "Standard Procedure For Evaluating Qualifications of Shop Painting Applicators" (SSPC-QP 3, Enclosed Shop Facility). The AISC's Sophisticated Paint Endorsement (SPE) quality program, Certification P-1 Enclosed, will be considered equivalent to SSPC-QP 3, Enclosed Shop Facility.

In Section 59-2.12 replace the 3rd and 4th paragraphs with:

Contact surfaces of stiffeners, railings, built up members or open seam exceeding 6 mils in width that would retain moisture, shall be caulked with polysulfide or polyurethane sealing compound conforming to the requirements in ASTM Designation: C 920, Type S, Grade NS, Class 25, Use O, or other approved material.

The dry film thickness of the paint will be measured in place with a calibrated Type 2 magnetic film thickness gage in conformance with the requirements in SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages," of the "SSPC: The Society for Protective Coatings," except that there shall be no limit to the number or location of spot measurements to verify compliance with specified thickness requirements.

^^

SECTION 64 PLASTIC PIPE
(Issued 06-05-09)

In Section 64-1.02 replace the 5th paragraph with:

HDPE compounds used in the manufacture of corrugated polyethylene pipe and fittings shall comply with AASHTO M 294 except that the mix shall contain not less than 2 nor greater than 4 percent well dispersed carbon black. HDPE compounds used in the manufacture of ribbed profile wall polyethylene pipe shall comply with ASTM F 894 except that Type E ultraviolet stabilizers shall not be allowed and carbon black shall be well dispersed in an amount not less than 2 percent nor greater than 4 percent.

Manufacturers of corrugated polyethylene pipe shall:

1. Participate in the National Transportation Product Evaluation Control Program (NTPEP) for each plant supplying corrugated polyethylene pipe and fittings for the project.
2. Conduct and maintain a quality control program under NTPEP.
3. Submit a copy to the Engineer of manufacturing plant audits and NTPEP test results from the current cycle of NTPEP testing for all pipe diameters supplied.

Type D corrugated polyethylene pipe is not allowed. Corrugated polyethylene pipe greater than 60 inches in nominal diameter is not allowed.

In Section 64-1.05 replace the 1st paragraph with:

Excavation, backfill, and shaped bedding shall comply with Section 19-3, "Structure Excavation and Backfill," except the following:

1. At locations where pipe is to be backfilled with concrete, the backfill shall comply with Section 64-1.06, "Concrete Backfill."
2. Corrugated polyethylene pipe that is greater than 48 inches in nominal diameter but not exceeding 60 inches in nominal diameter shall be backfilled with either controlled low strength material under the special provisions or slurry cement backfill under Section 19-3.062, "Slurry Cement Backfill."
3. Where cementitious or flowable backfill is used for structure backfill, the backfill shall be placed to a level not less than 12 inches above the crown of the pipe.

In Section 64-1.06 replace the 1st paragraph with:

At locations where pipe is to be backfilled with concrete as shown on the plans, the concrete backfill shall be constructed of minor concrete or Class 4 concrete conforming to the provisions in Section 90, "Portland Cement Concrete." Minor concrete shall contain not less than 380 pounds of cementitious material per cubic yard. The concrete to be used will be designated in the contract item or shown on the plans.

In Section 64-1.06 replace the 3rd paragraph with:

The surface of the concrete backfill shall be broomed with a heavy broom to produce a uniform rough surface if hot mix asphalt is to be placed directly thereon.

^^

SECTION 65 REINFORCED CONCRETE PIPE
(Issued 07-31-07)

In Section 65-1.02 replace the 1st paragraph with:

Cementitious material and aggregate shall conform to the provisions in Section 90-2, "Materials" except that mortar strengths relative to Ottawa sand and grading requirements shall not apply to the aggregate. Use of supplemental cementitious material shall conform to AASHTO Designation: M 170.

In Section 65-1.02A(1) in the 11th paragraph, replace item c with:

c. Cementitious material and aggregate for non-reinforced concrete pipe shall conform to the provisions in Section 65-1.02, "Materials."

In Section 65-1.035 replace the 1st paragraph with:

At locations where pipe is to be backfilled with concrete as shown on the plans, the concrete backfill shall be constructed of minor concrete or Class 4 concrete in conformance with the provisions in Section 90, "Portland Cement Concrete." Minor concrete shall contain not less than 380 pounds of cementitious material per cubic yard. The concrete to be used will be designated in the contract item.

In Section 65-1.035 replace the 3rd paragraph with:

The surface of the concrete backfill shall be broomed with a heavy broom to produce a uniform rough surface if hot mix asphalt is to be placed directly thereon.

In Section 65-1.06 in the 2nd paragraph, replace the 1st subparagraph with:

Cement Mortar. - Mortar shall be composed of one part cementitious material and 2 parts sand by volume. Supplementary cementitious material will not be required.

^^

SECTION 66 CORRUGATED METAL PIPE
(Issued 07-31-07)

In Section 66-1.045 replace the 1st paragraph with:

At locations where pipe is to be backfilled with concrete as shown on the plans, the concrete backfill shall be constructed of minor concrete or Class 4 concrete conforming to the provisions in Section 90, "Portland Cement Concrete." Minor concrete shall contain not less than 380 pounds of cementitious material per cubic yard. The concrete to be used will be designated in the contract item or shown on the plans.

In Section 66-1.045 replace the 3rd paragraph with:

The surface of the concrete backfill shall be broomed with a heavy broom to produce a uniform rough surface if hot mix asphalt is to be placed directly thereon.

^^

SECTION 68 SUBSURFACE DRAINS
(Issued 07-31-07)

In Section 68-3.02D replace the 1st and 2nd paragraphs with:

Concrete for splash pads shall be produced from minor concrete conforming to the provisions in Section 90-10, "Minor Concrete." Minor concrete shall contain not less than 470 pounds of cementitious material per cubic yard.

Mortar placed where edge drain outlets and vents connect to drainage pipe and existing drainage inlets shall conform to the provisions in Section 51-1.135, "Mortar."

In Section 68-3.03 replace the 13th paragraph with:

Cement treated permeable material, which is not covered with hot mix asphalt within 12 hours after compaction of the permeable material, shall be cured by either sprinkling the material with a fine spray of water every 4 hours during daylight hours or covering the material with a white polyethylene sheet, not less than 6 mils thick. The above curing requirements shall begin at 7:00 a.m. on the morning following compaction of the cement treated permeable material and continue for the next 72 hours or until the material is covered with hot mix asphalt, whichever is less. The cement treated permeable material shall not be sprayed with water during the first 12 hours after compacting, but may be covered with the polyethylene sheet during the first 12 hours or prior to the beginning of the cure period.

In Section 68-3.03 replace the 17th and 18th paragraphs with:

Hot mix asphalt for backfilling trenches in existing paved areas shall be produced from commercial quality aggregates and asphalt and mixed at a central mixing plant. The aggregate shall conform to the 3/4 inch grading, or the 1/2 inch grading for Type A and Type B hot mix asphalt specified in Section 39-1.02E, "Aggregate." The amount of asphalt binder to be mixed with the aggregate shall be between 4 percent and 7 percent by weight of the dry aggregate, as determined by the Engineer.

Hot mix asphalt backfill shall be spread and compacted in approximately 2 equal layers by methods that will produce a hot mix asphalt surfacing of uniform smoothness, texture and density. Each layer shall be compacted before the temperature of the mixture drops below 250 ºF. Prior to placing the hot mix asphalt backfill, a tack coat of asphaltic emulsion conforming to the provisions in Section 94, "Asphaltic Emulsions," shall be applied to the vertical edges of existing pavement at an approximate rate of 0.05 gallon per square yard.

In Section 68-3.03 replace the 20th paragraph with:

Type A pavement markers conforming to the details shown on the plans and the provisions in Section 85, "Pavement Markers," shall be placed on paved shoulders or dikes at outlet, vent and cleanout locations as directed by the Engineer. The waiting period for placing pavement markers on new hot mix asphalt surfacing will not apply.

Replace Section 68-3.05 with:

68-3.05 PAYMENT

The contract price paid per linear foot for plastic pipe (edge drain) of the size or sizes shown in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in installing edge drains complete in place, including excavation (and removal of any concrete deposits that may occur along the lower edge of the concrete pavement in Type 1 installations) and hot mix asphalt backfill for Type 1 edge drain installation, tack coat, filter fabric, and treated permeable material, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

The contract price paid per linear foot for plastic pipe (edge drain outlet) of the size or sizes shown in the Engineer's Estimate shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in installing edge drain outlets, vents and cleanouts complete in place, including outlet and vent covers, expansion plugs, pavement markers, concrete splash pads, connecting outlets and vents to drainage facilities, and excavation and backfill [aggregate base, hot mix asphalt, tack coat, and native material] for outlets, vents, and cleanouts to be installed in embankments and existing shoulders, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

^^

SECTION 69 OVERSIDE DRAINS
(Issued 07-31-07)

In Section 69-1.01 replace the 1st paragraph with:

This work shall consist of furnishing and installing entrance tapers, pipe downdrains, tapered inlets, flume downdrains, anchor assemblies, reducers, slip joints and hot mix asphalt overside drains to collect and carry surface drainage down the roadway slopes as shown on the plans or as directed by the Engineer and as specified in these specifications and the special provisions.

Replace Section 69-1.02D with:

69-1.02D Hot Mix Asphalt

Hot mix asphalt for overside drains shall conform to the provisions in Section 39-1.13, "Miscellaneous Areas."

Replace Section 69-1.04 with:

69-1.04 HOT MIX ASPHALT OVERSIDE DRAINS

Hot mix asphalt overside drains shall be constructed as shown on the plans or as directed by the Engineer. The hot mix asphalt shall be placed in conformance with the provisions in Section 39-1.13, "Miscellaneous Areas."

In Section 69-1.06 replace the 2nd paragraph with:

Quantities of hot mix asphalt placed for overside drains will be paid for as provided in Section 39-5, "Measurement and Payment," for hot mix asphalt placed in miscellaneous areas.

^^

SECTION 70 MISCELLANEOUS FACILITIES
(Issued 07-18-08)

In Section 70-1.02C replace the 2nd paragraph with:

Precast concrete flared end sections shall conform to the requirements for Class III Reinforced Concrete Pipe in AASHTO Designation: M 170M. Cementitious materials and aggregate shall conform to the provisions in Section 90-2, "Materials," except that mortar strengths relative to Ottawa sand and grading requirements shall not apply to the aggregate. Use of supplementary cementitious material shall conform to the requirements in AASHTO Designation: M 170. The area of steel reinforcement per linear foot of flared end section shall be at least equal to the minimum steel requirements for circular reinforcement in circular pipe for the internal diameter of the circular portion of the flared end section. The basis of acceptance of the precast concrete flared end section shall conform to the requirements of Section 5.1.2 of AASHTO Designation: M 170.

In Section 70-1.02H replace the 1st paragraph with:

Precast concrete pipe risers and pipe reducers, and precast concrete pipe sections, adjustment rings and tapered sections for pipe energy dissipators, pipe inlets and pipe manholes shall conform to the requirements in AASHTO Designation: M 199M/M 199, except that the cementitious material and aggregate shall conform to the provisions in Section 90-2, "Materials," except that mortar strengths relative to Ottawa sand and grading requirements shall not apply to the aggregate. Use of supplementary cementitious material shall conform to the requirements in AASHTO Designation: M 170.

In Section 70-1.03 replace the 2nd paragraph with:

Cutoff walls for precast concrete flared end sections shall be constructed of minor concrete conforming to the provisions in Section 90-10, "Minor Concrete." Minor concrete shall contain not less than 470 pounds of cementitious material per cubic yard.

^^

SECTION 72 SLOPE PROTECTION
(Issued 03-13-09)

In Section 72-4.04 replace the 6th paragraph with:

Pervious backfill material, if required by the plans, shall be placed as shown. A securely tied sack containing one cubic foot of pervious backfill material shall be placed at each weep hole and drain hole. The sack material shall conform to the requirements for filter fabric in Section 88-1.02, "Filtration."

^^

SECTION 73 CONCRETE CURBS AND SIDEWALKS
(Issued 06-05-09)

In Section 73-1.01 in the 2nd paragraph, replace item 2 with:

2. Minor concrete shall contain not less than 463 pounds of cementitious material per cubic yard except that when extruded or slip-formed curbs are constructed using 3/8-inch maximum size aggregate, minor concrete shall contain not less than 505 pounds of cementitious material per cubic yard.

In Section 73-1.06 replace the 15th paragraph with:

Where hot mix asphalt or portland cement concrete pavements are to be placed around or adjacent to manholes, pipe inlets or other miscellaneous structures in sidewalk, gutter depression, island paving, curb ramps or driveway areas, the structures shall not be constructed to final grade until after the pavements have been constructed for a reasonable distance on each side of the structures.

^^

SECTION 74 PUMPING PLANT EQUIPMENT
(Issued 07-01-08)

In Section 74-1.02 delete the 2nd paragraph.

^^

SECTION 75 MISCELLANEOUS METAL
(Issued 06-05-09)

In Section 75-1.03 replace the 13th paragraph with:

Concrete anchorage devices shall be mechanical expansion or resin capsule types installed in drilled holes or cast-in-place insert types. The anchorage devices shall be selected from the Department's Pre-Qualified Products List. The qualification requirements for concrete anchorage devices may be obtained from the Pre-Qualified Products List Web site.

The anchorage devices shall be a complete system, including threaded studs, hex nuts, and cut washers. Thread dimensions for externally threaded concrete anchorage devices prior to zinc coating shall conform to the requirements in ASME Standard: B1.1 having Class 2A tolerances or ASME Standard: B1.13M having Grade 6g tolerances. Thread dimensions for internally threaded concrete anchorage devices shall conform to the requirements in ASTM A 563.

In Section 75-1.03 replace the 18th paragraph with:

Mechanical expansion anchors shall, when installed in accordance with the manufacturer's instructions and these specifications and tested in conformance with the requirements in California Test 681, withstand the application of a sustained tension test load of at least the following values for at least 48 hours with a movement not greater than 0.035 inch:

Stud Diameter (inches)	Sustained Tension Test Load (pounds)
*3/4	5,000
5/8	4,100
1/2	3,200
3/8	2,100
1/4	1,000

* Maximum stud diameter permitted for mechanical expansion anchors.

Resin capsule anchors shall, when installed in accordance with the manufacturer's instructions and these specifications and tested in conformance with the requirements in California Test 681, withstand the application of a sustained tension test load of at least the following values for at least 48 hours with a movement not greater than 0.010 inch:

Stud Diameter (inches)	Sustained Tension Test Load (pounds)
1-1/4	31,000
1	17,900
7/8	14,400
3/4	5,000
5/8	4,100
1/2	3,200
3/8	2,100
1/4	1,000

At least 25 days before use, the Contractor shall submit one sample of each resin capsule anchor per lot to the Transportation Laboratory for testing. A lot of resin capsule anchors is 100 units, or fraction thereof, of the same brand and product name.

In Section 75-1.03 replace the 20th paragraph with:

A Certificate of Compliance for concrete anchorage devices shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance."

In Section 75-1.03 replace the 24th paragraph with:

Sealing compound, for caulking and adhesive sealing, shall be a polysulfide or polyurethane material conforming to the requirements in ASTM Designation: C 920, Type S, Grade NS, Class 25, Use O.

In Section 75-1.035 in the 3rd paragraph, replace the 1st sentence with:

Cables shall be 3/4 inch preformed, 6 x 19, wire strand core or independent wire rope core (IWRC), galvanized in conformance with the requirements in Federal Specification RR-W-410, right regular lay, manufactured of improved plow steel with a minimum breaking strength of 23 tons.

In Section 75-1.035 in the 4th paragraph, replace item C with:

C. Nuts shall conform to the requirements in ASTM Designation: A 563 including Appendix X1, except lubrication is not required.

In Section 75-1.035 replace the 12th paragraph with:

Concrete for filling cable drum units shall conform to the provisions in Section 90-10, "Minor Concrete," or at the option of the Contractor, may be a mix with 3/8-inch maximum size aggregate and not less than 675 pounds of cementitious material per cubic yard.

In Section 75-1.05 replace the 6th paragraph with:

Galvanizing of iron and steel hardware and nuts and bolts, when specified or shown on the plans, shall conform to the requirements in ASTM Designation: A 153/A 153M, except whenever threaded studs, bolts, nuts, and washers are specified to conform to the requirements in ASTM Designation: A 307, A 325, A 449, A 563, or F 436 and zinc coating is required, they shall be hot-dip zinc coated or mechanically zinc coated in conformance with the requirements in the ASTM Designations. Unless otherwise specified, galvanizing shall be performed after fabrication.

In Section 75-1.05 replace the 8th paragraph with:

Tapping of nuts or other internally threaded parts to be used with zinc coated bolts, anchor bars or studs shall be done after galvanizing and shall conform to the requirements for thread dimensions and overtapping allowances in ASTM Designation: A 563.

^^

SECTION 80 FENCES
(Issued 01-05-07)

In Section 80-3.01F replace the 4th paragraph with:

Portland cement concrete for metal post and brace footings and for deadmen shall be minor concrete conforming to the provisions in Section 90-10, "Minor Concrete." Minor concrete shall contain not less than 470 pounds of cementitious material per cubic yard.

In Section 80-4.01C replace the 4th paragraph with:

Portland cement concrete for metal post and for deadmen shall be produced from minor concrete conforming to the provisions in Section 90-10, "Minor Concrete." Minor concrete shall contain not less than 470 pounds of cementitious material per cubic yard.

^^

SECTION 83 RAILINGS AND BARRIERS
(Issued 04-03-09)

In Section 83-1.02 replace the 7th paragraph with:

Mortar shall conform to the provisions in Section 51-1.135, "Mortar," and shall consist of one part by volume of cementitious material and 3 parts of clean sand.

In Section 83-1.02B in the 24th paragraph in the 8th subparagraph, replace the 1st sentence with:

Anchor cable shall be 3/4 inch preformed, 6 x 19, wire strand core or independent wire rope core (IWRC), galvanized in conformance with the requirements in Federal Specification RR-W-410, right regular lay, manufactured of improved plow steel with a minimum breaking strength of 23 tons.

In Section 83-1.02E in the 6th paragraph, replace the 2nd sentence with:

Cable shall be galvanized in conformance with the requirements in Federal Specification RR-W-410.

In Section 83-1.02I replace the 5th paragraph with:

Where shown on the plans, cables used in the frame shall be 5/16 inch in diameter, wire rope, with a minimum breaking strength of 5,000 pounds and shall be galvanized in conformance with the requirements in Federal Specification RR-W-410.

In Section 83-1.02I replace the 14th paragraph with:

Chain link fabric shall be 11-gage conforming to one of the following:

1. AASHTO Designation: M181, Type I, Class C
2. AASHTO Designation: M181, Type IV, Class A
3. ASTM F 1345, Class 2

In Section 83-2.02D(1) replace the 5th paragraph with:

When concrete barriers are to be constructed on existing structures, the dowels shall be bonded in holes drilled in the existing concrete. Drilling of holes and bonding of dowels shall conform to the following:

1. The bonding materials shall be either magnesium phosphate concrete, modified high alumina based concrete or portland cement based concrete. Magnesium phosphate concrete shall be either single component (water activated) or dual component (with a prepackaged liquid activator). Modified high alumina based concrete and portland cement based concrete shall be water activated. Bonding materials shall conform to the following requirements:

Property	Test Method	Requirements
Compressive Strength		
at 3 hours, MPa	California Test 551	21 min.
at 24 hours, MPa	California Test 551	35 min.
Flexure Strength		
at 24 hours, MPa	California Test 551	3.5 min.
Bond Strength: at 24 hours		
SSD Concrete, MPa	California Test 551	2.1 min.
Dry Concrete, MPa	California Test 551	2.8 min.
Water Absorption, %	California Test 551	10 max.
Abrasion Resistance		
at 24 hours, grams	California Test 550	25 max.
Drying Shrinkage at 4 days, %	ASTM Designation: C 596	0.13 max.
Soluble Chlorides by weight, %	California Test 422	0.05 max.
Water Soluble Sulfates by weight, %	California Test 417	0.25 max.

2. Magnesium phosphate concrete shall be formulated for minimum initial set time of 15 minutes and minimum final set time of 25 minutes at 70° F. The materials, prior to use, shall be stored in a cool, dry environment.
3. Mix water used with water activated material shall conform to the provisions in Section 90-2.03, "Water."
4. The quantity of water for single component type or liquid activator (for dual component type) to be blended with the dry component, shall be within the limits recommended by the manufacturer and shall be the least amount required to produce a pourable batter.
5. Addition of retarders, when required and approved by the Engineer, shall be in conformance with the manufacturer's recommendations.
6. Before using concrete material that has not been previously approved, a minimum of 45 pounds shall be submitted to the Engineer for testing. The Contractor shall allow 45 days for the testing. Each shipment of concrete material that has been previously approved shall be accompanied by a Certificate of Compliance as provided in Section 6-1.07, "Certificates of Compliance."
7. Magnesium phosphate concrete shall not be mixed in containers or worked with tools containing zinc, cadmium, aluminum or copper metals. Modified high alumina based concrete shall not be mixed in containers or worked with tools containing aluminum.
8. The surface of any dowel coated with zinc or cadmium shall be coated with a colored lacquer before installation of the dowel. The lacquer shall be allowed to dry thoroughly before embedment of the dowels.
9. The holes shall be drilled by methods that will not shatter or damage the concrete adjacent to the hole. The diameter of the drilled hole shall be $^{1}/_{2}$ inch larger than the nominal diameter of the dowels.
10. The drilled holes shall be clean and dry at the time of placing the bonding material and the steel dowels. Bonding material and dowel shall completely fill the drilled hole. The surface temperature shall be 40° F or above when the bonding material is placed.
11. After bonding, dowels shall remain undisturbed for a minimum of 3 hours or until the bonding material has reached a strength sufficient to support the dowels. Dowels that are improperly bonded, as determined by the Engineer, shall be removed. The holes shall be cleaned or new holes shall be drilled and the dowels replaced and securely bonded to the concrete. Removing, redrilling and replacing improperly bonded dowels shall be performed at the Contractor's expense. Modified high alumina based concrete and portland cement based concrete shall be cured in conformance with the provisions in Section 90-7.01B, "Curing Compound Method," of the Standard Specifications. Magnesium phosphate concrete shall not be cured.

In Section 83-2.02D(2) in the 1st paragraph, replace item b with:

b. If the 3/8-inch maximum size aggregate grading is used to construct extruded or slip-formed concrete barriers, the cementitious material content of the minor concrete shall be not less than 675 pounds per cubic yard.

In Section 83-2.02D(2) replace the 3rd paragraph with:

The concrete paving between the tops of the 2 walls of concrete barrier (Types 50E, 60E, 60GE, and 60SE) and the optional concrete slab at the base between the 2 walls of concrete barrier (Types 50E, 60E, 60GE, and 60SE) shall be constructed of minor concrete conforming to the provisions of Section 90-10, "Minor Concrete," except that the minor concrete shall contain not less than 505 pounds of cementitious material per cubic yard.

^^

SECTION 85 PAVEMENT MARKERS
(Issued 07-31-07)

In Section 85-1.06 replace the 6th paragraph with:

Pavement markers shall not be placed on new hot mix asphalt surfacing or seal coat until the surfacing or seal coat has been opened to public traffic for a period of not less than 7 days when hot melt bituminous adhesive is used, and not less than 14 days when epoxy adhesive is used.

In Section 85-1.06 in the 14th paragraph, replace the 2nd sentence with:

Cleaning shall be done by blast cleaning on all surfaces regardless of age or type, except that blast cleaning of clean, new hot mix asphalt and clean, new seal coat surfaces will not be required when hot melt bituminous adhesive is used.

^^

SECTION 86 SIGNALS, LIGHTING AND ELECTRICAL SYSTEMS
(Issued 06-05-09)

Replace Section 86 with:

SECTION 86 ELECTRICAL SYSTEMS
86-1 GENERAL

86-1.01 DESCRIPTION

Section 86 includes specifications for installing, modifying, and removing:

1. Traffic signal
2. Interconnect system
3. Ramp metering system
4. Flashing beacon system
5. Lighting system
6. Sign illumination system
7. Traffic monitoring station
8. Communication system
9. Electrical equipment in structure
10. Falsework lighting

Comply with Part 4 of the California MUTCD. Nothing in this Section 86 is to be construed as to reduce the minimum standards in this manual.

The locations of electrical system elements are approximate; the Engineer will approve final location.

86-1.015 DEFINITIONS

Definitions pertain only to Section 86, "Electrical Systems."

actuation: The action of a vehicle or pedestrian causing a detector to create a call in that phase or movement to request right of way.

channel: Discrete information path.

controller assembly: Controller unit and auxiliary equipment housed in a rainproof cabinet to control a system's operations.
controller unit: Part of the controller assembly performing the basic timing and logic functions.
detector: Device indicating passage or presence of vehicles or pedestrians.
electrolier: Complete assembly of lighting standard and luminaire.
flasher: Device to open and close signal circuits at a repetitive rate.
flashing beacon control assembly: Switches, circuit breakers, terminal blocks, flasher, wiring, and necessary electrical components all housed in a single enclosure to properly operate a beacon.
inductive loop detector: Detector capable of being actuated by inductance change caused by vehicle passing or standing over the loop.
lighting standard: Pole and mast arm supporting the luminaire.
luminaire: Consists of housing, reflector, refractor or lens, lamp socket, integral ballast, terminal strip, and lamp.
magnetic detector: Detector capable of being actuated by induced voltage caused by vehicle passing through the earth's magnetic field.
powder coating: A coating applied electrostatically using UV-stable polyester triglycidyl isocyanurate exterior grade powder
pre-timed controller assembly: Operates traffic signals under a predetermined cycle length.
signal face: As defined in the California MUTCD.
signal head: As defined in the California MUTCD.
signal indication: As defined in the California MUTCD.
signal section: As defined in the California MUTCD.
signal standard: Pole and mast arm supporting one or more signal faces with or without a luminaire mast arm.
traffic-actuated controller assembly: Operates traffic signals under the varying demands of traffic as registered by detector actuation.
traffic phase: Signal phase as defined in the California MUTCD.
vehicle: As defined in the California Vehicle Code.

86-1.02 REGULATIONS AND CODE Electrical equipment must comply with one or more of the following:

1. EIA
2. ETL
3. NEMA
4. NETA
5. UL

Materials and workmanship must comply with:

1. ANSI
2. ASTM
3. 8 CA Code of Regs § 2299 et seq.
4. FCC
5. ITE
6. NEC
7. Public Utilities Commission, General Order No. 95, "Rules for Overhead Electrical Line Construction"
8. Public Utilities Commission, General Order No. 128, "Rules for Construction of Underground Electric Supply and Communication Systems"

86-1.03 COST BREAK-DOWN

Determine quantities required to complete work. Submit the quantities as part of the cost breakdown.

The sum of the amounts for the units of work listed in the cost breakdown must equal the contract lump sum price bid for the work. Include overhead and profit for each unit of work listed in the cost breakdown. If mobilization is a bid item, include bond premium, temporary construction facilities, and material plants into the mobilization bid item, otherwise, include in each unit of work listed in the cost breakdown. Do not include costs for traffic control system in the cost breakdown.

The cost breakdown may be used to determine partial payment and to calculate payment adjustments for additional costs incurred due to a change order. If a change order increases or decreases the quantities, payment adjustment may be determined under Section 4-1.03B, "Increased or Decreased Quantities."

The cost breakdown must include type, size, and installation method for:

1. Foundations
2. Standards and poles
3. Conduit
4. Pull boxes
5. Conductors
6. Service equipment enclosures
7. Telephone demarcation cabinet
8. Signal heads and hardware
9. Pedestrian signal heads and hardware
10. Pedestrian push buttons
11. Loop detectors
12. Luminaires and lighting fixtures

86-1.04 EQUIPMENT LIST AND DRAWINGS

Within 15 days of contract approval, submit for review a list of equipment and materials that you propose to install. Comply with Section 5-1.02, "Plans and Working Drawings." The list must include:

1. Name of manufacturer
2. Dimension
3. Item identification number
4. List of components

The list must be supplemented by other data as required, including:

1. Schematic wiring diagrams
2. Scale drawings of cabinets showing location and spacing of shelves, terminal blocks, and equipment, including dimensioning
3. Operation manual

Submit 2 copies of the above data. The Engineer will review within 15 days.

Electrical equipment that is manufactured as detailed on the plans will not require detailed drawings and diagrams.

Furnish 3 sets of computer-generated cabinet schematic wiring diagrams.

The cabinet schematic wiring diagram must be placed in a heavy duty plastic envelope and attached to the inside of the door of each cabinet.

Prepare diagrams, plans, and drawings using graphic symbols in IEEE 315, "Graphic Symbols for Electrical and Electronic Diagrams."

86-1.05 CERTIFICATE OF COMPLIANCE

Submit a Certificate of Compliance for all electrical material and equipment to the Engineer under Section 6-1.07, "Certificates of Compliance."

86-1.06 MAINTAINING EXISTING AND TEMPORARY ELECTRICAL SYSTEMS

Keep existing electrical system or approved temporary replacement in working order during the progress of the work. Shutdown is allowed for alteration or removal of the system. Traffic signal shutdown must be limited to normal working hours. Lighting system shutdown must not interfere with the regular lighting schedule.

Notify the Engineer before performing work on the existing system.

Notify the local traffic enforcement agency before traffic signal shutdown.

If existing or temporary system must be modified, work not shown on the plans or specified in the special provisions, but required to keep the system in working order will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

The State or local agency will:

1. Continue the operation and maintenance of existing electrical facilities
2. Continue to provide electrical energy to operate existing electrical facilities
3. Repair or replace existing facilities damaged by public traffic
4. Pay for electrical energy to operate existing or new facilities undergoing the functional tests described in Section 86-2.14C, "Functional Testing"

Verify location and depth of existing detectors, conduits, pull boxes, and other electrical facilities before using tools or equipment that may damage those facilities or interfere with an electrical system.

Notify the Engineer immediately if existing facility is damaged by your activities. Repair or replace damaged facility promptly. If you fail to complete the repair or replacement, promptly, the State will repair or replace and deduct the costs.

Damaged detectors must be replaced within 24 hours at your expense. If you fail to complete the repair within 24 hours, the State will repair and deduct the repair costs.

If roadway remains open to traffic while an existing lighting system is modified:

1. Keep existing system in working order
2. Make final connection so the modified circuit is in operation by nightfall

Keep temporary electrical installations in working order until no longer required. Remove temporary installations as specified in Section 86-7, "Removing, Reinstalling or Salvaging Electrical Equipment."

These provisions do not void your responsibilities as specified in Section 7-1.12, "Indemnification and Insurance," and Section 7-1.16, "Contractor's Responsibility for the Work and Materials."

During traffic signal system shutdown, place W3-1a, "STOP AHEAD," and R1-1, "STOP," signs in each direction to direct traffic through the intersection. For 2-lane approaches, place 2 R1-1 signs.

W3-1a and R1-1 signs must comply with Section 12-3.06, "Construction Area Signs." Use a minimum size of 30 inches for the R1-1 sign.

Cover signal faces when the system is shut down overnight. Cover temporary W3-1a and R1-1 signs when the system is turned on.

86-1.07 SCHEDULING OF WORK

Except service installation and service equipment enclosure, do not work above ground until all materials are on hand to complete electrical work at each location. Schedule work to allow each system to be completed and ready for operation before opening the corresponding section of the roadway to traffic.

If street lighting exists or is installed in conjunction with traffic signals, do not turn on the signals until the street lighting is energized.

Traffic signals will not be placed in operation until the roadways to be controlled are open to public traffic.

Lighting and traffic signals, including flashing operation, will not be placed in operation before starting the functional test period specified in Section 86-2.14, "Testing."

Do not pull conductors into conduit until:

1. Pull boxes are set to grade
2. Metallic conduit is bonded

In vehicular undercrossings, soffit lights must be in operation as soon as practicable after falsework has been removed from the structure. Lighting for pedestrian structures must be in operation before opening the structure to pedestrian traffic.

If the Engineer orders soffit lights or lighting for pedestrian structures to be activated before permanent power service is available, the cost of installing and removing temporary power service will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

The initial traffic signal turn-on must be made between 9:00 a.m. and 2:00 p.m. Before the initial turn-on, all equipment, including pedestrian signals, pedestrian push buttons, vehicle detectors, lighting, signs, and pavement delineation must be installed and in working order. Direct louvers, visors, and signal faces to maximize visibility.

Start functional tests on any working day except Friday or the day before a legal holiday. You must notify the Engineer 48 hours before the start of functional test.

86-1.08 (BLANK)

86-2 MATERIALS AND INSTALLATION

86-2.01 EXCAVATING AND BACKFILLING

Dispose of surplus excavated material under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way."

Backfill as specified in Section 19-3, "Structure Excavation and Backfill." Compact backfill in conduit trenches outside the hinge point of slopes and not under pavement to a minimum relative compaction of 90 percent. Compact backfill within hinge points and in areas where pavement is to be constructed to a minimum relative compaction of 95 percent.

Backfill trenches and restore sidewalk, pavement, and landscaping at one intersection before starting excavation at another intersection.

If excavating on a street or highway, restrict closure to 1 lane at a time.

86-2.02 REMOVING AND REPLACING IMPROVEMENTS

Replace or reconstruct sidewalk, curb, gutter, concrete pavement, asphalt concrete pavement, underlying material, lawn, plant, and other facilities damaged by your activities. Replacement material must be of equal or better quality than the material replaced. Work must be in a serviceable condition.

If a part of a square or slab of concrete sidewalk, curb, gutter, or driveway is broken or damaged, the entire square or slab must be removed and reconstructed.

Cut outline of PCC sidewalk or driveway to be removed:

1. Using a power-driven saw
2. On a neat line
3. To a 0.17-foot minimum depth

86-2.03 FOUNDATIONS

Except for concrete for cast-in-drilled-hole concrete pile foundation, PCC must comply with Section 90-10, "Minor Concrete."

Construct concrete foundation on firm ground.

After each post, standard, and pedestal is properly positioned, place mortar under the base plate. Finish exposed portion to present a neat appearance. Mortar must comply with Section 51-1.135, "Mortar," except mortar must have:

1. 1 part by volume of cementitious material
2. 3 parts by volume of clean sand

Reinforced cast-in-drilled-hole concrete pile foundation must comply with Section 49, "Piling," except:

1. Material resulting from drilling holes must be disposed of as specified in Section 86-2.01, "Excavating and Backfilling"
2. Concrete for cast-in-drilled-hole concrete pile will not be considered as designated by compressive strength

Form exposed portion of the foundation to present a neat appearance and true to line and grade. The top of a foundation for post and standard must be finished to curb or sidewalk grade. Forms must be rigid and securely braced in place. Conduit ends and anchor bolts must be placed at proper height and position. Anchor bolts must be installed a maximum of 1:40 from vertical and held in place by rigid top and bottom templates. Use a steel bottom template at least 1/2 inch thick that provides proper spacing and alignment of anchor bolts near the embedded bottom end. Install bottom template before placing footing concrete.

Provide new foundation and anchor bolts of the proper type and size for relocated standards.

Steel parts must be galvanized as specified in Section 75-1.05, "Galvanizing."

Provide 2 nuts and washers for the upper threaded part of each anchor bolt. Provide 3 nuts and washers for each anchor bar or stud.

Do not weld high-strength steel used for anchor bolt, anchor bar, or stud.

Before placing concrete, moisten forms and ground. Keep forms in place until the concrete sets for at least 24 hours and is strong enough to prevent damage to surface.

Except if located on a structure, construct foundation for post, standard, and pedestal monolithically.

Apply ordinary surface finish as specified in Section 51-1.18A, "Ordinary Surface Finish."

If a foundation must be extended for additional depth, the extension work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

Do not erect post, pole, standard, pedestal, or cabinet until the foundation is set for a minimum of 7 days.

The Engineer will choose the plumbing or raking technique for posts, standards, and pedestals. Plumb or rake by adjusting the leveling nuts before tightening nuts. Do not use shims or similar devices. After final adjustments of both top nuts and leveling nuts on anchorage assemblies have been made, and each post, standard, and pedestal on structure is properly positioned, tighten nuts as follows:

1. Tighten leveling nuts and top nuts, following a crisscross pattern, until bearing surfaces of all nuts, washers, and base plates are in firm contact.
2. Use an indelible marker to mark the top nuts and base plate with lines showing relative alignment of the nut to the base plate.
3. Tighten top nuts, following a crisscross pattern, an additional 1/6th of a turn.

In unpaved areas, construct a raised PCC pad in front of each controller cabinet.

Completely remove foundations not to be reused or abandoned.

If abandoning a foundation, remove the top of foundation, anchor bolts, and conduits to a minimum depth of 0.5 foot below sidewalk surface or original ground. Backfill the resulting hole with material equivalent to the surrounding material.

86-2.04 STANDARDS, STEEL PEDESTALS AND POSTS

Bolts, including anchor bolts, nuts, and washers for signal and lighting support structures must comply with Section 55-2, "Materials." Except for bearing-type connection or slip-base, high-strength bolted connection must comply with Section 55-3.14, "Bolted Connections." Welding, nondestructive testing of welds, and acceptance and repair criteria for steel member nondestructive testing must comply with American Welding Society (AWS) D1.1.

Using stainless steel rivets, attach rectangular corrosion-resistant metal identification tag on all standards and poles, except Type 1:

1. Above the hand hole, near the base of standards and poles
2. On the underside of mast arms near the arm plate

The lettering on each identification tag must be depressed or raised, 1/4 inch tall, legible, and include the following information:

1. Name of the manufacturer
2. Date of manufacture
3. Identification number
4. Contract number
5. Unique identification code that is:

    5.1. Assigned by the manufacturer
    5.2. Traceable to a particular contract and the welds on that component
    5.3. Readable after the support structure is coated and installed

Type 1 standard and steel pedestal for controller cabinet must be manufactured of one of the following:

1. 0.12-inch or thicker galvanized steel
2. 4-inch standard weight galvanized steel pipe as specified in ASTM A 53
3. 4-inch Type 1 conduit with the top designed for post-top slip-fitter

Ferrous metal parts of a standard that has a shaft length of 15 feet or longer must comply with the provisions in Section 55-2, "Materials," and the following:

1. Standard must be manufactured from sheet steel of weldable grade having a minimum yield strength of 40,000 psi after manufacturing.
2. Certified test report verifying compliance with minimum yield strength requirements must be submitted. Test report may be the mill test report for the as-received steel or if the as-received steel has a lower yield strength than required you must provide test data assuring that your method of cold forming will consistently increase the tensile properties of the steel to meet the specified minimum yield strength. Test data must include tensile properties of the steel after cold forming for specific heats and thicknesses.
3. If a single-ply 5/16-inch thick pole is specified, a 2-ply pole with equivalent section modulus may be substituted.
4. Standard may be manufactured of full-length sheets or shorter sections. Each section must be manufactured from 1 or 2 pieces of sheet steel. If 2 pieces are used, the longitudinal welded seams must be directly opposite from one another. If the sections are butt-welded together, the longitudinal welded seams of adjacent sections must be placed to form continuous straight seams from base to top of standard.
5. Butt-welded circumferential joints of tubular sections requiring CJP groove welds must be made using a metal sleeve backing ring inside each joint. The sleeve must be 1/8 inch nominal thickness, or thicker, and manufactured from steel having the same chemical composition as the steel in the tubular sections to be joined. If the sections to be joined have different specified minimum yield strengths, the steel in the sleeve must have the same chemical composition as the tubular section having the higher minimum yield strength. The width of the metal sleeve must be consistent with the type of nondestructive testing selected and must be a minimum width of 1 inch. At fitting time, the sleeve must be centered at the joint and in contact with the tubular section at the point of the weld.
6. Welds must be continuous.
7. Weld metal at the transverse joint must extend to the sleeve, making the sleeve an integral part of the joint.

8. During manufacturing, longitudinal seams on vertical tubular members of cantilevered support structures must be centered on and along the side of the pole that the pole plate is located. Longitudinal seams on horizontal tubular members, including signal and luminaire arms, must be within ±45 degrees of the bottom of the arm.
9. Longitudinal seam weld in steel tubular section may be made by the electric resistance welding process.
10. Longitudinal seam weld must have 60 percent minimum penetration, except:

    10.1. Within 6 inches of circumferential weld, longitudinal seam weld must be CJP groove weld.
    10.2. Longitudinal seam weld on lighting support structure having telescopic pole segment splice must be CJP groove weld on the female end for a length on each end equal to the designated slip-fit splice length plus 6 inches.

11. Exposed circumferential weld, except fillet and fatigue-resistant weld, must be ground flush with the base metal before galvanizing or painting. Ground flush is specified as -0, +0.08-inch.
12. Circumferential weld and base plate-to-pole weld may be repaired only one time.
13. Exposed edges of the plates that make up the base assembly must be finished smooth and exposed corners of the plates must be broken. Provide shafts with slip-fitter shaft caps.
14. Surface flatness requirements of ASTM A 6 apply to plates:

    14.1. In contact with concrete, grout, or washers and leveling nuts
    14.2. In high-strength bolted connections
    14.3. In joints, where cap screws are used to secure luminaire and signal arms
    14.4. Used for breakaway slip-base assemblies

15. Standard must be straight with a maximum variation of:

    15.1. 1 inch measured at the midpoint of a 30-foot to 35-foot standard
    15.2. 3/4 inch measured at the midpoint of a 17-foot to 20-foot standard
    15.3. 1 inch measured 15 feet above the base plate for Type 35 and Type 36 standards

16. Zinc-coated nuts used on fastener assemblies having a specified preload obtained by specifying a prescribed tension, torque value, or degree of turn must be provided with a colored lubricant, clean and dry to the touch. The lubricant color must contrast the zinc coating color on the nut so the presence of the lubricant is visually obvious. Lubricant must be insoluble in water or the fastener components must be shipped to the job site in a sealed container.
17. Do not make additional holes in structural members.
18. Standard with an outside diameter of 12 inches or less must be round. Standard with an outside diameter greater than 12 inches must be round or multisided. Multisided standard must be convex with a minimum of 12 sides and have a minimum bend radius of 4 inches.
19. Manufacture mast arm from material specified for standard.
20. Manufacture cast steel option for slip base from material of Grade 70-40, as specified in ASTM A 27/A 27M. Other comparable material may be used if approved by the Engineer. The casting tolerances must comply with the Steel Founders' Society of America's recommendations for green sand molding.
21. One casting from each lot of a maximum of 50 castings must be radiographed as specified in ASTM E 94. Casting must comply with the acceptance criteria for severity level 3 or better for the types and categories of discontinuities in ASTM E 186 and E 446. If the casting fails the inspection, 2 additional castings must be radiographed. If the 2 additional castings fail the inspection, the entire lot will be rejected.
22. Material certification, consisting of physical and chemical properties, and radiographic film of the casting must be filed at the manufacturer's office. Certification and film must be available for inspection.
23. High-strength bolts, nuts, and flat washers used to connect slip-base plate must comply with ASTM A 325 or A 325M and be galvanized as specified in Section 75-1.05, "Galvanizing."
24. Plate washers must be manufactured by saw cutting and drilling steel plate. Steel plate must comply with AISI 1018 and be galvanized as specified in Section 75-1.05, "Galvanizing." Before galvanizing, remove burrs and sharp edges and chamfer both sides of holes to allow the bolt head to make full contact with the washer without tension.
25. High-strength cap screws for attaching arms to standards must comply with ASTM A 325, A 325M, or A 449, and the mechanical requirements in ASTM A 325 or A 325M after galvanizing. Cap screws must be galvanized as specified in Section 75-1.05, "Galvanizing." Coat threads of cap screws with a colored lubricant, clean and dry to the touch. Lubricant color must contrast the zinc-coating color on the cap screw so the presence of the lubricant is visually obvious. Lubricant must be insoluble in water or the fastener components must be shipped to the job site in a sealed container.

26. Bolted connection attaching signal or luminaire arm to pole must be considered slip critical. Galvanized faying surfaces of plates on luminaire, signal arm, and pole must be roughened by hand using a wire brush before assembly and must comply with requirements for Class C surface conditions for slip-critical connections in "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts," a specification approved by the Research Council on Structural Connections (RCSC). Paint for faying surfaces must be as specified in the RCSC specification for Class B coating.
27. The Engineer will randomly take samples of fastener components from each production lot and submit to the Transportation Laboratory with test reports as specified in ASTM fastener specifications for QA testing and evaluation. The Engineer will determine sample sizes for each fastener component.

Change in mast arm configuration is allowed as long as the mounting height and stability are maintained.

Before manufacturing, details must be adjusted to ensure that cap screw heads can be turned using conventional installation tools. During manufacturing process, to avoid interference with the cap screw heads, the position of the luminaire arm on the arm plate must be properly located.

Configure mast arm as a smooth curving arm.

Push button post, pedestrian barricade, and guard post must comply with ASTM A 53.

Assemble and tighten slip base when pole is on the ground. Threads of heavy hex nuts for each slip-base bolt must be coated with additional lubricant that is clean and dry to the touch. Tighten high strength slip-base bolts to within ±10 foot-pounds of the following:

Slip-Base Bolt-Tightening Requirements

Standard Type	Torque (foot-pounds)
15-SB	150
30	150
31	200
36-20A	165

Hole in shaft of existing standard, due to removal of equipment or mast arms, must be sealed by fastening a galvanized steel disk to cover the hole. Fasten using a single central galvanized steel fastener. Seal edges of disk and hole with polysulfide or polyurethane sealing compound of Type S, Grade NS, Class 25, and Use O, as specified in ASTM C 920.

If existing standard is ordered to be relocated or reused, remove large dents, straighten shafts, and replace parts that are in poor condition. You must furnish anchor bolts or bars and nuts required for relocating or reusing standard. Repair and replacement work will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

New nuts, bolts, cap screws, and washers must be provided if:

1. Standard or mast arm is relocated
2. Used standard or mast arm is State furnished

If the standard has a slip base, a new keeper plate must be provided.

86-2.05 CONDUIT

Run conductors in conduit except for overhead and where conductors are run inside poles.

You may use a larger size conduit than specified as long as you use it for the entire length between outlets. Do not use reducing coupling.

New conduit must not pass through existing foundations for standards.

86-2.05A Material

Conduit and conduit fitting must be UL or ETL listed and comply with the following:

Conduit and Conduit Fitting Requirements

Type 1	Hot-dip galvanized rigid steel conduit and conduit couplings must comply with UL 6 and ANSI C80.1. Zinc coating testing must comply with copper sulfate test requirements in UL 6. Conduit couplings for rigid steel conduit must be electrogalvanized.
Type 2	Hot-dip galvanized rigid steel conduit must comply with requirements for Type 1conduit and be coated with polyvinyl chloride (PVC) or polyethylene. Exterior thermoplastic coating must have a minimum thickness of 35 mils. Internal coating must have a minimum thickness of 2 mils. Coated conduit must comply with UL 6; NEMA RN 1; or ETL PVC-001.
Type 3	Rigid non-metallic conduit must comply with UL 651, UL 651A or UL 651B. Install at underground locations only.
Type 4	Waterproof flexible metal conduit must consist of conduit with a waterproof non-metallic sunlight-resistant jacket over an inner flexible metal core. Type4 conduit must be UL listed for use as the grounding conductor.
Type 5	Intermediate steel conduit and conduit couplings must comply with UL 1242 and ANSI C80.6. Zinc coating testing must comply with copper sulfate test requirements in UL 1242. Conduit couplings for intermediate rigid steel conduit must be electrogalvanized. Type 5 conduit must only be used if specified.

Bonding bushings to be installed on metal conduit must be insulated and either galvanized or zinc alloy type.
Fittings for steel conduit and for watertight flexible metal conduit must be UL listed at UL 514B.

86-2.05B Use

Install Type 1 conduit on all exposed surfaces and at the following locations:

1. In concrete structures
2. Between a structure and nearest pull box

Exposed conduit installed on painted structure must be painted the same color as the structure.
Change or extend existing conduit runs using the same material. Install pull box if an underground conduit changes from the metallic type to Type 3.
Minimum trade size of conduit must be:

1. 1-1/2 inches from electrolier to adjacent pull box
2. 1 inch from pedestrian push button post to adjacent pull box
3. 2 inches from signal standard to adjacent pull box
4. 3 inches from controller cabinet to adjacent pull box
5. 2 inches from overhead sign to adjacent pull box
6. 1-1/2 inches if unspecified

Two conduits must be installed between controller cabinet and adjacent pull box.

86-2.05C Installation

Whether shop or field cut, ream ends of conduit to remove burrs and rough edges. Make cuts square and true. Slip joints and running threads are not allowed for coupling conduit. If a standard coupling cannot be used for coupling metal type conduit, use a threaded union coupling that is UL or ETL listed. Tighten couplings for metal conduit to maintain a good electrical connection through conduit run.
Cut Type 3 conduit with tools that will not deform the conduit. Use solvent weld for connections.
Cut Type 2 conduit with pipe cutters; do not use hacksaws. Coated conduit must be threaded with standard conduit-threading dies. Tighten conduit into couplings or fittings using strap wrenches or approved groove-joint pliers.
Protect shop-cut threads from corrosion as follows:

Shop-Cut Thread Protection

Steel conduit and conduit couplings	ANSI C80.1
Intermediate metal conduit and conduit couplings	ANSI C80.6

Paint conduits as specified in Section 91, "Paint." Apply 2 coats of approved unthinned zinc-rich primer of organic vehicle type. Do not use aerosol cans. Paint the following parts of conduits:

1. All exposed threads
2. Field-cut threads before installing conduit couplings to steel conduit
3. Damaged surfaces on metal conduit

Do not remove shop-installed conduit couplings.

Damaged Type 2 conduit or conduit coupling must be wrapped with at least 1 layer of 2 inch wide, 20 mil minimum thickness PVC tape, as specified in ASTM D 1000, with a minimum tape overlap of 1/2 inch. Before applying the tape, conduit or fitting must be cleaned and painted with 1 coat of rubber-resin based adhesive as recommended by the tape manufacturer. You may repair damaged spots in the thermoplastic coating by painting over with a brushing type compound supplied by the conduit manufacturer instead of the tape wrap.

The ends of Types 1, 2, or 5 conduit must be threaded and capped with standard pipe caps until wiring is started. The ends of Types 3 and 4 conduit must be capped until wiring is started. If caps are removed, replace with conduit bushings. Fit insulated bonding bushings on the end of metal conduit ending in pull box or foundation. Bell or end bushings for Type 3 conduit must be non-metallic type.

Conduit bends, except factory bends, must have a radius of not less than 6 times the inside diameter of the conduit. If factory bends are not used, bend the conduit without crimping or flattening using the longest radius practicable. Bend conduits as follows:

Conduit-Bending Requirements

Type 1	By methods recommended by the conduit manufacturer and with equipment approved for the purpose.
Type 2	Use standard bending tool designed for use on thermoplastic coated conduit. Conduit must be free of burrs and pits.
Type 3	By methods recommended by the conduit manufacturer and with equipment approved for the purpose. Do not expose conduit to direct flame.
Type 4	--
Type 5	By methods recommended by the conduit manufacturer and with equipment approved for the purpose.

Install pull tape in conduit that is to receive future conductors. The pull tape must be a flat woven lubricated soft-fiber polyester tape with a minimum tensile strength of 1,800 pounds and have printed sequential measurement markings every 3 feet. At least 2 feet of pull tape must be doubled back into the conduit at each end.

Existing underground conduit to be incorporated into a new system must be cleaned with a mandrel or cylindrical wire brush and blown out with compressed air.

Install conduit to a depth of not less than 30 inches below finished grade, except in sidewalk and curbed paved median areas, where it must be at least 18 inches below grade. You may lay conduit on existing pavement within new curbed median.

Conduit coupling must be a minimum of 6 inches from face of foundation.

Place a minimum of 2 inches of sand bedding in the trench before installing Type 2 or Type 3 conduit. Place a minimum of 4 inches of same material over conduit before placing additional backfill material.

Obtain approval from the Engineer before disturbing pavement. If obstruction is encountered, obtain approval from Engineer to cut small holes in the pavement to locate or remove obstruction If jacking or drilling method is used, keep jacking or drilling pit 2 feet away from edge of pavement. Pavement must not be weakened or subgrade softened from excess water use.

Conduit used for drilling or jacking must be removed; install new conduit for completed work. If a hole larger than the conduit is pre-drilled and you install conduit by hand or by method recommended by the conduit manufacturer with equipment approved for purpose, you may install Type 2 or Type 3 conduit under pavement.

If trenching in pavement method is specified, conduit installation under pavement that is not a freeway lane or freeway to freeway connector ramp, must comply with the following:

1. Use Type 3 conduit. Place conduit under pavement in a trench approximately 2 inches wider than the outside diameter of conduit, but not exceeding 6 inches in width. Trench depth must not exceed the greater of 12 inches or conduit trade size plus 10 inches, except that at pull boxes the trench may be hand dug to required depth. The top of the installed conduit must be a minimum of 9 inches below finished grade.
2. Trenching installation must be completed before placing final pavement layer.
3. Cut pavement to be removed with a rock cutting excavator. Minimize shatter outside the removal area.
4. Place conduit in bottom of trench and backfill with minor concrete as specified in Section 90-10, "Minor Concrete.". Minor concrete must contain a minimum of 590 pounds of cementitious material per cubic yard. If the trench is in asphalt concrete pavement and pavement overlay is not placed, backfill the top 1-3/4-inch of trench with minor HMA.
5. Before spreading HMA, apply tack coat as specified in Section 39, "Hot Mix Apshalt."
6. Backfill trenches, except for the top 0.10 foot, by the end of each day. The top 0.10 foot must be filled within 3 days after trenching.

Conduit installed beneath railroad tracks must be:

1. Type 1 or 2
2. 1-1/2-inch minimum diameter
3. Placed a minimum depth of 3 feet below bottom of tie

If jacking or drilling method is used, construct jacking pit to a minimum of 13 feet from the centerline of track at the near side of jacking pit. Cover jacking pit with substantial planking if left overnight.

Conduit ending in standard or pedestal must not extend more than 3 inches vertically above the foundation and must be sloped toward the handhole opening. Conduit entering through the side of non-metallic pull box must end inside the box within 2 inches of the wall and 2 inches above the bottom and be sloped toward the top of box to facilitate pulling of conductors. Conduit entering through the bottom of a pull box must end 2 inches above the bottom and be located near the end walls to leave the major portion of the box clear. At outlet, conduit must enter from the direction of the run.

Underground conduit runs, including under sidewalks, that are adjacent to gasoline service stations or other underground gasoline or diesel storage, piping, or pumps and that lead to a controller cabinet, circuit breaker panel, service, or enclosure where an arc may occur during normal operations must be sealed if the conduit is within the limits specified in the NEC for Class 1, Division 1. Use Type 1 or Type 2 conduit for these runs.

Conduit for future use in structures must be threaded and capped. Conduit leading to soffit, wall, or other lights or fixtures below pull box grade must be sealed and made watertight, except where conduit ends in a No. 9 or No. 9A pull box.

Support for conduit in or on wall or bridge superstructure must comply with the following:

1. Steel hangers, steel brackets, and other fittings must comply with Section 75-1.03, "Miscellaneous Bridge Metal."
2. Construct precast concrete conduit cradles using minor concrete and commercial quality welded wire fabric. Minor concrete must comply with Section 90-10, "Minor Concrete," and contain a minimum of 590 pounds of cementitious material per cubic yard.. The cradles must be moist cured for a minimum of 3 days. Bond precast concrete cradles to structure with epoxy adhesives specified in one of the following:

    2.1. Section 95-2.03, "Epoxy Resin Adhesive for Bonding New Concrete to Old Concrete"
    2.2. Section 95-2.04, "Rapid Set Epoxy Adhesive for Pavement Markers"
    2.3. Section 95-2.05, "Standard Set Epoxy Adhesive for Pavement Markers"

3. Use pipe sleeve or form opening for conduit through bridge superstructure concrete. Sleeve or opening through either prestressed member or conventionally reinforced precast member must be:

    3.1. Transverse to the member
    3.2. Through the web
    3.3. Not more than 3 inches maximum gross opening in concrete

4. Where conduits pass through the abutment concrete, wrap conduit with 2 layers of asphalt-felt building paper securely taped or wired in place. Fill space around conduit that runs through bridge abutment wall with mortar as specified in Section 51-1.135, "Mortar," except the proportion of cementitious material to sand must be 1 to 3. Fill the space around conduits that run through abutments after prestressing is completed.

5. Run surface-mounted conduit straight and true, horizontal or vertical on the wall, and parallel to wall on ceiling or other similar surfaces. Support conduit at a maximum of 5-foot intervals or closer where necessary to prevent vibration or unsightly deflection. The supports must include galvanized malleable iron conduit clamps and clamp backs secured with expansion anchorage devices as specified for concrete anchorage devices in Section 75-1.03, "Miscellaneous Bridge Metal." Threaded studs must be galvanized and be of the largest diameter that will pass through the mounting hole in conduit clamp.
6. Where pull boxes are placed in conduit runs, conduit must be fitted with threaded bushings and bonded.
7. Mark location of conduit end in structure, curb, or wall with a "Y" that is a minimum of 3 inches tall, directly above conduit.

86-2.05D Expansion Fittings

Install expansion fitting where the conduit crosses an expansion joint in structure. Each expansion fitting for metal conduit must include a copper bonding jumper having the ampacity specified in NEC.

Each expansion-deflection fitting for expansion joints of 1-1/2-inch movement rating must be watertight and include a molded neoprene sleeve, a bonding jumper, and 2 silicon bronze or zinc-plated iron hubs. Each fitting must allow a minimum of 3/4-inch expansion, contraction, and lateral deflection.

86-2.06 PULL BOXES

You may use a larger standard size pull box than that shown on the plans or specified. Pull box, cover, and extensions must be of the same material.

86-2.06A Materials

Pull box, cover, and extension for installation in ground or sidewalk area must be precast reinforced PCC or non-PCC material. Non-PCC material must:

1. Be fire resistant with a burn rate no greater than 0.3-inch per minute per 0.1 inch of thickness when tested as specified in ASTM D 635
2. Show no significant change in physical properties with exposure to weather
3. Be dense, free of voids or porosity, and gray or brown in color

Non-PCC pull box must comply with the following:

1. Top dimensions must not exceed the bottom dimensions by more than 1 inch.
2. Extension must be attached to pull box to maintain the minimum combined depths.
3. Cover must not fail and must not deflect more than 1/4 inch when a vertical force of 1,500 pounds is applied through a 1/2" x 3" x 6" steel plate to a non-PCC cover on a pull box. Center the steel plate on cover with its longitudinal axis coinciding with longitudinal axis of cover.

Non-PCC pull boxes must be of sufficient rigidity that when a designated concentrated force is applied perpendicularly to the midpoint of one of the long sides at the top while the opposite long side is supported by a rigid surface, it must be possible to remove the cover without the use of tools. The designated concentrated force must be 150 pounds for a No. 3-1/2 pull box and must be 100 pounds for a No. 5 or No. 6 pull box.

If a transformer or other device must be placed in a non-metallic pull box, include recesses for hanger.

Secure cover, except ceiling pull box cover, with 3/8-inch hold down bolts, cap screws, or studs, washers, and brass stainless steel or other non-corroding-metal nut. Stainless steel hardware must have an 18 percent or greater chromium content and an 8 percent or greater nickel content.

Galvanize ferrous metal parts as specified in Section 75-1.05, "Galvanizing."

Traffic pull box must be provided with steel cover and special concrete footing. Steel cover must have a embossed non-skid pattern.

Traffic pull box and cover must have a vertical proof-load strength of 25,000 pounds. Comply with Federal Specification RR-F-621 and distribute the 25,000 pound load through a 9" x 9" x 2" steel plate. You must be able to place the load anywhere on box and cover for 1 minute without causing cracks or permanent deformations.

No. 3-1/2(T) and No. 5(T) traffic pull box must be reinforced with a galvanized Z bar welded frame and cover similar to that shown on the plans for No. 6(T) pull box. Frame must be anchored to box with 1/4" x 2-1/4" concrete anchors. Four concrete anchors must be included for No. 3-1/2(T) pull box; one placed in each corner. Six concrete anchors for must be included for No. 5(T) and No. 6(T) pull boxes; one placed in each corner and one near the middle of each of the longer sides.

Hold down screws must be 3/8 inch hex flange cap screws of Type 316 stainless steel. Nut must be zinc plated carbon steel, vibration resistant, and have a wedge ramp at the root of the thread. Nut must be spot welded to the underside or manufactured with galvanized Z bar pull box frame.

Steel cover must be countersunk approximately 1/4 inch to accommodate bolt head. When tightened, bolt head must not exceed more than 1/8 inch above the top of cover. A 1/4 inch tapped hole and brass bonding screw must be included.

Concrete placed around and under traffic pull box must be minor concrete as specified in Section 90-10, "Minor Concrete."

86-2.06B Cover Marking

Marking must be clearly defined, uniform in depth, and parallel to either the long or short sides of cover.

Marking letters must be between 1 inch to 3 inch high.

Before galvanizing steel or cast iron cover, apply marking by one of the following methods:

1. Use cast iron strip at least 1/4-inch thick with letters raised a minimum of 1/16 inch. Fasten strip to cover with 1/4 inch flathead stainless steel machine bolts and nuts. Peen bolts after tightening.
2. Use sheet steel strip at least 0.027-inch thick with letters raised a minimum of 1/16 inch. Fasten strip to cover by spot welding, tack welding, or brazing, with 1/4 inch stainless steel rivets or 1/4 inch roundhead stainless steel machine bolts and nuts. Peen bolts after tightening.
3. Bead weld the letters on cover so that letters are raised a minimum of 3/32 inch.

86-2.06C Installation and Use

Space pull boxes no more than 200 feet apart. You may install additional pull boxes to facilitate the work.

Pull box in ground or sidewalk area must be installed as follows:

1. Embed bottom of pull box in crushed rock.
2. Place a layer of roofing paper on crushed rock.
3. Place mortar over layer of roofing paper. Mortar must be 0.50 inch to 1 inch thick and be sloped toward the drain hole.
4. Make a 1-inch drain hole in center of pull box through mortar and roofing paper.
5. Place mortar between pull box and pull box extension, and around conduits.

Reconstruct sump of existing pull box if disturbed by your operations. Remove old grout and replace with new if the sump was grouted.

After installation of traffic pull box, install steel cover and keep bolted down when your activities are not in progress at the pull box. When steel cover is placed for final time, cover and Z bar frame must be cleaned of debris and securely tightened.

86-2.07 (BLANK)

86-2.08 CONDUCTORS AND CABLES

Conductor must be copper wire that complies with ASTM B 3 and B 8.

Wire size must comply with the following:

Wire Size Requirements

Conductor usage	Requirement
In loop detector lead-in cable	ASTM B 286
Everywhere except in loop detector lead-in cable	American Wire Gage (AWG)[a]

[a]Except conductor diameter must not be less than 98 percent of specified AWG diameter.

Single conductor and cable, except detector lead-in cable, must have clear, distinctive, and permanent markings on the outer surface throughout its length. The markings must include the manufacturer's name or trademark, insulation type letter designation, conductor size, voltage, and temperature rating, and for cables, it must also include number of conductors.

86-2.08A Conductor Identification

Conductor insulation must be a solid color with a permanent stripe as specified below. The solid color must be homogeneous through the full depth of insulation. Identification stripe must be continuous throughout the length of conductor. For conductor sizes No. 2 and larger, the insulation may be black and the ends of the conductors must be taped for a minimum length of 20 inches with electrical insulating tape of the required color.

Conductor Identification

Circuit	Signal Phase or Function	Identification			Size
		Insulation Color[j]		Band Symbols[f]	
		Base	Stripe[a]		
Vehicle Signals[a,b,d]	2,6	Red, Yel, Brn	Blk	2,6	14
	4,8	Red, Yel, Brn	Ora	4,8	14
	1,5	Red, Yel, Brn	None	1,5	14
	3,7	Red, Yel, Brn	Pur	3,7	14
	Ramp Meter 1	Red, Yel, Brn	None	NBR	14
	Ramp Meter 2	Red, Yel, Brn	Blk	NBR	14
Pedestrian Signals[d]	2p,6p	Red, Brn	Blk	2p,6p	14
	4p,8p	Red, Brn	Ora	4p,8p	14
	1p,5p	Red, Brn	None	1p,5p	14
	3p,7p	Red, Brn	Pur	3p,7p	14
Pedestrian Push Buttons[d]	2p,6p	Blu	Blk	P-2,P-6	14
	4p,8p	Blu	Ora	P-4,P-8	14
	1p,5p	Blu	None	P-1,P-5	14
	3p,7p	Blu	Pur	P-3,P-7	14
Traffic Signal Controller Cabinet	Ungrounded Circuit Conductor	Blk	None	CON-1	6
	Grounded Circuit Conductor	Wht	None	CON-2	6
Highway Lighting Pull Box to Luminaire	Ungrounded-Line 1	Blk	None	NBR	14
	Ungrounded-Line 2	Red	None	NBR	14
	Grounded	Wht	None	NBR	14
Multiple Highway Lighting	Ungrounded-Line 1	Blk	None	ML1	10
	Ungrounded-Line 2	Red	None	ML2	10
Lighting Control	Ungrounded to PEU	Blk	None	C1	14
	Switching leg from PEU unit or SM transformer	Red	None	C2	14
Multiple Service	Ungrounded-Line 1 (Signals)	Blk	None	NBR[e]	6
	Ungrounded-Line 2 (Lighting)	Red[i]	None	NBR[e]	8
Sign Lighting[h]	Ungrounded-Line 1	Blk	None	SL-1	10
	Ungrounded-Line 2	Red	None	SL-2	10
Flashing Beacons[g]	Ungrounded between Flasher and Beacons	Red or Yel	None	F-Loc.[c]	14
Grounded and Common	Pedestrian Push Buttons	Wht	Blk	NBR	14
	Signals and Multiple Lighting	Wht	None	NBR	10
	Flashing Beacons and Sign Lighting	Wht	None	NBR	12
	Lighting Control	Wht	None	C-3	14
	Multiple Service	Wht	None	NBR	14
Railroad Preemption		Blk	None	R	14
Spares		Blk	None	NBR	14

NBR = No Band Required PEU=Photoelectric unit
[a]On overlaps, insulation is striped for 1st phase in designation. e.g., phase (2+3) conductor is striped as for phase 2.
[b]Band for overlap and special phases as required.
[c]Flashing beacons having separate service do not require banding.
[d]These requirements do not apply to signal cable.
[e]"S" if circuit is switched on line side of service equipment by utility.
[f]Band conductors in each pull box and near ends of termination points. On signal light circuits, a single band may be placed around 2 or 3 ungrounded conductors comprising a phase.
[g]Ungrounded conductors between service switch and flasher mechanism must be black and banded.
[h]Conductors between ballasts and sign lighting lamps must be No. 16 and color must correspond to the ballast leads.
[i]Black acceptable for size No. 2 and larger. Tape ends for 20 inches with indicated color.
[j]Color Code: Yel-Yellow, Brn-Brown, Blu-Blue, Blk-Black, Wht-White, Ora-Orange, Pur-Purple.

86-2.08B Multiple Circuit Conductors

Conductor for multiple circuit must be UL or ETL listed and rated for 600 V(ac) operation. Insulation for No. 14 to No. 4 conductors must be one of the following:

1. Type TW PVC as specified in ASTM D 2219
2. Type THW PVC
3. Type USE, RHH, or RHW cross-linked polyethylene

Minimum insulation thickness must comply with the following:

Insulation Thickness

Insulation Type	Conductor Size	Insulation Thickness (mils)
USE, RHH, or RHW	No. 14 to No. 10	39
	No. 8 to No. 2	51
THW or TW	No. 14 to No. 10	27
	No. 8	40
	No. 6 to No. 2	54

Insulation for No. 2 and larger conductor must be one of the types listed above or Type THWN.

Conductor for wiring wall and soffit luminaire must be stranded copper with insulation rated for use at temperatures up to 125 °C.

86-2.08C Signal Cable

Signal cable, except for the 28-conductor type, must:

1. Not be spliced
2. Be marked in each pull box with the signal standard information it is connecting to

Signal cable must comply with the following:

1. Cable jacket must be:

    1.1. Black polyethylene with an inner polyester binder sheath
    1.2. Rated for 600 V(ac) and 75 °C

2. Filler material, if used, must be polyethylene material.
3. Conductor must be solid copper with Type THWN insulation as specified in Section 86-2.08, "Conductors and Cables," and ASTM B 286. The minimum thickness of Type THWN insulation must be 12 mils for conductor sizes No. 14 to No. 12 and 16 mils for conductor size No. 10. The minimum thickness of nylon jacket must be 4 mils.

Conductor Signal Cable Requirements

Cable Type[a]	Conductor Quantity and Type	Cable Jacket Thickness (mils) Average	Cable Jacket Thickness (mils) Minimum	Maximum Nominal Outside Diameter (inch)	Conductor Color Code	Remarks
3CSC	3 - No. 14	44	36	0.40	blue/black, blue/orange, white/black stripe	Use for pedestrian push buttons and spare
5CSC	5 - No. 14	44	36	0.50	red, yellow, brown, black, white	
9CSC	8 - No. 14 1 - No. 12	60	48	0.65	No. 12 - white No. 14 - red, yellow, brown, black, and red/black, yellow/black, brown/black, white/black stripe	
12CSC	11 - No. 14 1 - No. 12	60	48	0.80	No. 12 - white No. 14 - see "12CSC Color Code and Functional Connection" table	Use for vehicle signals, pedestrian signals, spares, and signal common
28CSC	27 - No. 14 1 - No. 10	80	64	0.90	No. 10 - white No. 14 - see "28CSC Color Code and Functional Connection" table	Keep signal commons in each cable separate except at the signal controller. Label each cable as "C1" or "C2" in pull box. Use "C1" for signal phases 1, 2, 3, and 4. Use "C2" for phases 5, 6, 7, and 8.

[a]Conductor signal cable description starts with the number of conductors, followed by "CSC".
(e.g., a signal cable with 3 conductors is labeled "3CSC.")

12CSC Color Code and Functional Connection

Color Code	Termination	Phase
Red	Vehicle signal red	2, 4, 6, or 8
Yellow	Vehicle signal yellow	2, 4, 6, or 8
Brown	Vehicle signal green	2, 4, 6, or 8
Red/black stripe	Vehicle signal red	1, 3, 5, or 7
Yellow/black stripe	Vehicle signal yellow	1, 3, 5, or 7
Brown/black stripe	Vehicle signal green	1, 3, 5, or 7
Black/red stripe	Spare, or use as required for red or DONT WALK	
Black/white stripe	Spare, or use as required for yellow	
Black	Spare, or use as required for green or WALK	
Red/white stripe	Ped signal DONT WALK	
Brown/white stripe	Ped signal WALK	

28CSC Color Code and Functional Connection

Color Code	Termination	Phase
Red/black stripe	Vehicle signal red	2 or 6
Yellow/black stripe	Vehicle signal yellow	2 or 6
Brown/black stripe	Vehicle signal green	2 or 6
Red/orange stripe	Vehicle signal red	4 or 8
Yellow/orange stripe	Vehicle signal yellow	4 or 8
Brown/orange stripe	Vehicle signal green	4 or 8
Red/silver stripe	Vehicle signal red	1 or 5
Yellow/silver stripe	Vehicle signal yellow	1 or 5
Brown/silver stripe	Vehicle signal green	1 or 5
Red/purple stripe	Vehicle signal red	3 or 7
Yellow/purple stripe	Vehicle signal yellow	3 or 7
Brown/purple stripe	Vehicle signal green	3 or 7
Red/2 black stripes	Ped signal DONT WALK	2 or 6
Brown/2 black stripes	Ped signal WALK	2 or 6
Red/2 orange stripes	Ped signal DONT WALK	4 or 8
Brown/2 orange stripes	Ped signal WALK	4 or 8
Red/2 silver stripes	Overlap A, C red	OLA, OLC
Brown/2 silver stripes	Overlap A, C green	OLA, OLC
Red/2 purple stripes	Overlap B, D red	OLB, OLD
Brown/2 purple stripes	Overlap B, D green	OLB, OLD
Blue/black stripe	Ped push button	2 or 6
Blue/orange stripe	Ped push button	4 or 8
Blue/silver stripe	Overlap A, C yellow	OLA(y), OLC(y)
Blue/purple stripe	Overlap B, D yellow	OLB(y), OLD(y)
White/black stripe	Ped push button common	
Black/red stripe	Railroad preemption	
Black	Spare	

86-2.08D Signal Interconnect Cable (SIC)

Signal interconnect cable must be a 3-pair or 6-pair type with stranded tinned copper No. 20 conductors. Each conductor insulation must be 13 mils minimum nominal thickness, color-coded, polypropylene material. Conductors must be in twisted pairs. Color coding distinguishes each pair. Each pair must be wrapped with an aluminum polyester shield and must have a No. 22 or larger stranded tinned copper drain wire inside the shielded pair.

Cable jacket must be black, high density polyethylene, rated for a minimum of 300 V(ac) and 60 °C, and must have a minimum nominal wall thickness of 40 mils. Cable jacket or moisture-resistant tape directly under the outer jacket must be marked as specified in Section 86-2.08.

You must have a minimum of 6 feet of slack at each controller cabinet. Splicing is allowed only if shown on the plans.

Insulate conductor splice with heat-shrink tubing and overlap at least 0.6 inch. Cover overall cable splice with heat-shrink tubing and overlap the cable jacket at least 1-1/2 inch.

86-2.09 WIRING

Run conductors in conduit, except for overhead and temporary installations and where conductors are run inside poles.

Solder by hot iron, pouring, or dipping method, connectors and terminal lugs for conductor sizes No. 8 and smaller. Do not perform open-flame soldering.

86-2.09A Circuitry

Do not run traffic signal indication conductors to a terminal block on a standard unless connected to a mounted signal head.

Use only 1 conductor to connect to each terminal of a pedestrian push button.

The common for pedestrian push button circuit must be separate from traffic signal circuit grounded conductor.

86-2.09B Installation

Use a UL- or ETL-listed inert lubricant for placing conductors in conduit.

Pull conductors into conduit by hand using pull tape specified in Section 86-2.05C, "Installation." Do not use winches or other power-actuated pulling equipment.

If adding new conductors or removing existing conductors, remove all conductors, clean conduit as specified in Section 86-2.05C, "Installation," and pull all conductors in conduit as 1 unit.

If traffic signal conductors are run in lighting standard containing street lighting conductors from a different service point, you must encase the traffic signal conductors or the lighting conductors with a flexible or rigid metal conduit for a length until the 2 types of conductors are no longer in the same raceway.

If less than 10 feet above grade, enclose temporary conductors in flexible or rigid metal conduit.

Leave slack for each conductor as follows:

Conductor Slack Requirements

Location	Slack (feet)
Signal standard	1
Lighting standard	1
Signal and lighting standard	1
Pull box	3
Splice	3
Standards with slip base	0

After conductors are installed, seal ends of conduits with an approved sealing compound.

To form a watertight seal, tape ends of spare conductors and conductors ending in pull boxes.

Conductors and cables inside fixture or cabinet must be neatly arranged and tied together by function with self-clinching nylon cable ties or enclosed in plastic tubing or raceway.

Identify conductors for:

1. Signal overlap phase as specified for vehicle signals in the table titled "Conductor Identification."
2. Metered and unmetered conductors occupying the same pull box. Identify unmetered circuit conductors with "UNMETERED-STREET LTG," or "UNMETERED-COUNT STATION."

Permanently identify conductors by function. Place identification on each conductor, or each group of conductors forming a signal phase, at each pull box and near the end of conductors.

Label, tag, or band conductors by mechanical methods. Identification must not move along the conductors.

86-2.09C Connectors and Terminals

Connectors and terminals must be UL- or ETL-listed crimp type. Use manufacturer-recommended tool for connectors and terminals to join conductors. Comply with MIL-T-7928.

Terminate stranded conductors smaller than No. 14 in crimp style terminal lugs.

86-2.09D Splicing and Terminations

Splices are allowed for:

1. Grounded conductors in pull box.
2. Pedestrian push button conductors in pull box.
3. Conductors in pull box adjacent to each electrolier or luminaire.
4. Ungrounded traffic signal conductors in pull box, if traffic signals are modified.
5. Ungrounded traffic signal conductors to a terminal compartment or signal head on a standard with conductors of the same phase in the pull box adjacent to the standard.
6. Ungrounded lighting circuit conductors in pull box, if lighting circuits are modified.

86-2.09E Splice Insulation

Splice must function under continuous submersion in water.

Multi-conductor cable must be spliced and insulated to form a watertight joint and to prevent moisture absorption by the cable.

Low-voltage tape must be:

1. UL or ETL listed
2. Self-fusing, oil and flame-resistant, synthetic rubber
3. PVC, pressure-sensitive adhesive of 6 mils minimum thickness

Insulating pad must be a combination of an 80-mils thick electrical grade PVC laminate and a 120-mils thick butyl splicing compound with removable liner.

Heat-shrink tubing must comply with the following:

1. Be medium or heavy wall thickness, irradiated polyolefin tubing with an adhesive mastic inner wall.
2. Before contraction, minimum wall thickness must be 40 mils.
3. Heating must be as recommended by the manufacturer. Do not perform open-flame heating.
4. When heated, the inner wall must melt and fill crevices and interstices of the covered object and the outer wall must shrink to form a waterproof insulation.
5. After contraction, each end of the heat-shrink tubing or the open end of end cap of heat-shrink tubing must overlap the conductor insulation at least 1-1/2 inches. Coat ends and seams with electrical insulation coating.
6. Comply with requirements for extruded insulated tubing at 600 V(ac) in UL Standard 468D and ANSI C119.1, and the following requirements:

Heat-Shrink Tubing Requirements

Shrinkage Ratio	33 percent, maximum, of supplied diameter when heated to 125 °C and allowed to cool to 25 °C
Dielectric Strength	350 kV per inch, minimum
Resistivity	25^{13} Ω per inch, minimum
Tensile Strength	2,000 psi, minimum
Operating Temperature	-40 °C to 90 °C (135 °C in emergency)
Water Absorption	0.5 percent, maximum

7. If 3 or more conductors are to be enclosed in 1 splice, place mastic around each conductor before placing inside tubing. Use mastic type recommended by heat-shrink tubing manufacturer.

You may use "Method B" as an alternative method for splice insulation. Use at least 2 thicknesses of electrical insulating pad. Apply pad to splice as recommended by manufacturer.

86-2.095 FUSED SPLICE CONNECTORS

Install a fused disconnect splice connector in each ungrounded conductor, between the line and the ballast, in the pull box adjacent to each luminaire. Connector must be accessible in the pull box.

For 240 and 480 V(ac) circuits, each connector must simultaneously disconnect both ungrounded conductors. Connector must not have exposed metal parts, except for the head of stainless steel assembly screw. Recess head of stainless steel assembly screw a minimum of 1/32 inch below top of plastic boss that surrounds the head.

Splice connector must protect fuse from water or weather damage. Contact between fuse and fuseholder must be spring loaded. Splice connector terminals must be:

1. Rigidly crimped, using a tool recommended by manufacturer of fused splice connector, onto ungrounded conductors
2. Insulated
3. Watertight

Fuses must be standard midget ferrule type, with "Non-Time-Delay" feature, and 13/32" x 1-1/2".

86-2.10 BONDING AND GROUNDING

Secure all metallic components, mechanically and electrically, to form a continuous system that is effectively grounded.

Bonding jumper must be copper wire or copper braid of the same cross sectional area as a No. 8 or larger to match the load. Equipment grounding conductors must be color coded as specified in NEC or be bare.

Attach bonding jumper to standard as follows:

Bonding Jumper Attachment

Standard type	Requirements
Standard with handhole and traffic pull box lid cover	Use UL-listed lug and 3/16-inch diameter or larger brass or bronze bolt. Run jumper to conduit or bonding wire in adjacent pull box. Grounding jumper must be visible after the standard is installed and mortar pad is placed on foundation.
Standard without handhole	Use UL-listed ground clamp on each anchor bolt.
Slip-base standard	Use UL-listed ground clamp on each anchor bolt or attach UL-listed lug to bottom slip-base plate with 3/16-inch diameter or larger brass or bronze bolt.

Ground one side of secondary circuit of step-down transformer.

Ground metal conduit, service equipment, and grounded conductor at service point as specified by NEC and service utility, except grounding electrode conductor must be No. 6 or larger.

Equipment bonding and grounding conductors are required in conduit. Run a No. 8 minimum bare copper wire continuously in conduit system. The bonding wire must be sized as specified in the NEC.

Ground electrode must be:

1. 1 piece
2. 10-foot minimum length of one of the following:

    2.1. Galvanized steel rod or pipe not less than 3/4 inch in diameter
    2.2. Copper clad steel rod not less than 5/8 inch in diameter

3. Installed as specified in NEC
4. Bonded to service equipment using one of the following:

    4.1. Ground clamp
    4.2. Exothermic weld
    4.3. No. 6 or larger copper conductor

On wood pole, metallic equipment mounted less than 8 feet above ground surface must be grounded.

Bond metallic conduit in non-metallic pull box using bonding bushing or bonding jumper.

Bond metallic conduit in metal pull box using bonding bushings and bonding jumpers connected to bonding wire running in the conduit system.

86-2.11 SERVICE

Electrical service installation and materials must comply with service utility requirements.

If service equipment is to be installed on utility-owned pole, you must furnish and install conduit, conductors, and other necessary material to complete service installation. Service utility will decide riser and equipment position.

Install service equipment early on to allow service utility to schedule its work before project completion.

Furnish each service with a circuit breaker that simultaneously disconnects all ungrounded service entrance conductors.

Circuit breakers must:

1. Be quick-break on either automatic or manual operation.
2. Have operating mechanism that is enclosed and trip-free from operating handle on overload.
3. Be trip indicating.
4. Have frame size plainly marked.
5. Have trip rating clearly marked on operating handle.
6. Have overload tripping of breakers not influenced by ambient temperature range of -18 °C to 50 °C.
7. Be internal trip type.
8. Be UL or ETL listed and comply with UL 489 or equal.
9. Have minimum interrupting capacity of 10,000 A, rms, if used as service disconnect.

Service equipment enclosure must be a NEMA 3R enclosure with dead-front panel and a hasp with a 7/16-inch hole for a padlock. Enclosure must be field marked as specified in the NEC to warn qualified persons of potential electric arc flash hazards.

Service equipment enclosure, except Types II and III, must be galvanized or have a factory-applied rust-resistant prime coat and finish coat.

Types II and III service equipment enclosures must be manufactured from one of the following:

1. Galvanized sheet steel
2. Sheet steel plated with zinc or cadmium after manufacturing
3. Aluminum

Manufacture service equipment enclosure as specified in Section 86-3.04A, "Cabinet Construction." Overlapping exterior seams and doors must comply with requirements for NEMA 3R enclosures in the NEMA Enclosure Standards.

If an alternative design is proposed for Type II or III service equipment enclosure, submit plans and shop drawings to the Engineer for approval before manufacturing.

Except for falsework lighting and power for your activities, when you submit a written request, the Engineer will arrange:

1. With the service utility to complete service connections for permanent installations and the Department will pay all costs and fees required by the service utility. Submit request at least 15 days before service connections are required.
2. For furnishing electrical energy. Energy used before contract completion will be charged to you, except cost of energy used for public benefit as ordered by the Engineer will be paid by the Department or local authorities.

Full compensation for furnishing and installing State-owned or permanent service poles, service equipment, conduit, conductors, and pull boxes, including equipment, conduit, and conductors placed on utility-owned poles, is included in the contract item of electrical work involved and no additional compensation will be allowed therefor.

If the service point is indeterminate and is shown on the plans as "approximate location" or "service point not yet established," the labor and materials required for making the connection between the service point, when established, and the nearest pull box shown on the plans will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

86-2.12 WOOD POLES

Wood poles must comply with the following:

1. Class 5 or larger as specified in ANSI O 5.1
2. Less than 180-degree twist in grain over the full length
3. 4-inch or less sweep
4. Beveled top
5. Placed in ground at least 6 feet
6. Length must be:

    6.1. 25 feet for service pole
    6.2. 35 feet for other

After each pole is set in ground, backfill space around pole with selected earth or sand, free of rocks and other deleterious material, placed in 4-inch thick layers. Moisten each layer and thoroughly compact.

Manufacture mast arm from standard pipe, free from burrs. Each mast arm must have an insulated wire inlet and wood pole mounting brackets for mast arm and tie-rod cross arm. Manufacture tie rod from structural steel and pipe.

Mount mast arm for luminaire to provide a 34-foot mounting height for a 200 W high pressure sodium luminaire and 40-foot mounting height for 310 W high pressure sodium luminaire. Traffic signals and flashing beacons on mast arm must provide a minimum vertical clearance of 17 feet from bottom of equipment to pavement.

After manufacturing, pressure-treat pole as specified in Section 58, "Preservative Treatment of Lumber, Timber and Piling," and AWPA Use Category System: UC4B, Commodity Specification D.

If specified, treat pole with waterborne wood preservative.

86-2.13 LIGHTING AND SIGN ILLUMINATION CONTROL

Enclosure for the circuit breaker for lighting and sign illumination control must:

1. Be NEMA 3R
2. Be galvanized, cadmium plated, or powder-coated
3. Include dead front panel and a hasp with a 7/16 inch diameter hole for padlock

86-2.14 TESTING

86-2.14A Materials Testing

Deliver material and equipment to be tested to either the Transportation Laboratory or a testing location ordered by the Engineer.

Allow 30 days for acceptance testing from the time material or equipment is delivered to test site. You must pay for all shipping, handling, and related transportation costs associated with testing. If equipment is rejected, you must allow 30 days for retesting. Retesting period starts when corrected equipment is delivered to test site. You must pay for all retesting costs. Delays resulting from submittal of non-compliant materials do not relieve you from executing the contract within the allotted time.

If equipment submitted for testing does not comply with specifications, remove the equipment within 5 business days after notification that the equipment is rejected. If equipment is not removed within that period, it may be shipped to you at your expense.

When testing is complete, you will be notified. You must pick up the equipment at the test site and deliver it to the job site.

Testing and quality control procedures for all other traffic signal controller assemblies must comply with NEMA TS Standards for Traffic Control Systems.

86-2.14B Field Testing

Before starting functional testing, perform the following tests in the presence of the Engineer:

86-2.14B(1) Continuity

Test each circuit for continuity.

86-2.14B(2) Ground

Test each circuit for grounds.

86-2.14B(3) Insulation Resistance

Perform insulation resistance test at 500 V(dc) on each circuit between the circuit and a ground. Insulation resistance must be 10 MΩ minimum on all circuits, except for inductive loop detector circuits that must have an insulation resistance value at least 100 MΩ.

86-2.14C Functional Testing

Test periods must comply with Section 86-1.07, "Scheduling of Work."

Acceptance of new or modified traffic signal will be made only after all traffic signal circuits have been thoroughly tested.

Perform functional test to show that each part of the system functions as specified.

Functional test for each new or modified system must include at least 5 business days of continuous, satisfactory operation. If unsatisfactory performance of the system occurs, the condition must be corrected and the system retested until the 5 business days of continuous, satisfactory operation is obtained.

Except for new or modified parts of existing lighting circuit and sign illumination system, the State or local agency will maintain the system during test period and pay the electrical energy cost. Except for electrical energy, you must pay the cost of necessary maintenance performed by the State or local agency on new circuits or on the portions of existing circuits modified under the contract.

Shutdown of electrical system caused by traffic from a power interruption or from unsatisfactory performance of State-furnished materials does not constitute discontinuity of the functional test.

86-2.15 GALVANIZING

Galvanize as specified in Section 75-1.05, "Galvanizing." Cabinet material may be galvanized before manufacturing as specified in ASTM A 653/653M, Coating Designation G 90.

Steel pipe standard and pipe mast arm must be hot-dip galvanized after manufacturing and must comply with Section 75-1.05, "Galvanizing." . Remove spikes from galvanized surfaces.

A minimum of 10 inches of upper end of anchor bolts, anchor bars or studs, and nuts and washers must be galvanized as specified in Section 75-1.05, "Galvanizing."

After galvanizing, bolt threads must accept galvanized standard nuts without requiring tools or causing removal of protective coatings.

Galvanizing existing materials in an electrical installation will not be required.

86-2.16 PAINTING

Paint electrical equipment and material as specified in Section 59, "Painting," and the following:

1. Use paint material specified in Section 91, "Paint."
2. Factory or shop cleaning methods for metals are acceptable if equal to the methods specified.
3. Instead of temperature and seasonal restrictions for painting as specified in Section 59, "Painting," paint may be applied to equipment and materials for electrical installations if ordered by the Engineer.
4. Ungalvanized ferrous surface to be painted must be cleaned before applying prime coat. Blast cleaning is not required.
5. If an approved prime coat is applied by manufacturer, and in good condition, the 1st primer application is not required.
6. Existing equipment to be painted in the field, including State-furnished equipment, must be washed with a stiff bristle brush using a solution of water containing 2 tablespoons of heavy duty detergent powder per gallon. After rinsing, surface must be wire-brushed with a coarse, cup-shaped, power-driven brush to remove badly bonded paint, rust, scale, corrosion, grease, or dirt. Dust or residue remaining after wire brushing must be removed before priming.
7. Do not paint galvanized metal guard post, galvanized equipment, State-furnished controller cabinet, and wood poles for traffic signal or flashing beacon.
8. New galvanized metal surface to be painted in the field must be cleaned as specified for existing equipment before applying the prime coat. Do not wire brush new galvanized surface.
9. After erection, examine exterior surface for damaged primer, clean, and spot coat with primer.
10. Paint Types II and III steel service equipment enclosures with a polymeric or an enamel coating system matching Color No. 14672, light green, of Federal Standard 595B. Coating must be commercially smooth and free of flow lines, paint washout, streaks, blisters, and other defects that would impair serviceability or detract from general appearance. Coating must comply with the following:

    10.1. Coating hardness - Finish must have pencil lead hardness of HB, minimum, using an Eagle Turquoise pencil.
    10.2. Salt spray resistance - Undercutting coating system's film must not exceed 1/8-inch average, from lines scored diagonally and deep enough to expose the base metal, after 336 hours of exposure in a salt spray cabinet complying with ASTM B 117.
    10.3. Adherence - Must not have coating loss when tested as specified in California Test 645. Perform testing by applying coating to 4" x 8" x 0.024" test specimens of the same material as the cabinet, using the same application method.

11. Finish interior of metal signal visor, louver, and front face of back plates with 2 applications of lusterless black exterior grade latex paint formulated for application to properly prepared metal surface. Good condition factory finish will be acceptable.
12. Finish metal signal section, signal head mounting, brackets and fittings, outside of visor, pedestrian push button housing, pedestrian signal section and visor, and back face of back plate with 2 applications of lusterless black or dark olive green exterior grade latex paint formulated for application to properly prepared metal surface. Match dark olive green color to Color Chip No. 68 filed at the Transportation Laboratory.
13. Prepare and finish conduit and conduit fitting above ground the same as adjacent standard or post.
14. Relocated, reset or modified equipment previously finished as specified in this section, except for previously-finished galvanized standard with traffic signal yellow enamel, must be given a spot finishing application on newly primed areas and 1 finishing application over the entire surface. If signal face or mounting brackets are required to be painted under this section, all signal faces and mounting brackets on the same mounting must be repainted.
15. Small rusted or repaired areas of relocated or reset galvanized equipment must be cleaned and painted as specified in Section 75-1.05, "Galvanizing," for repairing damaged galvanized surfaces.
16. Stencil equipment number neatly on the standard or adjacent structure. Obtain number from the Engineer.
17. Perform painting neatly. The Engineer reserves the right to require use of brushes if the work performed by paint spraying machine is unsatisfactory.

86-3 CONTROLLER ASSEMBLIES

86-3.01 CONTROLLER ASSEMBLIES

A controller assembly houses a complete mechanism for controlling the operation of traffic signals or other systems.

Model 170 and Model 2070, specified as a Model 170/2070 controller assembly, includes a Model 170, 170E or 2070 controller unit, a wired cabinet, and all auxiliary equipment required to control the system.

86-3.02 (BLANK)

86-3.03 (BLANK)

86-3.04 CONTROLLER CABINETS

Controller cabinets for controller assemblies other than Model 170/2070 must comply with the following:

86-3.04A Cabinet Construction

Cabinet must be rainproof and the top crowned 1/2 inch or slanted toward the back to prevent standing water.
Cabinet and door must be manufactured from one of the following:

1. 0.073-inch minimum thickness cold-rolled steel with continuously-welded exterior seams
2. 0.073-inch minimum thickness stainless steel with overlapping exterior seams complying with Type 4 enclosures of the NEMA Enclosure Standards
3. 0.125-inch minimum thickness aluminum with continuously-welded exterior seams

Exterior welds must be ground smooth and edges filed to a radius of at least 0.03 inch.
Cabinet manufactured from cold-rolled steel must comply with Section 86-2.16, "Painting," and the following:

1. Cabinet manufactured from cold-rolled steel must be finished with a polymeric or an enamel coating system conforming to Color No. 14672 of Federal Standard 595B.
2. Cabinet must not have coating loss when 2 test specimens, 4" x 8", of the same material and coating as the cabinet are tested. Two 9-inch-diagonal scratches exposing bare metal will be made on a specimen. Soak specimen in demineralized water for 192 hours. Tightly affix a 1-inch wide strip of masking tape to the surface and remove with one quick motion. Specimen showing evidence of blistering, softening, or peeling of paint or coating from the base metal will be rejected. Testing must comply with California Test 645, except passing 180 Degree Bend Test is not required.
3. Metal must be prepared by the 3-step, iron phosphate conversion coating bonderizing technique.
4. Inside walls, doors, and ceiling of the housing must be the same as the outside finish.

Cabinet manufactured from stainless steel must comply with the following:

1. Use annealed or quarter-hard stainless steel that complies with ASTM A 666 for Type 304, Grades A or B.
2. Use gas tungsten arc welding (GTAW) process with bare stainless steel welding electrodes. Electrodes must comply with AWS A5.9 for ER308 chromium-nickel bare arc welding electrodes.
3. Procedures, welder, and welding operator must comply with requirements and practices recommended in AWS C5.5.
4. Ground or brush exposed, exterior surfaces of stainless steel cabinet to a 25 to 50-microinch finish using iron-free abrasives or stainless steel brushes.
5. After grinding or brushing, cabinet must not show rust discoloration when:

   5.1. Exposed for 48 hours in a salt spray cabinet as specified in ASTM B 117
   5.2. Exposed 24 hours in a tap water spray cabinet with the water temperature between 38 °C and 45 °C

6. After the test, cabinet showing rust discoloration anywhere on its surface will be rejected. Rejected cabinets may be cleaned, passivated, and resubmitted for testing.

Cabinet manufactured from aluminum sheet must comply with ASTM B 209 or B 209M for 5052-H32 aluminum sheet, and the following:

1. Use gas metal arc welding (GMAW) process with bare aluminum welding electrodes. Electrodes must comply with AWS A5.10 for ER5356 aluminum alloy bare welding electrodes.
2. Procedures, welder, and welding operator for welding must comply with requirements in AWS B3.0, "Welding Procedure and Performance Qualification," and to practices recommended in AWS C5.6.
3. Surface finish of each aluminum cabinet must comply with MIL-A-8625 for a Type II, Class I coating, except anodic coating must have a minimum thickness of 0.0007 inch and a minimum coating weight of 0.001 ounce per square inch. The anodic coating must be sealed in a 5 percent aqueous solution of nickel acetate, pH 5.0 to 6.5, for 15 minutes at 97 °C. Before applying anodic coating, clean and etch cabinets using the steps below:

3.1. Clean by immersing into inhibited alkaline cleaner, Oakite 61A, Diversey 909, or equal, 6 to 8 ounces per gallon at 71 °C for 5 minutes.
3.2. Rinse in cold water.
3.3. Etch in solution of 1-1/2 ounce of sodium fluoride and 4 to 6 ounces of sodium hydroxide per gallon of distilled water at 60 °C to 65 °C for 5 minutes.
3.4. Rinse in cold water.
3.5. Immerse in 50 percent by volume nitric acid solution at room temperature for 2 minutes.
3.6. Rinse in cold water.

Cabinet must have:

1. Single front door with:

   1.1. 44-inch maximum door width.
   1.2. Lock, when closed and latched, that is locked.
   1.3. Police panel mounted on door, equipped with a keyed lock and 2 police keys. Each police key must have a shaft at least 1-3/4 inch in length.

2. Dust-tight gasketing on all door openings, permanently bonded to the metal. Mating surface of the gasketing must be covered with silicone lubricant to prevent sticking.
3. Handle that:

   3.1. Allows padlocking in closed position
   3.2. Has a minimum length of 7 inches
   3.3. Has a 5/8-inch, minimum, steel shank
   3.4. Is manufactured of cast aluminum, or zinc-plated or cadmium-plated steel

4. Cabinet door frame with:

   4.1. Latching mechanism that:

      4.1.1. Holds tension on and forms a firm seal between door gasketing and frame.
      4.1.2. Is a 3-point cabinet latch with nylon rollers that have a minimum diameter of 3/4 inch and equipped with ball bearings.
      4.1.3. Has a center catch and a pushrod made of zinc-plated or cadmium-plated steel. Pushrod must be at least 1/4" x 3/4" and turned edgewise at outer supports. Cadmium plating must comply with MIL-QQ-416. Zinc plating must comply with MIL-QQ-325.

   4.2. Hinging that:

      4.2.1. Has 3-bolt butt hinges, each having a stainless steel fixed pin. Hinges must be stainless steel or may be aluminum for aluminum cabinet.
      4.2.2. Is bolted or welded to the cabinet. Hinge pins and bolts must not be accessible when door is closed.
      4.2.3. Has a catch to hold the door open at 90 degrees and 180 degrees, ± 10 degrees, if a door is larger than 22 inches in width or 6 square feet in area. Catch must be at least 3/8-inch diameter, stainless steel plated rod capable of holding door open at 90 degrees in a 60 mph wind at an angle perpendicular to the plane of the door.

5. Lock that:

   5.1. Is solid brass, 6-pin tumbler, rim type
   5.2. Has rectangular, spring-loaded bolts
   5.3. Is left hand and rigidly mounted with stainless steel machine screws approximately 2 inches apart
   5.4. Extends 1/8 to 3/8 inch beyond the outside surface of door

6. 2 keys that are removable in the locked and unlocked positions.

Submit alternative design details for review and approval before manufacturing cabinet.
Use metal shelves or brackets that will support controller unit and auxiliary equipment.
Machine screws and bolts must not protrude outside the cabinet wall.

86-3.04B Cabinet Ventilation

Each controller cabinet must have:

1. 8 screened, 1/2-inch diameter or larger, raintight vent holes, in lower side or bottom of cabinet. You may use louvered vents with a permanent metal mesh or 4-ply woven polypropylene air filter held firmly in place, instead.
2. Electric fan with ball or roller bearings and capacity of at least 100 cubic feet per minute. Fan must be thermostatically controlled and manually adjustable to turn on between 32 °C and 65 °C with a differential of not more than 6 °C between automatic turn on and turn off. Fan circuit must be fused at 125 percent of ampacity of installed fan motor.

Fan and cabinet vent holes must be positioned to direct bulk of airflow over controller unit or through ventilating holes of controller unit.

86-3.04C Cabinet Wiring

Conductors used in controller cabinet wiring must:

1. Be neatly arranged and laced, or enclosed in plastic tubing or raceway.
2. End with properly sized captive or spring-spade terminal or be soldered to a through-panel solder lug on the back side of the terminal block. Apply crimp-style connector with proper tool to prevent opening of handle until crimp is completed.

Controller cabinet must have an equipment grounding conductor bus that is grounded to the cabinet and connected to metal conduit system or other approved ground with a No. 8, or larger, grounding conductor.

With all cabinet equipment in place and connected, resistance between grounded conductor terminal bus and equipment grounding conductor bus must be 50 MΩ, minimum, when measured with an applied voltage of 150 V(dc).

If direct current is to be grounded, connect to equipment ground only.

Use two or more terminal blocks for field connection. Install field terminal within 22 inches from front of cabinet and orient for screwdriver operation. Terminal must be a minimum of 5 inches above foundation.

No more than 3 conductors per terminal are allowed. Two flat metal jumpers, straight or U shaped, may be placed under terminal screw. At least 2 full threads of terminal screws must be fully engaged when screw is tightened. Live parts must not extend beyond the barrier.

86-3.05 CABINET ACCESSORIES

86-3.05A Labels

Include permanently printed, engraved, or silk-screened label for equipment and removable items of equipment.

Labeling must match cabinet wiring diagram. Label for shelf-mounted equipment must be on shelf face below item. Label for wall-mounted equipment must be below item.

86-3.05B Convenience Receptacle

Mount convenience receptacle in a readily accessible location inside the cabinet.

Convenience receptacle must be a duplex, 3-prong, NEMA 5-15R grounding type outlet that complies with UL Standard 943.

86-3.05C Surge Arrestor

Surge arrestor must reduce effects of power line voltage transients and have ratings as follows:

Surge Arrestor Requirements

Recurrent peak voltage	184 V(ac)
Energy rating, maximum	20 J
Power dissipation, average	0.85 W
Peak current for pulses less than 7 µs	1,250 A

Standby current must be 1 mA or less for 120 V(ac), 60 Hz sinusoidal input.

86-3.05D Terminal Blocks

Terminal block must be rated 600 V(ac), minimum, and have nickel-, silver-, or cadmium-plated brass binder head screw terminal.

Heavy duty terminal block must be rated at 20 A and have 12 position with No. 10 x 5/16-inch nickel-plated brass binder head screws and nickel-plated brass inserts. Each position must have 2 screw-type terminals. Terminal block must be barrier type with shorting bars in each of the 12 positions, and must have integral type marking strips.

Light duty terminal block must be rated at 5 A and have 12 positions with No. 6 x 1/8 inch binder head screws. Each position must have 1 screw-type terminal.

86-3.06 COMPONENTS

86-3.06A Toggle Switches

Toggle switch must

1. Have poles as required
2. Be rated at 200 percent of circuit current for circuits of 10 A or less and 125 percent of circuit current for circuits over 10 A

86-3.06B Cartridge Fuses

Install cartridge fuse in panel-mounted fuseholder. Fuse type and rating must be as recommended by the fuse manufacturer for protecting the load.

86-3.06C Circuit Breakers

Circuit breaker must comply with Section 86-2.11, "Service," except breaker must have a minimum interrupting capacity of 5,000 A, rms.

86-3.06D Connectors

Use connector designed to interconnect various parts of circuit together and constructed for the application involved. Design connector for positive connection of circuit and easy insertion and removal of mating contacts. Connector must be permanently keyed to prevent improper connection of circuit.

Connector, or device plugging into connector, must have positive connection to prevent a circuit from breaking due to vibration, a pull on connecting cable, or similar disruptive force.

86-3.07 ACCESSORIES

Accessories must comply with the following:

86-3.07A Telephone Bridge

Telephone bridge must comply with the following:

86-3.07A(1) General Description

Dual 5-way active data bridge must include:

1. 4-wire transmission interconnection between a dedicated common port and 4 multiple ports. Ports must be characterized by a balanced 600 Ω terminating impedance. The module's active circuit must allow unused multiple ports to be left unterminated without affecting the transmission response of ports in use.
2. Splitter channel and combiner channel. Connect multiple inputs to a common output in combiner channel. Connect common input to multiple outputs in splitter channel. Splitter and combiner must be separate and independent, allowing operation in full-duplex data transmission applications. Input, output, and line monitor jacks on front panel of bridge must allow isolated-module, isolated-facility, and cross-bridge measurement of transmission parameters in both, splitter and combiner channels.
3. Front-panel-accessible potentiometers with continuous adjustment of cross-bridge loss or gain within -30 to -10 dB and -10 to +10 dB ranges. Select either range for each channel. Adjusted level must be same for all cross-bridge port combinations so if the splitter-channel potentiometer is set for +3 dB gain, all common-to-multiple-port paths in the splitter channel must receive a +3 dB level increase.
4. Input voltage of -22 to -56 V(dc) at a maximum current of 60 mA.

Individually package each dual 5-way active bridge unit in housing. Circuitry must be solid state, constructed on removable industry standard circuit boards with plug in edge connectors. Test jack, edge connector, and external plug connector must be made of material suitable for use in above stated environment without deterioration of electrical connection for useful life of equipment. Physical size of case must not exceed 225 cubic inches and must be suitable for mounting to frame of field cabinet. Use mounting holes to attach unit to one side of frame of relay rack.

Include input and output ports for 5 full duplex telephone circuits with input and output ports labeled as to function. Level control, or switches and level adjustment potentiometers, and input and output level test jacks must provide external adjustments without removal of the housing.

86-3.07A(2) Application

Use dual 5-way active data bridge to interconnect 4-wire data modems to a common data channel or link. At the distant end, terminate common data link into a computer that may time sequentially poll outlying or remote data terminals. Use bridge for central transmission arrangement, or "hubbing" network, to extend data transmission to outlying terminals.

To expand number of multiple ports of a 4-wire data hubbing network in a tandem bridge arrangement, directly connect 1 multiple port in each channel of 1st bridge to common port of the same channel of 2nd bridge to get a 4-wire data bridge with 1 common and 7 multiple ports.

86-3.07A(3) Circuit Description

Combiner channel of dual 5-way active data bridge must have a variable-gain-integrated-circuit operational amplifier with an input summing circuit. Summing circuit must add transmission energy from all multiple input ports at low-impedance summing point for input port isolation. Connect amplifier output to transformer for balanced connection to facility.

Splitter channel must include a transformer-input, variable-gain, integrated-circuit operational amplifier and power amplifier. Power transformer output must be very low impedance and drive eight 300 Ω resistors to derive proper impedance at multiple output circuits and provide isolation between output circuits.

Multiple ports in bridge splitter and combiner channels must be isolated, and balanced by output transformer and matched precision resistors in each channel.

86-3.07A(4) Electrical Requirements

Comply with following electrical requirements:

Electrical Requirements

Specification	Requirement
Splitter channel loss or gain	-30 to +10 dB usable range
Combiner channel loss or gain	-30 to +10 dB usable range
Maximum output level (overload point)	Splitter: +5 dBm Combiner: +12 dBm
Level change with loading	1 dB max, 1 port to all ports loaded
Input port impedance	Splitter (multiple ports): 600 Ω balanced Combiner (common port): 600 Ω balanced
Output port impedance	Splitter (multiple ports): 600 Ω balanced Combiner (common port): 600 Ω balanced
Harmonic distortion	Splitter: less than 1percent at +3 dBm Combiner: less than 1 percent at +8 dBm
Noise	20 dBm max
Frequency response	±1 dB re 1,000 Hz level, 300 to 5,000 Hz
Delay distortion	Less than 75 µs, 400 to 3,000 Hz
Cross-port coupling loss (crosstalk)	Greater than 55 dB
Input power	-22 to -56 V(dc), 60 mA max
Operating environment	-7 °C to 54 °C, humidity to 95% (no condensation)
Mounting	1 position

86-3.07A(5) Testing and Troubleshooting

You must have complete testing and troubleshooting instructions, circuit diagrams and pictorial component location, and identification guides for each unit.

86-4 TRAFFIC SIGNAL FACES AND FITTINGS

86-4.01 VEHICLE SIGNAL FACES

Each vehicle signal face must:

1. Be adjustable and allow for 360-degree rotation about vertical axis
2. Comply with ITE publication ST-017B, "Vehicle Traffic Control Signal Heads"
3. Comply with California Test 604, except for arrow and "X" faces
4. Have 3 sections arranged vertically: red at top, yellow at center, and green at bottom
5. Be of the same manufacturer and material, if more than 1 is installed at an intersection, except for programmed visibility type
6. Be sealed with neoprene gasket at top opening
7. Be LED modules

86-4.01A Signal Sections

Each signal section must comply with the following:

1. Maximum height must be 10-1/4 inches for an 8-inch section and 14-3/4 inches for a 12-inch section.
2. Housing must:

    2.1. Be either die-cast or permanent mold-cast aluminum, or if specified, be structural plastic.
    2.2. Comply with ITE publication ST-017B if die-cast or permanent mold-cast aluminum is used.
    2.3. Have a 1-piece, hinged, square-shaped door designed to allow access for relamping without the use of tools. Door must be secured to hold the door closed during loading tests. Module or lens must be watertight and mounted in the door.

3. Hinge pins, door latching devices, and other exposed hardware must be Type 304 or 305 stainless steel. Interior screws and fittings must be stainless steel, or steel with a corrosion resistant plating or coating.
4. Opening must be placed on top and bottom to receive 1-1/2-inch pipe. The 8-inch and 12-inch sections of an individual manufacturer must be capable of joining to form a signal face in any combination. This interchangeability is not required between metal and plastic sections.
5. Gaskets must be made of a material that is not affected if installed in a section with metal or plastic housing that is continuously operated for 336 hours.

Structural failure is described as follows:

Signal Section Structural Failure

Signal Section Type	Requirements	Description of Structural Failure
Metal	California Test 666	Fracture within housing assembly or deflection of more than half the lens diameter of signal section during wind load test
Plastic	California Test 605	Fracture within housing assembly or deflection of more than 10 degrees in either the vertical or horizontal plane after wind load has been removed from front of signal face, or deflection of more than 6 degrees in either the vertical or horizontal plane after wind load has been removed from back of signal face

86-4.01A(1) Metal Signal Sections

Each metal signal section must have a metal visor. Metal signal faces requiring backplates must have metal backplates.

86-4.01A(2) Plastic Signal Sections

Housing must be molded in 1 piece, or fabricated from 2 or more pieces and joined into a single piece. Plastic must have ultraviolet stability, be unaffected by lamp heat, and be self-extinguishing. Housing and door must be colored throughout and be black, matching Color No. 17038, 27038, or 37038 of Federal Standard 595B.

Each face section must be joined to adjacent section by one of the following:

1. Minimum of 3 machine screws for 8-inch sections and 4 machine screws for 12-inch sections, installed through holes near front and back of housing. Each screw must be a No. 10 and have a nut, flat washer, and lock washer.
2. Two machine screws, each with a nut, flat washer, and lock washer, installed through holes near the front of the housing, and a fastening through the 1-1/2-inch pipe opening. Fastening must have 2 large flat washers to distribute the load around the pipe opening and 3 carriage bolts, each with a nut and lock washer. Minimum screw size must be No. 10. Minimum carriage bolt size must be 1/4 inch.

Supporting section of each signal face supported only at top or bottom must have reinforcement.

Reinforcement plate must be either sheet aluminum, galvanized steel, or cast aluminum. Each plate must be a minimum of 0.11-inch thick and have a hole concentric with 1-1/2-inch pipe-mounting hole in the housing. Place reinforcement plate as follows:

Reinforcement Plate Placement

Type of Reinforcement Plate	Placement
Sheet aluminum	Inside and outside of housing
Galvanized steel	Inside of housing
Cast aluminum	Outside of housing

Reinforcement plates placed outside of the housing must be finished to match signal housing color and be designed to allow proper serrated coupling between signal face and mounting hardware. Minimum of 3 No. 10 machine screws must be installed through holes in each plate and matching holes in the housing. Each screw must have a round or binder head, a nut, and lock washer.

If signal face is supported by a Type MAS side attachment slip-fitter inserted between 2 sections, place spacers between the 2 sections. Vertical dimension of spacers must allow proper seating of serrations between the slip-fitter and the 2 sections. In addition to the fastening through the large openings in housing, the 2 sections must join with at least 2 machine screws through holes near the front of housing and the spacers, and through matching holes in a reinforcing plate installed in housing. Machine screws must be No. 10 minimum size. Spacers must be made of same material as signal housing.

If reinforcing webs are used to connect back of housing to top, bottom, and sides, reinforcing plates are not required.

Holes for machine screws must be either cast or drilled during signal section manufacturing. Surround each hole with a 1/8-inch minimum width boss to allow contact between signal sections about axis of hole.

Each plastic signal section must have a plastic or metal visor. Plastic signal faces requiring backplates must have plastic backplates.

Serrated nylon washer must be inserted between each plastic signal section and metal mounting assembly. Each washer must be between 3/16- and 1/4-inch thick. Serrations must match those on signal section and mounting assembly.

86-4.01B Visors

Include removable visor with each signal section. Comply with ITE publication ST-017B. Visors are classified by lens enclosure as full circle, tunnel or cap. Bottom opens for tunnel type and both, bottom and lower sides open for cap type. Visors must be tunnel type.

Visor must have a downward tilt between 3 and 7 degrees with a length of:

1. 9-1/2-inch minimum for nominal 12-inch round lenses
2. 7 inch for nominal 8-inch round lenses

Metal visor must be formed from 0.050-inch, minimum thickness, aluminum alloy sheet.

Plastic visor must be either formed from sheet plastic or assembled from one or more injection, rotational, or blow-molded plastic sections. Material must be of a black homogeneous color with lusterless finish. Sections must be joined using thermal, chemical, or ultrasonic bonding, or with aluminum rivets and washers permanently colored to match visor.

Secure each visor to its door and prevent removal or permanent deformation when wind load specified in California Test 605 for plastic visors or 666 for metal visors is applied to its side for 24 hours.

If directional louvers are used, fit louvers snuggly into full-circular signal visors. Outside cylinder must be constructed of 0.030-inch nominal thickness, or thicker, sheet steel and vanes must be constructed of 0.016-inch nominal thickness, or thicker, sheet steel, or the cylinder and vanes must be constructed of 5052-H32 aluminum alloy of equal thickness.

86-4.02 (BLANK)

86-4.03 (BLANK)

86-4.04 BACKPLATES

Background light must not be visible between backplate and signal face or between sections.

Plastic backplates must be either formed from sheet plastic or assembled from extruded, molded, or cast sections. Sections must be factory joined using one of the following:

1. Appropriate solvent cement
2. Aluminum rivets and washers painted or permanently colored to match backplate
3. No. 10 machine screws with washers, lock washers, and nuts, painted to match backplate

Backplate material must be of black homogeneous color with a lusterless finish. Secure each plastic backplate to the plastic signal face in a manner that prevents its removal or permanent deformation when the wind-load test is applied to either the front or back of signal face. Permanent deformation of any portion of backplate must not exceed 5 degrees forward or backward after wind loading is applied for 24 hours.

If plastic backplate requires field assembly, join with at least 4 No. 10 machine screws at each field-assembled joint. Each machine screw must have an integral or captive flat washer, a hexagonal head slotted for a standard screwdriver, and either a locking nut or a nut and lockwasher. Machine screws, nuts, and washers must be stainless steel or steel with a zinc or black-oxide finish.

If a metal backplate has 2 or more sections, fasten sections with rivets or aluminum bolts peened after assembly to avoid loosening.

Instead of the screws shown on the plans, you may use self-threading No. 10 steel screws to fasten plastic backplates to plastic signal face. Each screw must have an integral or captive flat washer, a hexagonal head slotted for a standard screwdriver, and is stainless steel or steel with a zinc or black-oxide finish.

86-4.05 PROGRAMMED VISIBILITY VEHICLE SIGNAL FACES

Programmed visibility signal face and its installation must comply with Section 86-4.01, "Vehicle Signal Faces," Section 86-4.04, "Backplates," and Section 86-4.08, "Signal Mounting Assemblies."

Each programmed visibility signal section must:

1. Have a nominal 12-inch diameter circular or arrow indication
2. Comply with ITE publication ST-017B for color and arrow configuration
3. Have a cap visor
4. Have an adjustable connection that provides incremental tilting from 0 to 10 degrees above or below horizontal while maintaining a common vertical axis through couplers and mountings

Terminal connection must allow external adjustment about the mounting axis in 5-degree increments.

Signal must be mountable with ordinary tools and capable of servicing without tools. Preset adjustment at 4 degrees below horizontal.

Visibility of each programmed visibility signal face must be capable of adjustment or programming, within the face. When programmed, each signal face's indication must be visible only in those areas or lanes to be controlled, except that during dusk and darkness a faint glow to each side is allowed.

You must program the head as recommended by the manufacturer.

86-4.06 PEDESTRIAN SIGNAL FACES

Message symbols for pedestrian signal faces must be white "WALKING PERSON" and Portland orange "UPRAISED HAND." Comply with ITE Standards: "Pedestrian Traffic Control Signal Indications" and California MUTCD. Each symbol's height must be at least 10 inches and width must be at least 6-1/2 inches.

Luminance of "UPRAISED HAND" symbol must be 1,100 foot-lamberts, minimum, and luminance of "WALKING PERSON" symbol must be 1,550 foot-lamberts, minimum, when tested as specified in California Test 606.

Uniformity ratio of an illuminated symbol must not exceed 4 to 1 between the highest luminance area and the lowest luminance area.

Luminance difference between a nonilluminated symbol and the background around the symbol must be less than 30 percent when viewed with the visor and front screen in place and at a low sun angle.

Each housing, including front screen, must have maximum overall dimensions of 18-1/2-inch width, 19-inch height, and 11-1/2-inch depth.

All new pedestrian signal faces installed at an intersection must be the same make and type.

86-4.06A Type A

Each Type A pedestrian signal face must include a housing, 1 LED pedestrian signal combo module and a front screen.

86-4.06B Front Screen

Front screen installation for each Type A signal must comply with one of the following:

1. Install, tilting downward, at an angle of 15±2 degrees out from the top, an aluminum honeycomb screen with 0.2-inch cells, 3/8-inch thick, or a plastic screen of 3/8-inch squares, 1/2-inch thick with wall thickness of 1/16-inch. Completely cover message plate. Include a clear front cover of 1/8-inch minimum thickness acrylic plastic sheet or 1/16-inch minimum thickness polycarbonate plastic. Hold screen and cover firmly in place with stainless steel or aluminum clips or stainless steel metal screws.
2. Install a 1-1/2-inch deep eggcrate or Z crate type screen of 1/32-inch nominal thickness polycarbonate. Mount screening in a frame constructed of 0.040-inch minimum thickness aluminum alloy or polycarbonate. Install screen parallel to face of message plate and hold in place with stainless steel screws. Visor as specified in Section 86-4.06D, "Visors," is not required.

The Department will test screens in a horizontal position with its edges supported. When a 3-inch diameter, 4-pound steel ball is dropped on the screen from a height of 4 feet above, the front screen must not fracture, separate at the welds, or compress more than 1/8-inch. When pedestrian housing is used to support front screen during test, remove message plate from pedestrian signal housing, so there is no back support for the screen.

Screen and frame must be one of the following:

1. Manufactured from aluminum anodized flat black
2. Finished with lusterless black exterior grade latex paint formulated for application to properly prepared metal surfaces
3. Manufactured from flat black plastic

86-4.06C Housing

Pedestrian signal housing must comply with Section 86-4.01A, "Signal Sections."

86-4.06D Visors

Use material similar to housing. Extend top of visor a minimum length of 6 inches at top and 5 inches at bottom when measured from front surface of line. Front must be normal to top.

86-4.06E Finish

Paint exterior of each housing and visor, and interior of visor as specified in Section 86-2.16, "Painting."

86-4.06F Control

Pedestrian signals must be controllable by solid-state switching devices specified for traffic signal controller assemblies.

86-4.06G Terminal Blocks

Include light duty terminal block, as specified in Section 86-4.01B, "Electrical Components," with each pedestrian signal face.

86-4.07 (BLANK)

86-4.08 SIGNAL MOUNTING ASSEMBLIES

Signal mounting assembly must include:

1. 1-1/2-inch standard steel pipe or galvanized conduit
2. Pipe fitting made of ductile iron, galvanized steel, aluminum alloy Type AC-84B No. 380, or bronze
3. Mast arm and post top slip-fitters, and terminal compartments made of cast bronze or hot-dip galvanized ductile iron

After installation, clean and paint exposed threads of galvanized conduit brackets and bracket areas damaged by wrench or vise jaws. Use wire brush to clean and apply 2 coats of approved unthinned zinc-rich primer, organic vehicle type, as specified in Section 91, "Paint." Do not use aerosol can.

Fit each terminal compartment with a terminal block having a minimum of 12 positions, each with 2 screw-type terminals. Each terminal must accommodate at least five No. 14 conductors. Include a cover on compartment for ready access to terminal block. Terminal compartment used to bracket mount signals must be bolted securely to pole or standard.

Horizontal dimension of mounting assembly members between vertical centerline of terminal compartment or slip-fitter, and the vertical centerline of each signal face must not exceed 11 inches, except where required for proper signal face alignment or to allow programming of programmed visibility signal faces.

Mounting assembly members must be plumb or level, symmetrically arranged, and securely assembled.

Mounting assembly must be watertight, and free of sharp edges or protrusions that might damage conductor insulation. Include positive locking serrated fittings that, if mated with similar fittings on signal faces, will prevent faces from rotating.

Orient each mounting assembly to allow maximum horizontal clearance to adjacent roadway.

Use slip-fitter for post-top mounting of signals. Fit slip-fitter over a 4-1/2-inch outside diameter pipe or tapered standard end. Include cadmium-plated steel set screws. Include an integral terminal compartment for each slip-fitter used to post-top mount signals with brackets.

Do not install signal faces at an intersection until all other signal equipment, including complete controller assembly, is in place and ready for operation. You may mount signal faces if covered or not directed toward traffic.

86-4.09 FLASHING BEACONS

Flashing beacon must include:

1. Single section traffic signal face with yellow or red LED module indications
2. Backplate
3. Tunnel visor
4. Flashing beacon control assembly

Beacon flasher unit must be independent of intersection flasher unit.

86-4.09A Flashing Beacon Control Assembly

86-4.09A(1) Enclosure

Enclosure must be:

1. NEMA 3R with a dead front panel and a hasp with a 7/16-inch hole for a padlock
2. Powder coated, hot-dip galvanized, or factory-applied rust resistant prime coat and finish coat

86-4.09A(2) Circuit Breakers and Switches

Circuit breakers must comply with Section 86-2.11, "Service."

Switch for manually operating sign lighting circuit must be a single-hole-mounting toggle type with a single pole and throw and rated at 12 A, 120 V(ac). Furnish switch with an indicating nameplate reading "Auto-Test."

86-4.09A(3) Flasher

Comply with Section 8, "Solid-State Flashers," of NEMA Standards publication No. TS 1.

Flasher must be a solid-state device with no contact points or moving parts.

Include 2 output circuits to allow alternate flashing of signal faces. Flasher must be able to carry a minimum of 10 A per circuit at 120 V(ac).

86-4.09A(4) Wiring

Conductors and wiring in the enclosure must comply with Section 86-2.09B(1), "Cabinet and Enclosure Installation."

86-4.09A(5) Terminal Blocks

Terminal blocks must be:

1. Rated 25 A, 600 V(ac)
2. Molded phenolic or nylon material
3. Barrier type with plated brass screw terminals and integral marking strips

86-5 DETECTORS

86-5.01 VEHICLE DETECTORS

Sensor unit and isolator must comply with TEES.

86-5.01A Inductive Loop Detectors

86-5.01A(1) General

Inductive loop detector includes a completely installed loop or group of loops, in the roadway, lead-in cable, and a sensor unit, with power supply installed in a controller cabinet.

86-5.01A(2) Sensor Unit Construction

Card type sensor unit must comply with TEES, issued by the Department. Shelf-mounted sensor unit must comply with Section 11 of the NEMA Standards Publication No. TS 1.

86-5.01A(3) Construction Materials

Conductor for each inductive loop detector must be continuous, unspliced, and one of the following:

Conductor Options for Inductive Loop Detector

Option	Specifications
Type 1 loop wire	Type RHW-USE neoprene-jacketed or Type USE cross-linked polyethylene insulated, No. 12, stranded copper wire with a 40 mils minimum thickness at any point.
Type 2 loop wire	Type THWN or Type XHHW, No. 14, stranded copper wire in a plastic tubing. Plastic tubing must be polyethylene or vinyl, rated for use at 105 °C, and resistant to oil and gasoline. Outside diameter of tubing must be 0.27 inch maximum with a wall thickness of 0.028 inch minimum.

Conductor for loop detector lead-in cable must be two No. 16, 19 x 29, stranded, tinned copper wires, comply with the calculated cross sectional area of ASTM B 286, Table 1, and be one of the following:

Conductor Options for Loop Detector Lead-In Cable

Option	Specifications
Type B lead-in cable	Insulated with 20 mils of high-density polyethylene. Conductors must be twisted together with at least 2 turns per foot and the twisted pair must be protected with a copper or aluminum polyester shield. A No. 20, minimum, copper drain wire must be connected to equipment ground within cabinet. Cable must have a high-density polyethylene or high-density polypropylene outer jacket with a nominal thickness of 32 mils. Include an amorphous interior moisture penetration barrier of nonhydroscopic polyethylene or polypropylene fillers.
Type C lead-in cable	Comply with International Municipal Signal Association (IMSA) Specification No. 50-2. A No. 20, minimum, copper drain wire must be connected to equipment ground within cabinet.

86-5.01A(4) Installation Details

Install loop conductors without splices and end in nearest pull box. Seal open end of cable jacket or tubing similar to splicing requirements to prevent water from entering. Do not make final splices between loops and lead-in cable until loop operations under actual traffic conditions is approved.

Splice all loop conductors for each direction of travel for same phase of a traffic signal system, in same pull box, to a detector lead-in cable that runs from pull box adjacent to loop detector to a sensor unit mounted in controller cabinet.

End all loop conductors in a pull box or terminal strip in the cabinet.

Identify and band conductors for inductive loop installations. Band, in pairs, by lane, in the pull box adjacent to the loops and near the end of conductors in the cabinet. Bands must comply with Section 86-2.09, "Wiring."

If HMA surfacing is to be placed, install loop conductors before placing uppermost layer of HMA. Install conductors in compacted layer of HMA immediately below the uppermost layer. Install conductors as shown on the plans, except fill slot with sealant flush to the surface.

When cutting loops:

1. Residue from slot cutting activities must not be allowed to flow across shoulders or lanes occupied by public traffic and must be removed from the pavement surface before residue flows off. Dispose of residue from slot cutting activities under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way."
2. Surplus sealant must be removed from adjacent road surface without using solvents before setting.

Sealant for filling slots must comply with one of the following:

Elastomeric Sealant

Polyurethane material that will, within stated shelf life, cure only in the presence of moisture. Sealant must be suitable for use in both HMA and PCC.

The cured sealant must have the following performance characteristics:

Performance Characteristics of Cured Sealant

Specification	ASTM	Requirement
Hardness (indentation) at 25 °C and 50% relative humidity. (Type A, Model 1700 only)	D 2240 Rex.	65-85
Tensile Strength: Pulled at 508 mm per minute	D 412 Die C	3.45 MPa, min.
Elongation: Pulled at 508 mm per minute	D 412 Die C	400%, min.
Flex at -40 °C: 0.6-mm free film bend (180°) over 13-mm mandrel	--	No cracks
Weathering Resistance: Weatherometer 350 h, cured 7 days at 25 °C @ 50% relative humidity	D 822	Slight chalking
Salt Spray Resistance: 28 days at 38 °C with 5% NaCl, Die C & pulled at 508 mm per minute	B 117	3.45 MPa, min. tensile 400%, min. elongation
Dielectric Constant over a temperature range of -30 °C to 50 °C	D 150	Less than 25% change

Asphaltic Emulsion Sealant

Comply with State Specification 8040-41A-15. Use for filling slots in HMA pavement that are a maximum of 5/8 inch in width. Do not use where the slope causes the material to run from the slot. Material must not be thinned beyond manufacturer's recommendations. Place material when air temperature is at least 7 °C.

Hot-Melt Rubberized Asphalt Sealant

Hot-melt rubberized asphalt must be:

1. In solid form at room temperature and fluid at application temperature of 190 °C to 205 °C. Fumes must be non-toxic.
2. Suitable for use in both HMA and PCC.
3. Melted in a jacketed, double-boiler type melting unit. Temperature of heat transfer medium must not exceed 245 °C.
4. Applied with a pressure feed applicator or pour pot, when the pavement surface temperature is greater than 4 °C.
5. Packaged in containers clearly marked "Detector Loop Sealant" and specifying manufacturer's batch and lot number.

The cured sealant must have the following performance characteristics:

Performance Characteristics of Cured Sealant

Specification	ASTM	Requirement
Cone Penetration, 25 °C, 150 g, 5 s	D 5329, Sec. 6	3.5 mm, max
Flow, 60 °C	D 5329, Sec. 8	5 mm, max
Resilience, 25 °C	D 5329, Sec. 12	25%, min
Softening Point	D 36	82 °C, min
Ductility, 25 °C, 50 mm/min	D 113	300 mm, min
Flash Point, COC, °C	D 92	288 °C, min
Viscosity, Brookfield Thermosel, No. 27 Spindle, 20 rpm, 190 °C	D 150	Less than 25% change

86-5.01B Magnetic Detectors

Cable from pull box, adjacent to magnetic detector sensing element, to the field terminals in the controller cabinet must be the type specified for inductive loop detectors.

86-5.02 PEDESTRIAN PUSH BUTTON ASSEMBLIES

Housing must be either die-cast or permanent mold-cast aluminum, or ultraviolet stabilized, self-extinguishing structural plastic, if specified. Plastic housing must be black matching Color No. 17038, 27038 or 37038 of Federal Standard 595B, and colored throughout. Assembly must be rainproof and shockproof in any weather condition.

Switch must be a single-pole, double-throw, switching unit, with screw type terminals, rated 15 A at 125 V(ac), and must have:

1. Plunger actuator and a U frame to allow recessed mounting in push button housing
2. Operating force of 3.5 pounds
3. 1/64-inch maximum pretravel
4. 7/32-inch minimum overtravel
5. 0.0004- to 0.002-inch differential travel
6. 2-inch minimum diameter actuator

Where pedestrian push button is attached to a pole, shape housing to fit the pole curvature and secure. Include saddles to make a neat fit if needed.

Where a pedestrian push button is mounted on top of a 2-1/2-inch diameter post, fit housing with a slip-fitter and use screws for securing rigidly to post.

Pedestrian push button signs must be porcelain enameled metal or structural plastic.

Install push button and sign on crosswalk side of pole.

Point arrows on push button signs in the same direction as the corresponding crosswalk.

Attach sign on Type B push button assembly.

For Type C pedestrian push button assembly, mount instruction sign on the same standard as the push button assembly, using 2 straps and saddle brackets. Straps and saddle brackets must be corrosion-resisting chromium nickel steel and comply with ASTM A 167, Type 302B. Theft-proof bolts must be stainless steel with a chromium content of at least 17 percent and a nickel content of at least 8 percent.

86-6 LIGHTING

86-6.01 HIGH PRESSURE SODIUM LUMINAIRES

High pressure sodium luminaires must be the enclosed cutoff type.

Housing must be manufactured from aluminum. Painted or powder-coated housing must withstand a 1,000-hour salt spray test as specified in ASTM B 117.

Other metal parts must be corrosion resistant.

Each housing must include a slip-fitter that can be mounted on a 2-inch pipe tenon and can be adjusted 5 degrees from the axis of the tenon. Clamping brackets of slip-fitter must not bottom out on housing bosses when adjusted within the ±5 degree range.

The slip-fitter mounting bracket must not permanently set in excess of 0.020-inch when the 3/8-inch diameter cap screw used for mounting is tightened to 10 foot-pounds.

Luminaire to be mounted horizontally on mast arm, when tested as specified in California Test 611, must be capable of withstanding cyclic loading for a minimum of 2 million cycles without failure of any luminaire parts as follows:

Cyclic Loading

Plane	Internal Ballast	Minimum Peak Acceleration Level[a]
Vertical	Removed	3.0 G peak-to-peak sinusoidal loading (same as 1.5 G peak)
Horizontal[b]	Installed	1.5 G peak-to-peak sinusoidal loading (same as 0.75 G peak)
Vertical	Installed	1.0 G peak-to-peak sinusoidal loading (same as 0.5 G peak)

[a]G = Acceleration of gravity
[b]Perpendicular to direction of mast arm

If a photoelectric unit receptacle is included, a raintight shorting cap must be installed. If luminaire housing has a hole for the receptacle, hole must be permanently closed, covered, and sealed with weatherproof material.

Optical system must be in a sealed chamber and include:

1. Reflector shaped so that a minimum of light is reflected through the arc tube of the lamp. Reflector surface must be specular and protected by either an anodized finish or a silicate film on it's specular surface.
2. Refractor or lens mounted in a door frame that is hinged to the housing and secured with a spring-loaded latch. Refractor must be made of glass or polycarbonate plastic. Lens must be made of heat- and impact-resistant glass.
3. Lamp socket that is a porcelain enclosed mogul-multiple type. Shell must include integral lamp grips to assure electrical contact under conditions of normal vibration. Socket must be mounted in the luminaire to allow presetting a variety of specified light distribution patterns. Socket must be rated for 1,500 W and 600 V(ac), and a 4 kV pulse.
4. Lamp.

Sealing must be provided by a gasket between the reflector and:

1. Refractor or lens
2. Lamp socket

Chamber must allow for filtered flow of air in and out of the chamber from lamp heat. Filtering must be accomplished by either a separate filter or a filtering gasket.

If components are mounted on a down-opening door, door must be hinged and secured to luminaire housing separately from refractor or flat lens frame. Door must be easily removable and replaceable, and secured to housing to prevent accidental opening when refractor or flat lens frame is opened.

Field wires connected to luminaire must terminate on a barrier-type terminal block secured to the housing. Terminal screws must be captive and equipped with wire grips for conductors up to No. 6. Each terminal positions must be clearly identified.

Minimum light distribution for each luminaire must meet the isolux diagrams.

Maximum brightness of each cutoff luminaire, with the lamp indicated, must be as follows:

Cutoff Type

Lamp ANSI Code No.	Lamp Wattage	Maximum Brightness foot-lamberts
S55	150	40
S66	200	40
S50	250	50
S67	310	60
S51	400	75

Brightness readings will be taken using a brightness meter with an acceptance angle of 1.5 degrees. When measured on the 90-degree and 270-degree lateral angle line, maximum brightness must not exceed above specified brightness when meter is located at a horizontal distance of 120 feet and a vertical distance of 7.5 feet between luminaire and meter, or at an angle of 3 degrees 35 minutes from the horizontal to the line between luminaire and meter. Measurements must be made from 90-degree line and 270-degree line, and averaged. Lamp used for each test must operate at wattage necessary to produce the following light output:

Light Output

Lamp Wattage	Lumens
150	16,000
200	22,000
250	27,000
310	37,000
400	50,000

86-6.01A High Pressure Sodium Lamp Ballasts

Each ballast must:

1. Operate the lamp for its rated characteristics and wattage
2. Continuously operate at ambient air temperatures from -20 °C to 25 °C without reduction in ballast life
3. Operate for at least 180 cycles of 12 hours on and 12 hours off, with the lamp circuit in an open or short-circuited condition and without measurable reduction in operating requirements
4. Have a design life of not less than 60,000 hours
5. Provide proper starting and operating waveforms, voltage, and current
6. Provide reliable lamp starting and operation at ambient temperature down to -20 °C for the rated life of lamp

Ballast must be tested as specified in ANSI C82.6-1980, "Methods of Measurement of High-Intensity-Discharge Lamp Ballasts."

Starting aids for ballast of a given lamp wattage must be interchangeable between ballasts of same wattage and manufacturer, without adjustment.

Each integral ballast must consist of separate components that can be easily replaced. An encapsulated starting aid will be counted as a single component. Each component must include screw terminals, NEMA tab connectors, or a single multi-circuit connector. Conductors and terminals must be identified.

Mount heat-generating component so as to use the portion of the luminaire it is mounted to as a heat sink. Place capacitor a maximum practicable distance from heat-generating components or thermally shield to limit the case temperature to 75 °C.

Transformer and inductor must be resin-impregnated for protection against moisture. Capacitors, except those in starting aids, must be metal cased and hermetically sealed.

The Department will test high-pressure sodium lamp ballast. High-pressure sodium lamp ballast must have a characteristic curve that will intersect both of the lamp-voltage limit lines between the wattage limit lines and remain between the wattage limit lines throughout the full range of lamp voltage. This requirement must be met at the rated input voltage of the ballast and at the lowest and highest rated input voltage of the ballast.

Throughout the lifetime of the lamp, ballast curve must fall within the specified limits of the lamp voltage and wattage.

Ballast for luminaires must be located in the luminaire housing.

86-6.01A(1) Regulator Type Ballasts

Regulator type ballast must comply with the following:

1. For nominal input voltage and lamp voltage, ballast design center must not vary more than 7.5 percent from rated lamp wattage.
2. Ballast must be designed for a capacitance variance of ±6 percent that will not cause more than ±8 percent variation in lamp wattage regulation during rated lamp life.
3. Lamp current crest factor must not exceed 1.8 for input voltage variation of ±10 percent at any lamp voltage during lamp life.

Regulator-type ballast must be one of the following:

Regulator-Type Ballast

Ballast Type	Power Factor	Lamp Regulation
Lag-type[a]	Not less than 90 percent throughout the life of lamp when ballast is operated at nominal line voltage with a nominally-rated reference lamp	Lamp wattage regulation spread does not vary by more than 18 percent for ±10 percent input voltage variation from nominal through life
Lead-type[b]	Not less than 90 percent throughout the life of lamp when ballast is operated at nominal line voltage with a nominally-rated reference lamp	Lamp wattage regulation spread does not vary by more than 30 percent for ±10 percent input voltage variation from nominal through life

[a]Primary and secondary windings must be electrically isolated
[b]Constant wattage autoregulator (CWA)

86-6.01A(2) Nonregulator Type Ballasts

Each nonregulator type ballast must comply with the following:

1. For nominal input voltage and lamp voltage, ballast design center must not vary more than 7.5 percent from rated lamp wattage.
2. Lamp current crest factor must not exceed 1.8 for input voltage variation of ±5 percent at any lamp voltage during lamp life.

Nonregulator-Type Ballast

Ballast Type	Power Factor	Lamp Regulation
Autotransformer or High-Reactance	Not less than 90 percent throughout the life of lamp when ballast is operated at nominal line voltage with a nominally-rated reference lamp	Lamp wattage regulation spread does not vary by more than 25 percent for ±5 percent input voltage variation from nominal through life

86-6.01B High Pressure Sodium Lamps

High pressure sodium lamps must comply with ANSI C 78.42, "High Pressure Sodium Lamps," when tested as specified in ANSI C 78.389, "American National Standard for Electric Lamps - High Intensity Discharge-Methods of Measuring Characteristics." High pressure sodium lamps must have a minimum average rated life of 24,000 hours.

86-6.02 LOW PRESSURE SODIUM LUMINAIRES

Each low pressure sodium luminaire must be completely assembled with a lamp and ballast, and must:

1. Be the enclosed type, either semi-cutoff or cutoff type.
2. Include housing, reflector, refractor or lens, lamp socket, integral ballast, removable ballast tray, lamp support, terminal strip, capacitor, and slip fitter. Reflector may be an integral part of the housing.

Luminaire housing must be minimum 1/16-inch thick, corrosion resistant die cast aluminum sheet and plate with concealed continuous welds, or minimum nominal wall thickness of 3/32-thick acrylonitrile-butadiene-styrene sheet material, on a cast aluminum frame that provides mounting for all electrical components and slip fitter. Housing must be divided into optical and power compartments that are individually accessible for service and maintenance. Position and clamp luminaire to pipe tenon by tightening mounting bolts.

Painted exterior surface of luminaire must be finished with a fused coating of electrostatically applied polyester powder paint or other ultraviolet inhibiting film. Color must be aluminum gray.

High temperature neoprene, or equal, sealing ring must be installed in pipe tenon opening to prevent entry of water and insects into power and optical compartments.

Access to power unit assembly must be through a weathertight hinged cover, secured with spring type latches or captive screws, to luminaire housing.

Hardware must be stainless steel or cadmium plated. Use machine screws or bolts to secure removable components. Do not use sheet metal screws.

Semi-cutoff luminaires and molded refractor style cutoff luminaires must include a refractor. Other cutoff luminaires must include a flat lens.

Refractor must be 1-piece injection molded polycarbonate of 3/32 inch minimum thickness, or 1-piece injection molded acrylic of 1/8 inch minimum thickness. Flat lens must be 1-piece polycarbonate of 3/32 inch minimum thickness, mounted to metal frame. Refractor assembly and flat lens assembly must be constructed to rigidly maintain its shape, and hinged and secured with spring type latches to luminaire housing. Alternate methods of manufacturing refractor may be approved provided minimum specified thicknesses are maintained.

Lamp socket must be high temperature, flame retardant thermoset material with self-wiping contacts or equivalent. Socket must be rated for 660 W and 1,000 V(ac). Position of socket and support must maintain the lamp in correct relationship with reflector and refractor for designed distribution pattern.

Isofootcandle distribution must be ANSI Type III, short or Type IV, medium distribution, for cutoff or semi-cutoff luminaires.

With a 40-foot mounting height, each type of luminaire must maintain a minimum of 0.2 footcandle at least 60 feet each side, along the longitudinal roadway line below the luminaire, and a minimum of 0.35 footcandle at a transverse roadway distance from luminaire location equal to 1.5 times the luminaire mounting height.

Certified luminaire performance data must be provided. This data must include complete photometric test data in isofootcandle charts at a scale of 1 inch equals 20 feet, for the luminaire and lamp sizes shown on the plans.

Alternate data may be in horizontal footcandle values recorded on a 15' x 15' area extending 90 feet longitudinally each side of the light source, and 15 feet behind and 90 feet in front of the light source, for luminaire and lamp sizes, and mounting height shown on the plans. Horizontal footcandle levels in data submitted must equal or exceed levels specified. Failure to meet referenced values will be justification for rejection of the luminaires.

Photometric testing must be performed and certified by an independent and recognized testing laboratory.

Low pressure sodium lamps must:

1. Be 180 W, single-ended, bayonet base, tubular gas discharge lamp
2. Maintain a minimum of 93 percent of initial lumens during rated life and must comply with the following minimum performance requirements:

Performance Requirements

Lamp Designation	ANSI L74-RF-180
Initial Lumens	33,000 lumens
Rated Ave. Life (@ 10 hrs/Start)	18,000 hours
Operating Position	Horizontal ±20 degrees

3. Reach 80 percent of light output within 10 minutes and must restrike within 1 minute after an outage due to power interruption or voltage drop at the lamp socket
4. Identify the month and year of installation.
5. Have an autotransformer or high-reactance type ballast. The ballast must comply with the following:

    5.1. Lamp current crest factor must not exceed 1.8 at nominal line voltage
    5.2. Ballast loss must not exceed 24 percent for 180 W ballast at nominal line voltage

Autotransformer or High-Reactance Type Ballast

Ballast Type	Power Factor	Lamp Operation
Autotransformer or High-Reactance	Not less than 90 percent when ballast is operated at nominal line voltage with a nominally-rated reference lamp	Lamp wattage regulation spread does not vary by more than ±6 percent for ±10 percent input voltage variation from nominal through life

A multi-circuit connector must be included for quick disconnection of ballast tray.

86-6.03 SOFFIT AND WALL LUMINAIRES

Soffit and wall luminaire must be weatherproof and corrosion resistant.
Each flush-mounted soffit luminaire must consist of:

1. Metal body with two 1-inch minimum conduit hubs and provisions for anchoring into concrete
2. Prismatic refractor made of heat-resistant polycarbonate mounted in a door frame and clearly identified as to street side
3. Specular anodized aluminum reflector
4. Ballast located either within housing or in a ceiling pull box as shown on the plans
5. Lamp socket

The door frame assembly must be hinged, gasketed, and secured to body by at least 3 machine screws.
Each pendant soffit luminaire must be enclosed and gasketed, have an aluminum finish, and include:

1. Reflector with a specular anodized aluminum finish
2. Refractor made of heat-resistant polycarbonate
3. Optical assembly hinged and latched for lamp access and a device to prevent dropping
4. Ballast designed for operation in a raintight enclosure
5. Galvanized metal box with a gasketed cover, 2 captive screws, and 2 chains to prevent dropping and for luminaire mounting

Each wall-mounted luminaire must consist of:

1. Cast metal body
2. Prismatic refractor, made of glass, mounted in a door frame
3. Aluminum reflector with a specular anodized finish
4. Integral ballast
5. Lamp socket
6. Gasket between refractor and body
7. At least two 5/16-inch minimum diameter mounting bolts

Cast-aluminum bodies to be cast into or mounted against concrete must have a thick application of alkali-resistant bituminous paint on all surfaces to be in contact with concrete.

Each soffit luminaire and wall luminaire must include a 70 W high-pressure sodium lamp with a minimum average rated life of 24,000 hours. Each lamp socket must be positioned to locate the light center of the lamp within 1/2 inch of light center location of the luminaire design.

Ballast must comply with Section 86-6.01A, "High Pressure Sodium Lamp Ballasts." Wall luminaire ballast must be located in luminaire housing or, if shown on the plans, in a pull box adjacent to luminaire.

86-6.04 PEDESTRIAN CROSSING FIXTURES

Before starting fixture manufacturing, submit fixture design for approval. If requested, submit 1 complete prototype fixture for approval at least 30 days before manufacturing the fixtures. The prototype fixture will be returned to you, and if permitted, the fixture may be installed in the work.

Lens unit in door section must be formed of 1-1/2-inch methyl methacrylate rod cut and fire-glazed for a clear finish or a cast unit with equivalent tolerances and finish.

Lens must be secured to door section with an extruded lens retainer of 6063-T5 aluminum alloy that fits the lens shape. Lens retainer must fit the full length of lens on both sides. Continuous lens retainer for the full length of 3 lenses is allowed. Z bars of 5052-H32 or 5005-H14 aluminum alloy, 1/16 inch minimum thickness may be substituted for extruded lens retainer.

A captive positive-keyed screw-type latching device requiring a special socket wrench must be installed at upper edge to secure door in the closed position as shown on the plans. Furnish 2 special wrenches to the Engineer.

Each fixture must include a F48T12/CW rapid start fluorescent lamp with recessed, double contact base installed on back side of door directly behind lens.

Each lampholder must be UL listed for outdoor use without an enclosure and with 1,500 mA rapid start fluorescent lamp. Lampholder must be spring-loaded type.

For each lamp, the distance from face of lampholder to the lamp must be designed to provide a compression of at least 0.10-inch on the spring-type lampholder when lamp is in place. Lamp must have positive mechanical and electrical contact when lamp is in place. Socket on spring-type lampholder must have enough travel to allow lamp installation. Spring must not be a part of current-carrying circuit.

Ballast must be high-power-factor type with weatherproof leads for operation of one 48-inch rapid-start lamp. Ballast must be UL listed for outdoor operation on 110 to 125 V(ac) 60 Hz circuit and rated at 1,500 mA.

Conductors from ballast leads to lampholder must be minimum size of No. 16, stranded, and UL-listed copper AWM. Splicing of lampholder conductors to ballast leads must be performed by using mechanically secure connectors.

Conductors in fixture except ballast leads and entrance line conductors, must be UL-listed AWM.

Provide sufficient slack in the conductors to allow the fixture door to fully open.

Circuit conductors entering the fixture must be terminated on molded phenolic barrier-type terminal blocks rated at 15 A and 600 V(ac) and must have integral-type white waterproof-marking strips. Current-carrying parts of terminal blocks must be insulated from fixture with integral plugs or strips to provide protection from line-to-ground flashover voltage. Terminal blocks must be attached to wireway cover in top section. If you use sectionalized terminal blocks, each section must include an integral barrier on each side and be capable of rigid mounting and alignment.

Exposed surfaces of fixture must be uniform in appearance and free from significant defects, including improper fit, dents, deep scratches and abrasions, burrs, roughness, off-square ends, holes off-center or jagged, and surface irregularities. Screws for attaching components to fixture door, including Z bars, ballasts, and terminal block, must be tapped into door from the inside only. Screwheads, nuts, or other fasteners must not be removable from the outside.

86-6.04A Pedestrian Undercrossing Fixtures

Fixture shell must be cast aluminum alloy, industrial type or Federal Class 18 aluminum of 1/4 inch minimum thickness.

Door must be 1 piece of 6061-T6 aluminum alloy of 1/8 inch minimum thickness.

Continuous piano hinge must be Type 1100 aluminum alloy. The piano hinge must be welded or riveted to door section with 1/8 inch aluminum rivets. Matching holes must be drilled in the hinge and lower edge of fixture. After shell is in place, door assembly must be attached by minimum 3/8-inch No. 8 stainless steel self-tapping screws.

A neoprene gasket must be attached to frame to provide a cushion between the shell and the door.

Chain or other device must be included to prevent the door, when fully opened, from coming in contact with the undercrossing wall.

Fixture must be held in place by three 3/8" x 8" anchor bolts with 2 nuts each.

Fixture surfaces in contact with concrete, and with anchor bolts and nuts must be painted with a thick application of alkali-resistant bituminous paint. Paint must comply with MIL-P-6883.

Circuit conductor entering the fixture must be terminated on 2-position terminal blocks.

Both ends of fixture must have holes for 1-inch conduit. Unused holes must be plugged with pressed metal closures.

86-6.04B Pedestrian Overcrossing Fixtures

Fixture shell must consist of:

1. Top section and a door section of extruded 6063-T5 aluminum alloy, each with a nominal 1/8 inch wall thickness
2. 2 cast-end sections of 319 aluminum alloy
3. Internal wireway cover of 505-H32 aluminum alloy

Top section and door section must be joined together on one side by a continuous hinge formed as part of the 2 extrusions and must overlay to allow locking on the other side. Hinge must be treated with a silicone grease that will prevent the entrance of water by capillary action.

Wireway cover with 3/16 inch hemmed ends up and terminal blocks and circuit conductors must be inserted before welding end sections and must provide clearance at both ends for conductors. Cover must be fastened by at least two 1/4 inch No. 4 self-threading sheet metal screws with binding head and blunt point. You may substitute blind rivets of equivalent strength.

One or more bronze sash chains or other device must be included to prevent door from opening to an extent that will damage the hinge.

Lampholder must include heat-resistant circular cross section neoprene sealing gasket, silver-coated contacts, and waterproofed lead entrance for use with a 1,500 mA rapid start fluorescent lamp.

Ballast must be at most 13-1/4 inches long.

Circuit conductors entering the fixture must be terminated on 3-position terminal blocks.

Electrical system of pedestrian overcrossing must be grounded by a No. 8 copper wire installed in conduit from fixture to fixture, from end fixture to conduit fitting on end post and from conduit fitting on end post to grounding bushing in nearest pull box.

Ground wire must be secured to inside of telescoping sleeve end casting where conductors are carried and to the inside of Type LB conduit fitting on end post by a connecting lug and a No. 8 self-threading pan screw.

Lamp, lampholder, ballast, and fixture wire, must be attached to door section. Terminal blocks must be attached to top section or wireway cover.

Three No. 10, solid copper circuit conductors must be installed between terminal blocks as part of each completed fixture.

Before shipment to job site, fixture must be completely manufactured and assembled in the shop.

86-6.05 INDUCTION SIGN LIGHTING FIXTURES

Each induction sign lighting fixture must include housing with door, reflector, refractor or lens, lamp, power coupler, high frequency generator, socket assembly, fuse block, and fuses.

Each induction sign lighting fixture must:

1. Be designed for mounting near the bottom of sign panel on an overhead sign structure.
2. Be an enclosed design and be raintight and corrosion resistant.
3. Have a minimum average rating of 60,000 hours.
4. Be for a wattage of 87 W, 120/240 V(ac).
5. Have a power factor greater than 90 percent and total harmonic distortion less than 10 percent.
6. Be UL approved for wet locations and be FCC Class A-listed.
7. Not exceed 44 pounds in weight.
8. Include the manufacturer's brand name, trademark, model number, serial number, and date of manufacture on packaged assembly. Same information must be permanently marked on the outside and inside of housing.
9. Comply with minimum horizontal footcandle requirement shown on the plans.
10. Be a maximum height of 12 inches above the top of the mounting rails.

If fixture is located so that the light center of the lamp is 55 inches in front of, 1 foot below, and centered on a 10-foot high by 20-foot wide sign panel, the ratio of maximum to minimum illuminance level on the panel must not exceed 12 to 1 in 95 percent of the points measured. Illuminance gradient must not exceed 2 to 1 and is defined as the ratio of minimum illuminance on a 1-foot square of panel to that on an adjacent 1-foot square of panel.

Each fixture must have a mounting assembly that will allow fixture to be mounted on continuous slot channels. Mounting assembly must be either cast aluminum, hot-dip galvanized steel plate, or steel plate that has been galvanized and finished with a polymeric coating system or same finish that is used for housing.

Housing must have a door designed to hold a refractor or lens, and to open without the use of special tools. Housing and door must be manufactured of sheet or cast aluminum, and have a powder coat or polyester paint finish of a gray color resembling unfinished manufacturing. Sheet aluminum must comply with ASTM B 209 or B 209M for 5052-H32 aluminum sheet. External bolts, screws, hinges, hinge pins, and door closure devices must be corrosion resistant.

Housing must include weep holes.

Door must be hinged to housing on side of fixture away from the sign panel and include 2 captive latch bolts or other latching device. Door must be designed to lock in the open position, 50 degrees minimum from the plane of the door opening, with an 85-mph 3-second-wind-gust load striking the door from either side.

Door and housing must be gasketed to be raintight and dusttight. Thickness of gasket must be 1/4 inch, minimum.

Fixture height must be less than 12 inches above the top of mounting rails.

Reflector must be 1 piece, made from specularly finished aluminum protected with an electrochemically applied anodized finish or a chemically applied silicate film, and designed so deposited water due to condensation will drain away. Reflector must be secured to housing with a minimum of 2 screws and removable without removing any fixture parts. Do not attach reflectors to outside of housing.

Refractor or lens must have a smooth exterior and must be manufactured from the material as follows:

Refractor and Lens Material Requirements

Component	Manufactured From
Flat lens	Heat-resistant glass
Convex lens	Heat resistant, high-impact resistant tempered glass
Refractor	Borosilicate heat resistant glass

Refractor and convex lens must be designed or shielded so no fixture luminance is visible if fixture is approached directly from the rear and viewing level is the bottom of the fixture. If a shield is used, it must be an integral part of the door casting.

Each fixture must include an 85 W induction lamp with an interior wall that is fluorescent phosphor-coated. Light output must be at least 70 percent at 60,000 hours. Lamp must have a minimum color-rendering index of 80, be rated at a color temperature of 4,000K and be removable without the use of tools.

Lamp socket must be a porcelain enclosed mogul type with a shell that contains integral lamp grips to assure electrical contact under normal vibration conditions. Center contact must be spring-loaded. Shell and center contact must be nickel-plated brass. Socket must be rated for 1,500 W and 600 V(ac).

Power coupler must include a construction base with antenna, heat sink, and electrical connection cable, and be designed so it can be removed with common hand tools.

High frequency generator must:

1. Start and operate lamps at an ambient temperature of -25 °C or greater for the rated life of the lamp
2. Operate continuously at ambient air temperatures from -25 °C to 25 °C without reduction in generator life
3. Have a design life of at least 100,000 hours at 55 °C
4. Have an output frequency of 2.65 MHz ± 10 percent
5. Have radio frequency interference that complies with FCC Title 47, Part 18, regulations regarding harmful interference
6. Be replaceable with common hand tools
7. Mounted so the fixture can be used as a heat sink

Conductor terminal must be identified by the component terminal the conductor connects to.

Submit a copy of the high frequency generator test methods and results from the manufacturer with each lot of fixtures.

Each fixture must include a barrier-type fuse block for terminating field connections. Fuse block must:

1. Be secured to housing and be accessible without removal of any fixture parts
2. Be mounted to leave a minimum of 1/2 inch air space from sidewalls of housing
3. Be designed for easy removal of fuses with a fuse puller, be rated at 600 V(ac), and have box terminals.

Fuses must be 13/32-inch diameter, 1-1/2 inch long ferrule type and UL or ETL listed. For 120 V(ac) input fixture, only the ungrounded conductor must be fused and there must be a solid link between the neutral and the high frequency generator.

If shown on the plans, include a wire guard to prevent damage to the refractor or lens. Guard must be constructed of 1/4-inch minimum diameter galvanized steel wire, and either hot-dip galvanized or electroplated-zinc coated as specified in ASTM B 633, Service Condition SC4 with a clear chromate dip treatment. Guard elements must be spaced to prevent rocks larger than 1-1/2-inch diameter from passing through.

86-6.06 SIGN LIGHTING FIXTURES FOR FLASHING BEACON

Sign lighting fixture must:

1. Be UL or ETL listed for outdoor installation
2. Include a hood with side outlet tapped for conduit, a symmetrical 10-inch steel reflector with a white porcelain-enamel finish, and a medium base socket
3. Be rated at 150 W minimum

86-6.07 INTERNALLY ILLUMINATED STREET NAME SIGNS

Sign fixture must be:

1. Designed and constructed to prevent deformation or failure when subjected to an 85 mph 3-second-wind-gust load as specified in AASHTO publication, "Standard Specifications for Structural Supports of Highway Signs, Luminaires and Traffic Signals," and its interim revisions
2. Manufactured from all new material and all ferrous parts must be galvanized or cadmium-plated
3. Type A or B signs

Top and bottom must be formed or extruded aluminum and must be attached to formed or cast aluminum end fittings. Housing must be designed for continuous sealing between top and bottom assemblies, and end fittings, and be constructed to resist torsional twist and warp. Opening or removing 1 panel must allow access to the interior of the sign for lamp, ballast, and fuse replacement.

Photoelectric unit sockets are not allowed.

For Type A sign, both sides must be hinged at the top to allow installation or removal of sign panel, and to allow access to interior of sign.

For Type B sign, sign panel must be slide-mounted into housing.

Reflectors may be used to obtain required sign brightness. Reflectors must be formed aluminum with acrylic baked white enamel surface having a minimum reflectance of 0.85.

Sign panel must be slide-mounted or rigid-mounted in a frame, with white legend, symbols, arrows, and border on each face. Background must be green.

Sign panels surface must be evenly illuminated. Average of brightness readings for letters must be 150 foot-lamberts, minimum. Light transmission factor of sign panel must provide a letter to background brightness ratio between 10 to 1 and 20 to 1. Background luminance must not vary by more than 40 percent from the average background brightness reading. Luminance of letters, symbols, and arrows must not vary by more than 20 percent from their average brightness readings.

Sign panels must be translucent, high impact, resistant plastic panels of one of the following:

1. Glass fiber reinforced acrylated resin
2. Polycarbonate resin
3. Cellulose acetate butyrate plastic

Paint on the outside of plastic must be protected by a plastic film that seals the front surface of panel and filters out ultraviolet radiation. Paint must be acrylic plastic type.

Surface must be free of blemishes in the plastic or coating that may impair the serviceability or detract from the general appearance and color matching of sign.

White or green color must not fade or darken when sign is exposed to an accelerated test of ultraviolet light equivalent to 2 years of outdoor exposure. Green color of sign, when not illuminated, must match Color No. 14109 of Federal Standard 595B.

Sign panel must not crack or shatter when a 1-inch diameter, steel ball with a weight of 2.4 ounces is dropped from a height of 8.5 feet above the sign panel to any point of sign panel. For this test, sign panel must be lying in a horizontal position and supported within its frame.

For Type A sign, gasket must be installed between sign panel frame and fixture housing to prevent water entry between frame and fixture housing. Gasket must be uniform and even-textured, and be the closed-cell, sponge-neoprene type, designed for use at temperatures between -20 °C and +74 °C.

Gasket must be neatly applied to thoroughly degreased, clean surface with a suitable heat-resistant adhesive that will not allow the gasket to slip at temperatures between -20 °C and +74 °C.

Ballast must be high power factor type and capable of starting the lamp at -20 °C and above.

Ballast for Type A sign must be rated at 200 mA. Ballasts for Type B sign must be rated at 430 mA. Ballast must be UL or ETL listed for operation on 110 to 125 V(ac), 60 Hz circuits, and comply with ANSI C 82.1 and ANSI C 82.2.

Lampholder must be UL or ETL listed for outdoor use and of the spring-loaded type. Lampholder must have silver-coated contacts and waterproofed entrance leads for use with a rapid-start fluorescent lamp. Removal of lamp from socket must de-energize the primary of ballast. Each lampholder must include heat-resistant, circular cross section, partially-recessed neoprene ring to seal against lamp ends and protect electrical contacts from moisture, dirt or other injurious elements.

Distance between face of lampholders must be designed to provide compression of at least 0.10 inch on the spring-type lampholder when lamp is in place. Lamp must have positive mechanical and electrical contact when lamp is in place. Socket on spring-type lampholder must have sufficient travel to allow lamp installation. Spring must not be a part of current carrying circuit. Lampholder must match lamp requirements and must not increase cathode filament circuit resistance by more than 0.10 Ω.

Lamp must comply with ANSI C 78.

Wiring connections in fixture must be terminated on molded, phenolic, barrier-type, terminal blocks rated at 15 A, 1,000 V(ac), and must have integral-type white waterproof-marking strips. Current carrying parts of terminal blocks must be insulated from fixture with integral plugs or strips to provide protection from line-to-ground flashover voltage. If you choose to use sectionalized terminal blocks, each section must include an integral barrier on each side and be capable of rigid mounting and alignment. Terminal screws must be No. 10, minimum.

Fuses must be Type 3AG, miniature, slow-blowing type with appropriate current and voltage ratings.

Fuseholder must be a panel-mounting type with threaded or bayonet-type knob that grips the fuse tightly for extraction. Use a separate fuse for each ballast.

Screened weep holes must be constructed at strategic locations in members subject to moisture collection.

Fasteners, screws, and hardware must be passive stainless steel, Type 302 or 304, or aluminum Type 6060-T6.

Top of fixture housing must have 2 free-swinging mounting brackets. Each bracket must be adjustable vertically for leveling the sign to either a straight or curved mast arm. Bracket assembly must allow fixture to swing perpendicular to the sign panel.

Hinge pins for the free-swinging brackets must have a minimum diameter of 1/4 inch.

Message, as shown on the plans, must be displayed on both sign panels.

If not shown on the plans, the message and the size of symbols or arrows will be given by the Engineer at your request. Letters must be 8-inch upper case and 6-inch lower case, Series E.

Fixture conductors must be UL- or ETL-listed AWM stranded copper wire with 28 mils, minimum, thermoplastic insulation, rated at 1,000 V(ac) and rated for use at 90 °C. Conductors must be No. 16 minimum and must match color coding of ballast leads.

Conductors within the fixture must be secured with easily removable spring cross straps, not clamped, in the chassis or fixture. Straps must be installed 12 inches apart or less.

Stranded copper conductors connected to screw-type terminals must terminate in approved crimp-type ring connectors.

Splices are not allowed within fixture.

Submit shop drawings showing the message for each sign, including size of letters, symbols or arrows, as shown on the plans. If requested, you must supply, without cost to the State, sufficient samples of materials to be used in the manufacturing of the sign or a complete sign assembly, to allow adequate testing and evaluation of compliance to specified requirements.

86-6.08 PHOTOELECTRIC CONTROLS

Photoelectric controls must be capable of directly switching multiple lighting systems.

86-6.08A Types

Photoelectric control type must comply with the following:

Photoelectric Control Types

Type I	Includes a remote photoelectric unit and a test switch housed in an enclosure.
Type II	Includes a remote photoelectric unit, a separate contactor located in a service equipment enclosure, and a test switch located in service equipment enclosure.
Type III	Includes a remote photoelectric unit, a separate contactor, and a test switch housed in an enclosure.
Type IV	Includes a photoelectric unit that plugs into an EEI-NEMA twist-lock receptacle integral with the luminaire.
Type V	Includes a photoelectric unit, contactor, and test switch located in service equipment enclosure.

A switch to allow manual operation of lighting circuit must be included for each Type I, Type II, Type III, and Type V photoelectric control. Switches must be single-hole mounting toggle type, single-pole, single-throw, rated at 12 A with a voltage rating that matches the circuit. Switches must have an indicating nameplate reading "Auto-Test" and be connected in parallel with the load contacts of the photoelectric unit. Test switches must not have an "OFF" position.

Photoelectric unit for Types I, II, and III photoelectric controls, must be pole-top mounted.

86-6.08B Equipment Details

86-6.08B(1) Photoelectric Unit

Photoelectric unit must:

1. Have an output in response to changing light levels. Response level must remain stable throughout life of control unit.
2. Have a "turn-on" between 1 and 5 footcandles, and a "turn-off" between 1.5 and 5 times "turn-on." Measurements must be made by procedures in EEI-NEMA standards for physical and electrical interchangeability of light-sensitive control devices used in the control of roadway lighting.
3. Have a EEI-NEMA type receptacle. Mounting brackets must be used where pole-top mounting is not possible. Photoelectric controls must be installed at locations show on the plans and oriented.
4. Be screened to prevent artificial light from causing cycling.
5. Have a supply voltage rating of 60 Hz, 105-130 V(ac), 210-240 V(ac), or 105-240 V(ac), as specified.
6. Have a load rating of 800 W minimum, incandescent, high intensity discharge, or fluorescent.
7. Operate at a temperature range of -20 °C to 55 °C.
8. Have a power consumption less than 10 W.
9. Be housed in a weatherproof enclosure.
10. Have a base with a 3-prong, EEI-NEMA standard, twist-lock plug mounting.
11. Have a "fail-on" feature.

Unit components must not require periodic replacement.

Photoelectric controls, except Type IV and Type V, must include a 4-inch minimum inside diameter, pole-top mounting adaptor containing a terminal block, and cable supports or clamps to support pole wires.

For switching 480 V(ac), 60 Hz circuits, a 100 VA, minimum, 480/120 V(ac) transformer must be installed in the contactor enclosure to allow 120 V(ac) for the photoelectric control unit. If more than 1 photoelectric unit is to be installed at a location, a single transformer with a volt-ampere rating capable of handling the total controlled load, may be used.

86-6.08B(2) Contactor

Contactor must:

1. Have contacts rated to switch the specified lighting load
2. Be normally open
3. Be the mechanical armature type with contacts of fine silver, silver alloy, or superior alternative material

86-6.08B(3) Enclosure

Enclosure for Type I and Type III photoelectric controls must be NEMA 3R. Enclosure must be supplied with a factory-applied rust-resistant prime coat and finish coat. Two applications of paint to match the color of the standard must be applied as specified in Section 86-2.16, "Painting." Enclosure may be hot-dip galvanized instead of painting. A minimum of 2-1/2 inches must be provided between contactor terminals and end of enclosure for wiring connections. Enclosure must be mounted on the same standard as the photoelectric unit at a height of about 6 feet above finished grade.

86-6.08B(4) Terminal Blocks

Terminal blocks must be rated at 25 A, 600 V(ac), molded from phenolic or nylon material, and of the barrier type with plated-brass screw terminals and integral-type marking strips.

86-6.09 TRANSFORMERS

Multiple-to-multiple transformers must be single-phase dry type designed for operation on a 60 Hz supply.

86-6.09A Electrical Requirements

Transformers must have a decal showing a connection diagram. Diagram must show either color-coding or wire-tagging with primary (H1, H2) or secondary (X1, X2) markers, and the primary and secondary voltage and volt-ampere rating. Transformers must comply with the following:

Transformer Electrical Requirements

Transformer Characteristic	Multiple-to-Multiple Unit
Rating	120/480 V(ac), 240/480 V(ac), or 480/120 V(ac)
Efficiency	Exceed 95 percent
Secondary Voltage Regulation and Tolerance	±3 percent from half load to full load

Secondary 480 V(ac) windings must be center-tapped.

86-6.09B Physical Requirements

External leads for multiple-to-multiple secondary connections must be Type USE, No. 10, rated 600 V(ac).

Transformer leads must extend a minimum of 12 inches from the case.

Transformer insulation must be NEMA 185 C or better.

Multiple-to-multiple transformers must withstand the application of 2,200 V(ac) from core to coils and from coil to coil for a 1-minute period.

The above tests must be made immediately after operation of transformer at full load for 24 hours.

Non-submersible transformers must include metal half-shell coil protection, have moisture resistant synthetic varnish impregnated windings, and be suitable for outdoor operation in a raintight enclosure.

Each transformer to be installed in a pull box must be the submersible type and include a handle and a hanger.

86-6.09C Submersible Type Transformers

Submersible type transformers must be securely encased in a rugged corrosion resistant, watertight case and must withstand a 5-day test submerged in 2 feet of salt water, 2 percent salt by weight, with 12-hour on and off periods. The operating periods must be at full load.

Leads of submersible transformers must be brought out through one or more sealed hubs and secured to withstand a 100 pound static pull without loosening or leaking.

86-6.10 (BLANK)

86-6.11 FALSEWORK LIGHTING

86-6.11A General

Falsework lighting must include lighting to illuminate the pavement, portals, and pedestrian walkways at or under openings in the falsework required for traffic.

Lighting for pedestrian walkway illumination must be installed at all pedestrian openings through or under falsework.

Before starting falsework opening construction, you must submit a plan of proposed lighting installations for review and obtain approval. Approval will be made as specified in Section 5-1.02, "Plans and Working Drawings."

You must design falsework lighting so that required maintenance can be performed with a minimum of inconvenience to public traffic. Closing of traffic lanes for routine maintenance will not be permitted on roadways with posted speed limits greater than 25 mph.

Pavement under falsework with portals less than 150 feet apart and falsework portals must be illuminated only during the hours of darkness as defined in Division 1, Section 280, of the California Vehicle Code. Photoelectric switches must be used to control falsework lighting systems. Pavement under falsework with portals 150 feet or more apart and all pedestrian openings through falsework must be illuminated 24 hours per day.

Lighting fixtures must be aimed to avoid glare to oncoming motorists.

Type NMC cable with No. 12 minimum conductors, with ground wire, must be used. Fasten cable to supporting structure at sufficient intervals to adequately support cable and within 12 inches from every box or fitting. Conductors within 8 feet of ground must be enclosed in a 1/2 inch or larger metal conduit.

Each illumination system must be on a minimum of 1 separate branch circuit at each bridge location. Each branch circuit must be fused, not to exceed 20 A.

For falsework lighting, you must arrange with the serving utility to complete service connections. You must pay for energy, line extension, service, and service hookup costs.

At completion of project or when ordered by the Engineer, falsework lighting equipment will become your property and you must remove it from the job site.

You may propose a lighting plan that fulfills light intensity requirements to the systems specified herein. You must supply sufficient data to allow evaluation of alternative methods.

86-6.11B Pavement Illumination

Illumination of pavement at vehicular openings through falsework must comply with the following:

1. Fixture must include R/FL commercial type floodlamp holder with protective covers.
2. Fixture must be fully adjustable with brackets and locking screws, and allow mounting directly to a standard metal junction box.
3. Lamp must be medium-base 120 V(ac), 120 W, minimum, PAR-38 quartz-halogen floodlamp.
4. A continuous row of fixture types required must be installed at locations and spacing specified. Fixtures must be installed beneath falsework structure, with the end fixtures not further than 10 feet inside portal faces. Fixtures must be installed and energized immediately after the members supporting them have been erected.
5. Fixtures along the sides of the opening must be placed not more than 4 feet behind or 2 feet in front of the roadway face of the temporary railing. Mounting heights of fixtures must be between 12 and 16 feet above the roadway surface and must present an unobstructed light pattern on the pavement.

86-6.11C Portal Illumination

Illumination of falsework portals must comply with the following:

1. On each side of each entrance portal, plywood sheet clearance guides, 4 feet wide by 8 feet high, must be fastened vertically, facing traffic, with the bottom of the panel 3 feet to 4 feet above the roadway. The center of the panel must be located approximately 3 feet horizontally behind the roadway face of the railing. Panels must be freshly painted for each installation with not less than 2 applications of flat white paint. Paint testing will not be required.
2. If ordered by the Engineer, in order to improve the general appearance of the painted surfaces, you must repaint designated areas and that painting will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."
3. Falsework portals must be illuminated on the side facing traffic with 150 W, minimum, PAR reflector floodlamps mounted on the structure directly over each vertical support adjacent to the traveled way, as needed to uniformly illuminate the exterior falsework beam, the clearance guides, and the overhead clearance sign. Each lamp must be supported approximately 16 feet above the pavement and approximately 6 feet in front of the portal face.
4. Portal lighting and clearance guides must be installed on the day that vertical members are erected.

86-6.11D Pedestrian Walkway Illumination

Illumination of pedestrian openings through or under falsework must comply with the following:

1. Fixtures must be flush-mounted in the overhead protection shield and equipped with a damage-resistant clear polycarbonate diffuser lens. Lamps must be standard incandescent 100 W, 120 V(ac).
2. Fixtures must be centered over the passageway at intervals of not more than 15 feet with the end fixtures not more than 7 feet inside the end of the pedestrian openings.
3. Pedestrian passageway light systems must be installed immediately after the overhead protection shield is erected.

86-7 REMOVING, REINSTALLING OR SALVAGING ELECTRICAL EQUIPMENT

86-7.01 REMOVING ELECTRICAL EQUIPMENT

Existing electrical equipment, pull boxes, and conduits, to be removed and not reused or salvaged, become your property and you must dispose of it under Section 7-1.13, "Disposal of Materials Outside the Highway Right of Way." Unused underground conduit may be abandoned in place after all conductors have been removed, except that conduit terminations from conduit to be abandoned must be removed from pull boxes to remain.

Exercise care in salvaging equipment so that it will not be damaged or destroyed. Mast arms must be removed from standards. Luminaires, signal heads, and signal mounting assemblies must be removed from standards and mast arms.

Holes resulting from removing pull boxes must be filled with material equivalent to the surrounding material.

86-7.02 REINSTALLING REMOVED ELECTRICAL EQUIPMENT

If removed electrical equipment is to be reinstalled, you must supply all necessary materials and equipment, including signal mounting assemblies, anchor bolts, nuts, washers, and concrete as required to complete the new installation.

Luminaires to be reinstalled must be cleaned and relamped.

Existing materials required to be reused and found to be unsatisfactory by the Engineer must be replaced with new material and the replacement cost will be paid for as extra work as specified in Section 4-1.03D, "Extra Work."

86-8 PAYMENT

86-8.01 PAYMENT

The contract lump sum price or prices paid for signal, ramp metering, flashing beacon, lighting, sign illumination, traffic monitoring station, highway advisory radio systems, closed circuit television systems, or combinations thereof; for modifying or removing those systems; for temporary systems; or the lump sum or unit prices paid for various units of those systems; or the lump sum or per foot price paid for conduit of the various sizes, types, and installation methods listed in the Engineer's Estimate include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing and installing, modifying, or removing the systems, combinations or units thereof, including any necessary pull boxes (except if the type required is shown as a separate contract item); excavation and backfill; concrete foundations (except if shown as a separate contract item); pedestrian barricades; furnishing and installing illuminated street name signs; installing sign panels on pedestrian barricades, on flashing beacon standards, and on traffic signal mast arms; restoring sidewalk, pavement and appurtenances damaged or destroyed during construction; salvaging existing materials; and making all required tests, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

If poles for electrical systems are manufactured from a source located more than 300 air-line miles from Sacramento and Los Angeles, the Department will deduct $5,000 for inspection costs for each inspection site. If poles for electrical systems are manufactured from a source located more than 3,000 air-line miles from Sacramento and Los Angeles, the Department will deduct $8,000 for inspection costs for each inspection site.

Full compensation for all additional materials and labor, not shown on the plans or specified, that are necessary to complete the installation of the various systems, is included in the prices paid for the systems, or units thereof, except as provided in Section 86-1.06, "Maintaining Existing and Temporary Electrical Systems," and no additional compensation will be allowed therefor.

If shown as a contract item, the contract price paid per foot for cast-in-drilled-hole concrete pile (signal foundation) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing reinforced concrete pile foundations of the size shown on the Engineer's Estimate, including drilling holes, disposing of the material resulting from drilling holes, furnishing and placing anchor bolt assemblies and reinforcing steel, complete in place, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

If shown as a contract item, non-reinforced PCC foundations will be measured and paid for by the cubic yard for foundation concrete in the same manner as specified for minor concrete (minor structure) in Section 51, "Concrete Structures."

If shown as a separate contract item by the lump sum or per foot, interconnection conduit and cable includes all interconnection conductors, and conduit and pull boxes containing interconnection cable and no other conductors. The quantity of interconnection conduit and cable to be paid for by the foot is the length of that conduit. Compensation for conduit containing interconnection cable and other conductors is included in the contract price paid for the item requiring the other conductors.

Full compensation for furnishing, installing, maintaining, and removing falsework lighting equipment is included in the contract prices paid for the items of work involved in the structure that requires the falsework lighting and no additional compensation will be allowed therefor.

^^

SECTION 88 ENGINEERING FABRICS
(Issued 06-05-09)

Replace Section 88 with:

SECTION 88 GEOSYNTHETICS

88-1.01 GENERAL

88-1.01A Summary

Section 88 includes specifications for geosynthetics. Geosynthetics are used for:

1. Filtration
2. Drainage
3. Reinforcement
4. Water pollution control

5. Channel and shore protection
6. Pavement interlayer
7. Separation and stabilization

88-1.01B Submittals

Submit:

1. Certificate of Compliance under Section 6-1.07, "Certificates of Compliance"
2. Samples representing each lot
3. Minimum average roll values (MARV)

Label submittals with the manufacturer's name and product information.

88-1.01C Quality Control and Assurance

Treat geosynthetics to resist degradation from exposure to sunlight. Using covers, protect geosynthetics from moisture, sunlight, and shipping and storage damage.

88-1.02 FILTRATION

88-1.02A Filter Fabric

Geosynthetics used for filter fabric must be permeable and nonwoven. Filter fabric must consist of 1 of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Filter fabric must comply with:

Filter Fabric

Property	ASTM	Specification		
		Class A	Class B	Class C
Grab breaking load, 1-inch grip, lb minimum in each direction	D 4632	157		
Apparent elongation, percent minimum in each direction	D 4632	50		
Hydraulic bursting strength, psi minimum	D 3786	210		
Ultraviolet resistance, percent minimum retained grab breaking load, 500 hr	D 4355	70		
Permittivity, sec^{-1} minimum	D 4491	0.5	0.2	0.1
Apparent opening size, average roll value, U.S. Standard sieve size maximum	D 4751	40	60	70

88-1.03 DRAINAGE

88-1.03A Geocomposite Wall Drain

Geocomposite wall drain must consist of a polymeric core with filter fabric integrally bonded to 1 or both sides of the core creating a stable drainage void.

Filter fabric must comply with Section 88-1.02, "Filtration."

Geocomposite wall drain must comply with:

Geocomposite Wall Drain

Property	ASTM	Specification
Thickness with fabric, inches maximum	--	2
Transmissivity, gradient = 1.0, normal stress = 5,000 psf, gal/min/ft	D 4716	4

88-1.04 REINFORCEMENT

88-1.04A Geotechnical Subsurface Reinforcement

General

Geosynthetic used for geotechnical subsurface reinforcement must be either of the following:

1. Geotextile
2. Geogrid

Geotextile permittivity must be at least 0.05 sec^{-1} determined under ASTM D 4491.
Geogrid must have a regular and defined open area. The open area must be from 50 to 90 percent of the total grid area.

Long Term Design Strength

Long Term Design Strength (LTDS) of geosynthetic reinforcement is the ultimate tensile strength in the primary strength direction divided by reduction factors. Calculate the LTDS from the guidelines in Geosynthetic Research Institute (GRI) Standard Practice GG4a, GRI GG4b, or GRI GT7.

The product of the appropriate reduction factors must be at least 1.30. Determine the reduction factor for creep using a 75-year design life for permanent applications and a 5-year design life for temporary applications. Determine the installation damage reduction factor based on the characteristics of the backfill materials used.

If test data is not available, use default values of reduction factors in the GRI Standard Practice to calculate LTDS.

Submit the LTDS and its supporting calculations at least 15 days before placing geosynthetic reinforcement. Do not install before the Engineer's approval. The LTDS must be signed by an engineer who is registered as a civil engineer in the State.

88-1.05 WATER POLLUTION CONTROL

Geosynthetics used for water pollution control must comply with:

Water Pollution Control Geosynthetics

Property	ASTM	Application				
		Silt Fence		Sediment Filter Bag	Gravel-Filled Bags	Temporary Cover
		Woven	Non-woven			
Grab breaking load, 1-inch grip, lb minimum in each direction	D 4632	120	120	255	205	200
Apparent elongation, percent minimum, in each direction	D 4632	15	50	--	--	50
Water flow rate, gallons per minute/square foot minimum and maximum average roll value	D 4491	10 - 100	100 - 150	80 - 200	80 - 150	75 - 120
Permittivity, sec^{-1} minimum	D 4491	0.1	1.1	1.0	0.2	1.0
Apparent opening size, inches maximum average roll value	D 4751	0.023	0.023	0.033	0.016	0.007
Ultraviolet resistance, percent minimum retained grab breaking load, 500 hr.	D 4355	70	70	70	70	70

88-1.06 CHANNEL AND SHORE PROTECTION

88-1.06A Rock Slope Protection

Rock slope protection (RSP) fabric must be a permeable, nonwoven, needle-punched geotextile. RSP fabric consists of 1 of the following:

1. Polyester
2. Polypropylene
3. Combined polyester and polypropylene

Polymers must be either virgin compounds or clean reworked material. Do not subject virgin compounds to use or processing other than required for initial manufacture. Clean reworked material must be previously processed material from the processor's own production that has been reground, pelletized, or solvated. RSP fabric must not consist of more than 20 percent by weight of clean reworked material. Do not use recycled materials from either post-consumer or post-industrial sources.

Class 8 or Class 10 RSP fabric must comply with:

Rock Slope Protection Fabric

Property	ASTM	Specification	
		Class 8	Class 10
Weight, oz/yd^2 minimum	D 5261	7.5	9.5
Grab breaking load, lb 1-inch grip, min. in each direction	D 4632	200	250
Apparent elongation, percent min., in each direction	D 4632	50	50
Permittivity, sec^{-1}, minimum	D 4491	1.0	0.70
Apparent opening size, U.S. Standard sieve size minimum and maximum	D 4751	70 - 100	70 - 100
Ultraviolet resistance, percent minimum retained grab breaking load, 500 hr.	D4355	70	70

88-1.07 PAVEMENT INTERLAYER

88-1.07A Paving Fabric

Geosynthetics used for paving fabric must be nonwoven. Paving fabric must comply with:

Geosynthetic Paving Fabric

Property	ASTM	Specification
Mass per unit area, oz/yd^2 minimum	D 5261	4.1
Grab breaking load, lb 1-inch grip, minimum, in each direction	D 4632	100
Apparent elongation, percent minimum in each direction	D 4632	50
Hydraulic bursting strength, psi minimum	D 3786	200
Melting point, °F minimum	D 276	325
Asphalt retention, gal/yd^2 minimum	D 6140	0.2

88-1.07B Paving Mat

Geosynthetics used for paving mat must be a nonwoven fiberglass and polyester hybrid material. Paving mat must comply with:

Geosynthetic Paving Mat

Property	ASTM	Specification
Breaking force, lb/2 inches minimum	D 5035	45
Ultimate elongation, percent maximum	D 5035	5
Mass per unit area, oz/ sq yd minimum	D 5261	3.7
Melting point, °F minimum	D 276	400
Asphalt retention, gal/yd^2 minimum	D 6140	0.10

88-1.07C Paving Grid

Geosynthetics used for paving grid must be a geopolymer material formed into a grid of integrally connected elements with openings. Paving grid must comply with:

Geosynthetic Paving Grid

Property	Test	Specification		
		Class I	Class II	Class III
Tensile strength at ultimate, lb/in [a] minimum	ASTM D 6637	560 x 1,120	560	280
Aperture size, inch minimum	Calipered	0.5	0.5	0.5
Elongation, % maximum	ASTM D 6637	12	12	12
Mass per area, oz / sqyd minimum	ASTM D 5261	16	10	5.5
Melting point, °F minimum	ASTM D 276	325	325	325

Note:
[a] For Class I, machine direction x cross direction. For Class II and Class III, both directions.

88-1.07D Paving Geocomposite Grid

Paving geocomposite grid consists of paving grid specified under Section 88-1.07C, "Paving Grid," bonded or integrated with paving fabric specified under Section 88-1.07A, "Paving Fabric."

Paving geocomposite grid must have a peel strength of at least 10 pounds per foot determined under ASTM D 413.

88-1.07E Geocomposite Strip Membrane

Geocomposite strip membrane must consist of various widths of strips manufactured from of asphaltic rubber and geosynthetics. Geocomposite strip membrane must comply with:

Geocomposite Strip Membrane

Property	ASTM	Specification
Strip tensile strength, lbs/inch minimum	D 882	50
Elongation at break, % minimum	D 882	50
Resistance to puncture, lbs. minimum	E 154	200
Permeance, perms maximum	E 96/E 96M	0.10
Pliability, 1/4 inch mandrel with sample conditioned at 25 °F	D 146	No cracks in fabric or bitumen
Melting point, °F	D 276	325

88-1.08 SEPARATION AND STABILIZATION

88-1.08A Subgrade Enhancement Geotextile

Subgrade enhancement geotextile must consist of either of the following:

1. Polyester
2. Polypropylene

Subgrade enhancement geotextile must comply with:

Subgrade Enhancement Geotextile

Property	ASTM	Specification [a]				
		Class A1	Class A2	Class B1	Class B2	Class B3
Elongation at break, %	D 4632	<50	≥50	<50	<50	≥50
Grab tensile strength, lb minimum	D4632	250	160	--	320	200
Wide width tensile strength at 5% strain, lb/ft minimum	D 4595	--	--	2,000	--	--
Wide width tensile strength at ultimate strength, lb/ft minimum	D 4595	--	--	4,800	--	--
Tear strength, lb minimum	D 4533	90	60	--	120	80
Puncture strength, lb minimum	D 6241	500	310	620	620	430
Permittivity, sec^{-1} minimum	D 4491	0.05	0.05	0.20	0.20	0.20
Apparent opening size, inches maximum	D 4751	0.012	0.012	0.024	0.012	0.012
Ultraviolet stability (retained strength after 500 hrs exposure), % minimum	D 4355	70	70	70	70	70

Notes:
[a] Specifications are based on minimum average roll value in the weaker principle direction except apparent opening size is based on maximum average roll value.

88-1.09 PAYMENT

The Department measures and pays for geosynthetics under the specifications requiring their use.

^^

SECTION 90 PORTLAND CEMENT CONCRETE
(Issued 06-05-09)

Replace Section 90 with:

SECTION 90 PORTLAND CEMENT CONCRETE

90-1 GENERAL

90-1.01 DESCRIPTION

Portland cement concrete shall be composed of cementitious material, fine aggregate, coarse aggregate, admixtures if used, and water, proportioned and mixed as specified in these specifications.

The Contractor shall determine the mix proportions for concrete in conformance with these specifications.

Minor concrete shall contain not less than 505 pounds of cementitious material per cubic yard unless otherwise specified in these specifications or the special provisions.

Unless otherwise designated on the plans or specified in these specifications or the special provisions, the amount of cementitious material used per cubic yard of concrete in structures or portions of structures shall conform to the following:

Use	Cementitious Material Content (Pounds/CY)
Concrete designated by compressive strength:	
Deck slabs and slab spans of bridges	675 min., 800 max.
Roof sections of exposed top box culverts	675 min., 800 max.
Other portions of structures	590 min., 800 max.
Concrete not designated by compressive strength:	
Deck slabs and slab spans of bridges	675 min.
Roof sections of exposed top box culverts	675 min.
Prestressed members	675 min.
Seal courses	675 min.
Other portions of structures	590 min.
Concrete for precast members	590 min., 925 max.

Except for when a modulus of rupture is specified, the minimum required compressive strength for concrete shall be the strength specified, or 2,500 pounds per square inch, whichever is greater. Concrete shall be proportioned such that the concrete will attain the minimum required compressive strength.

If the specified 28-day compressive strength is greater than 3,600 pounds per square inch, the concrete shall be designated by compressive strength, and 42 days will be allowed to obtain the specified strength.

For concrete not designated by compressive strength, the Engineer may test the concrete for compressive strength. The concrete will be accepted if the compressive strength at 28 days attains 85 percent or more of the minimum required compressive strength.

Concrete shall be proportioned to conform to the following shrinkage limitations when tested in conformance with the requirements of AASHTO Designation: T 160, modified as follows:

Condition	Maximum Shrinkage of Laboratory Cast Specimens at 28 days Drying (average of 3, %)
Paving and approach slab concrete	0.050
Bridge deck concrete	0.045

Note: Shrinkage requirement is waived for concrete that is used for precast elements.

Shrinkage tests shall be either:

A. Performed by a laboratory accredited to perform AASHTO Designation: T 160, or
B. Performed by a laboratory that maintains a current rating of 3 or better for the Cement and Concrete Reference Laboratory (CCRL) concrete proficiency sample program.

Laboratory cast specimens shall have a 4" x 4" cross section. Specimens shall be removed from the molds 23 ± 1 hours after mixing the concrete and placed in lime water at 73 ± 3 °F to 7 days age. A comparator reading shall be taken at 7 days age and recorded as the initial reading. Specimens then shall be stored in a humidity controlled room maintained at 73 ± 3 °F and 50 ± 4 percent relative humidity for the remainder of the test. Subsequent readings shall be taken at 7, 14, 21, and 28 days drying.

Test data verifying conformance to the shrinkage limitations shall be submitted with the mix design. Shrinkage testing data accepted by the Engineer no more than 3 years prior to the first working day of this contract will be acceptable for this entire contract, provided the data was for concrete with similar proportions and the same materials and material sources to be used on this contract. Concrete shall be considered to have similar proportions if, when compared to concrete to be used on this project, no more than 2 mix design elements are varied. Varied mix design elements shall fall within the tolerances in the following table:

Mix Design Element	Tolerance (±)
Water to cementitious material ratio	0.03
Total water content	5 %
Coarse aggregate (weight per cubic yard)	10 %
Fine aggregate (weight per cubic yard)	10 %
Supplementary cementitious material content	5 %
Admixture (as originally dosed)	25 %

Note: Admixtures must be of the same brand.

Before using concrete or in advance of revising the mix proportions, the Contractor shall submit in writing to the Engineer a copy of the mix design.

Compliance with cementitious material content requirements will be verified in conformance with procedures described in California Test 518 for cement content. For testing purposes, supplementary cementitious material (SCM) shall be considered to be cement. Batch proportions shall be adjusted as necessary to produce concrete having the specified cementitious material content.

If any concrete has a cementitious material, portland cement, or SCM content that is less than the minimum required, the concrete shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place and the Contractor shall pay to the State $0.25 for each pound of cementitious material, portland cement, or SCM that is less than the minimum required. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract. The deductions will not be made unless the difference between the contents required and those actually provided exceeds the batching tolerances permitted by Section 90-5, "Proportioning." No deductions will be made based on the results of California Test 518.

The requirements of the preceding paragraph shall not apply to minor concrete.

90-2 MATERIALS

90-2.01 CEMENTITIOUS MATERIALS

Unless otherwise specified, cementitious material shall be either a combination of Type II or Type V portland cement and SCM, or a blended cement. No cementitious material shall be used in the work unless it is on the Department's Pre-Qualified Products List at the time of mix design submittal. Information regarding cementitious material qualification and placement on the Department's approved list can be obtained at the Transportation Laboratory.

Cementitious materials used in cast-in-place concrete for exposed surfaces of like elements of a structure shall be from the same sources and of the same proportions.

Cementitious materials shall be protected from moisture until used. Sacked cementitious materials shall be piled to permit access for tallying, inspecting, and identifying each shipment.

Facilities shall be provided to ensure that the various cementitious materials meeting this Section 90-2.01 are kept separate from each other and from other cementitious materials. A storage silo containing a cementitous material shall be emptied before using that silo for a different cementitious material. Blended cements with a percentage of SCM differing by more than 2 percentage points are considered different cementitious materials. Sampling cementitious materials shall be in conformance with California Test 125.

The Contractor shall furnish a Certificate of Compliance for cementitious materials in conformance with the provisions in Section 6-1.07, "Certificates of Compliance." The Certificate of Compliance shall indicate the source by name and location (including country, state, and city). If cementitious material is delivered directly to the job site, the Certificate of Compliance shall be signed by the cementitious material supplier. If the cementitious material is used in ready-mixed concrete or in precast concrete products purchased as such by the Contractor, the Certificate of Compliance shall be signed by the manufacturer of the concrete or product. If blended cement is used, the Certificate of Compliance shall include a statement signed by the blended cement supplier that indicates the actual percentage, by weight, of SCM in the blend. Weight of SCM shall be by weighing device conforming to Section 9-1.01, "Measurement of Quantities," or as determined by chemical analysis.

90-2.01A Cement

Portland cement shall conform to the requirements in ASTM Designation: C 150 except the C_3S content of Type II cement shall not exceed 65 percent.

Blended cement shall conform to the requirements for Portland Blast-Furnace Slag Cement, Type IS (MS) or Portland-Pozzolan Cement, Type IP (MS) in AASHTO Designation: M 240, except that the maximum limits on the pozzolan content shall not apply. Blended cement shall be comprised of Type II or Type V cement and SCM produced either by intergrinding portland cement clinker and SCM, by blending portland cement and either finely ground granulated blast furnace slag or finely divided pozzolan, or a combination of intergrinding and blending.

In addition, Type II portland cement and Type V portland cement shall conform to the following requirements:

A. The cement shall not contain more than 0.60-percent by mass of alkalies, calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O, when determined by methods as required in AASHTO Designation: T 105; and
B. The autoclave expansion shall not exceed 0.50-percent

Type III portland cement shall be used only as specified or with the approval of the Engineer. Type III portland cement shall conform to the additional requirements listed above for Type II portland cement. The Contractor may use Type III portland cement in the manufacturing of precast concrete.

90-2.01B Supplementary Cementitious Materials

Each supplementary cementitious material shall conform to one of the following:

A. Fly ash conforming to the requirements in AASHTO Designation: M 295, Class F, and these specifications. The available alkali, as sodium oxide equivalent, shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 311 or the total alkali, as sodium oxide equivalent, shall not exceed 5.0 percent when determined in conformance with the requirements in AASHTO Designation: T 105.

B. Ultra fine fly ash (UFFA) conforming to the requirements in AASHTO Designation: M 295, Class F, and the following chemical and physical requirements:

Chemical Requirements	Percent
Sulfur Trioxide (SO_3)	1.5 max.
Loss on ignition	1.2 max.
Available Alkalies (as Na_2O) equivalent	1.5 max.

Physical Requirements	Percent
Particle size distribution	
Less than 3.5 microns	50
Less than 9.0 microns	90
Strength Activity Index with portland cement	
7 days	95 (minimum % of control)
28 days	110 (minimum % of control)
Expansion at 16 days when testing job materials in conformance with ASTM C 1567*	0.10 max.

* In the test mix, Type II or Type V portland cement shall be replaced with at least 12% UFFA by weight.

C. Raw or calcined natural pozzolans conforming to the requirements in AASHTO Designation: M 295, Class N. and the following requirements and these specifications. The available alkali, as sodium oxide equivalent, shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 311 or the total alkali, as sodium oxide equivalent, shall not exceed 5.0 percent when determined in conformance with the requirements in AASHTO Designation: T 105.

D. Metakaolin conforming to the requirements in AASHTO Designation: M 295, Class N, and the following chemical and physical requirements:

Chemical Requirements	Percent
Silicon Dioxide (SiO_2) + Aluminum Oxide (Al_2O_3)	92.0 min.
Calcium Oxide (CaO)	1.0 max
Sulfur Trioxide (SO_3)	1.0 max.
Loss on ignition	1.2 max.
Available Alkalies (as Na_2O) equivalent	1.0 max.

Physical Requirements	Percent
Particle size distribution Less than 45 microns	95
Strength Activity Index with portland cement	
7 days	100 (minimum % of control)
28 days	100 (minimum % of control)

E. Ground Granulated Blast Furnace Slag (GGBFS) conforming to the requirements in AASHTO Designation: M 302, Grade 100 or Grade 120.

F. Silica Fume conforming to the requirements of AASHTO Designation: M 307, with reduction in mortar expansion of 80 percent, minimum, using the cement from the proposed mix design.

Commingling of fly ash from different sources at uncontrolled ratios is permissible only if the following criteria are satisfied:

A. Sources of fly ash to be commingled shall each produce fly ash that conforms to the requirements in AASHTO Designation: M 295, Class F.
B. Testing of the commingled product is the responsibility of the fly ash supplier.
C. Each fly ash's running average of relative density shall not differ from any other by more than 0.25 pound per cubic inch at the time of commingling.
D. Each fly ash's running average of loss on ignition shall not differ from any other by more than one percent at the time of commingling.
E. The final product of commingled fly ash shall conform to the requirements in AASHTO Designation: M 295, Class F.

90-2.01C Required Use Of Supplementary Cementitious Materials

General

The amount of portland cement and SCM used in portland cement concrete shall conform to the minimum cementitious material content provisions in Section 90-1.01, "Description," or Section 90-4.05, "Optional Use of Chemical Admixtures," and these specifications.

The SCM content in portland cement concrete shall conform to one of the following:

A. Any combination of portland cement and at least one SCM, satisfying Equations (1) and (2):

Equation (1)

$$\frac{(25 \times UF) + (12 \times FA) + (10 \times FB) + (6 \times SL)}{MC} \geq X$$

Where:

UF = Silica fume, metakaolin, or UFFA, including the amount in blended cement, pounds per cubic yard.
FA = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N with a CaO content up to 10 percent, including the amount in blended cement, pounds per cubic yard.
FB = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N with a CaO content up to 15 percent, including the amount in blended cement, pounds per cubic yard.
SL = GGBFS, including the amount in blended cement, pounds per cubic yard.
MC = Minimum amount of cementitious material specified, pounds per cubic yard.
X = 1.8 for innocuous aggregate, 3.0 for all other aggregate.

Equation (2)

$$MC - MSCM - PC \geq 0$$

Where:

MC = Minimum amount of cementitious material specified, pounds per cubic yard.
MSCM = The minimum sum of SCMs that satisfies Equation (1) above, pounds per cubic yard.
PC = The amount of portland cement, including the amount in blended cement, pounds per cubic yard.

B. 15 percent of Class F fly ash with at least 48 ounces of $LiNO_3$ solution added per 100 pounds of portland cement. CaO content of the fly ash shall not exceed 15 percent.

Precast Concrete

The SCM content in precast portland cement concrete shall conform to one of the following:

A. Any combination of portland cement and SCM, satisfying the following equation:

Equation (3)

$$\frac{(25 \text{ x UF}) + (12 \text{ x FA}) + (10 \text{ x FB}) + (6 \text{ x SL})}{\text{TC}} \geq \text{X}$$

Where:

UF = Silica fume, metakaolin, or UFFA, including the amount in blended cement, pounds per cubic yard.
FA = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N with a CaO content up to 10 percent, including the amount in blended cement, pounds per cubic yard.
FB = Fly ash or natural pozzolan conforming to the requirements in AASHTO Designation: M 295, Class F or N with a CaO content up to 15 percent, including the amount in blended cement, pounds per cubic yard.
SL = GGBFS, including the amount in blended cement, pounds per cubic yard.
TC = Total amount of cementitious material used in the mix, pounds per cubic yard.
X = 0.0 if precast members are constructed with portland cement concrete using aggregate that is "innocuous" in conformance with the provisions in Section 90-2.02, "Aggregates."
X = 3.0 for all other aggregate.

B. 15 percent of Class F fly ash with at least 48 ounces of $LiNO_3$ solution added per 100 pounds of portland cement. CaO content of the fly ash shall not exceed 15 percent.
C. Any combination of supplementary cementitious material and portland cement may be used if the expansion of cementitious material and aggregate does not exceed 0.10 percent when tested in conformance with the requirements in ASTM C 1567. Test data shall be submitted with each mix design. Test data accepted by the Engineer no more than 3 years prior to the first working day of this contract will be acceptable for this entire contract, provided the data was for the same concrete mix and the same materials and material sources to be used on this contract.

90-2.02 AGGREGATES

To be considered innocuous, aggregate must be on the Department's approved list, "Innocuous Aggregates for use in Concrete." Information regarding aggregate qualification and placement on the Department's approved list can be obtained at the Transportation Laboratory.

Both coarse and fine aggregate must be on the approved list for the aggregate used in concrete to be considered innocuous.

Aggregates shall be free from deleterious coatings, clay balls, roots, bark, sticks, rags, and other extraneous material.

The Contractor shall provide safe and suitable facilities, including necessary splitting devices for obtaining samples of aggregates, in conformance with California Test 125.

Aggregates shall be of such character that it will be possible to produce workable concrete within the limits of water content provided in Section 90-6.06, "Amount of Water and Penetration."

Aggregates shall have not more than 10 percent loss when tested for soundness in conformance with the requirements in California Test 214. The soundness requirement for fine aggregate will be waived, provided that the durability index, D_f, of the fine aggregate is 60 or greater when tested for durability in conformance with California Test 229.

If the results of any one or more of the Cleanness Value, Sand Equivalent, or aggregate grading tests do not meet the requirements specified for "Operating Range" but all meet the "Contract Compliance" requirements, the placement of concrete shall be suspended at the completion of the current pour until tests or other information indicate that the next material to be used in the work will comply with the requirements specified for "Operating Range."

If the results of either or both the Cleanness Value and coarse aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete that is represented by the tests shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place, and the Contractor shall pay to the State $3.50 per cubic yard for paving concrete and $5.50 per cubic yard for all other concrete for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract.

If the results of either or both the Sand Equivalent and fine aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete which is represented by the tests shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place, and the Contractor shall pay to the State $3.50 per cubic yard for paving concrete and $5.50 per cubic yard for all other concrete for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract.

The 2 preceding paragraphs apply individually to the "Contract Compliance" requirements for coarse aggregate and fine aggregate. When both coarse aggregate and fine aggregate do not conform to the "Contract Compliance" requirements, both paragraphs shall apply. The payments specified in those paragraphs are in addition to any payments made in conformance with the provisions in Section 90-1.01, "Description."

No single Cleanness Value, Sand Equivalent, or aggregate grading test shall represent more than 300 cubic yards of concrete or one day's pour, whichever is smaller.

When the source of an aggregate is changed, the Contractor shall adjust the mix proportions and submit in writing to the Engineer a copy of the mix design before using the aggregates.

90-2.02A Coarse Aggregate

Coarse aggregate shall consist of gravel, crushed gravel, crushed rock, reclaimed aggregate, crushed air-cooled iron blast furnace slag or combinations thereof. Crushed air-cooled blast furnace slag shall not be used in reinforced or prestressed concrete.

Reclaimed aggregate is aggregate that has been recovered from plastic concrete by washing away the cementitious material. Reclaimed aggregate shall conform to all aggregate requirements.

Coarse aggregate shall conform to the following quality requirements:

Tests	California Test	Requirements
Loss in Los Angeles Rattler (after 500 revolutions)	211	45% max.
Cleanness Value		
Operating Range	227	75 min.
Contract Compliance	227	71 min.

In lieu of the above Cleanness Value requirements, a Cleanness Value "Operating Range" limit of 71, minimum, and a Cleanness Value "Contract Compliance" limit of 68, minimum, will be used to determine the acceptability of the coarse aggregate if the Contractor furnishes a Certificate of Compliance, as provided in Section 6-1.07, "Certificates of Compliance," certifying that:

A. Coarse aggregate sampled at the completion of processing at the aggregate production plant had a Cleanness Value of not less than 82 when tested in conformance with the requirements in California Test 227; and
B. Prequalification tests performed in conformance with the requirements in California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

90-2.02B Fine Aggregate

Fine aggregate shall consist of natural sand, manufactured sand produced from larger aggregate or a combination thereof. Manufactured sand shall be well graded.

Fine aggregate shall conform to the following quality requirements:

Test	California Test	Requirements
Organic Impurities	213	Satisfactory[a]
Mortar Strengths Relative to Ottawa Sand	515	95%, min.
Sand Equivalent:		
Operating Range	217	75, min.
Contract Compliance	217	71, min.

[a] Fine aggregate developing a color darker than the reference standard color solution may be accepted if it is determined by the Engineer, from mortar strength tests, that a darker color is acceptable.

In lieu of the above Sand Equivalent requirements, a Sand Equivalent "Operating Range" limit of 71, minimum, and a Sand Equivalent "Contract Compliance" limit of 68, minimum, will be used to determine the acceptability of the fine aggregate if the Contractor furnishes a Certificate of Compliance, as provided in Section 6-1.07, "Certificates of Compliance," certifying that:

A. Fine aggregate sampled at the completion of processing at the aggregate production plant had a Sand Equivalent value of not less than 82 when tested by California Test 217; and
B. Prequalification tests performed in conformance with California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

90-2.03 WATER

In conventionally reinforced concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 1,000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1,300 parts per million of sulfates as SO_4, when tested in conformance with California Test 417. In prestressed concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 650 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1,300 parts per million of sulfates as SO_4, when tested in conformance with California Test 417. In no case shall the water contain an amount of impurities that will cause either: 1) a change in the setting time of cement of more than 25 percent when tested in conformance with the requirements in ASTM Designation: C 191 or ASTM Designation: C 266 or 2) a reduction in the compressive strength of mortar at 14 days of more than 5 percent, when tested in conformance with the requirements in ASTM Designation: C 109, when compared to the results obtained with distilled water or deionized water, tested in conformance with the requirements in ASTM Designation: C 109.

In nonreinforced concrete work, the water for curing, for washing aggregates and for mixing shall be free from oil and shall not contain more than 2,000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, or more than 1,500 parts per million of sulfates as SO_4, when tested in conformance with California Test 417.

In addition to the above provisions, water for curing concrete shall not contain impurities in a sufficient amount to cause discoloration of the concrete or produce etching of the surface.

Water reclaimed from mixer wash-out operations may be used in mixing concrete. The water shall not contain coloring agents or more than 300 parts per million of alkalis (Na_2O + 0.658 K_2O) as determined on the filtrate. The specific gravity of the water shall not exceed 1.03 and shall not vary more than ±0.010 during a day's operations.

90-2.04 Admixture Materials

Admixture materials shall be stored and dispersed in liquid form and conform to the following requirements:

A. Chemical Admixtures—ASTM Designation: C 494.
B. Air-entraining Admixtures—ASTM Designation: C 260.
C. Lithium Nitrate shall be in an aqueous solution conforming to the following:

1. Lithium Nitrate ($LiNO_3$) must be 30 percent +/- 0.5 percent by weight
2. Sulfate (SO_4) must be less than 1000 ppm
3. Chloride (Cl) must be less than 1000 ppm
4. Alkalis (Na_2O + 0.658 K_2O) must be less than 1000 ppm

90-3 AGGREGATE GRADINGS

90-3.01 GENERAL

Before beginning concrete work, the Contractor shall submit in writing to the Engineer the gradation of the primary aggregate nominal sizes that the Contractor proposes to furnish. If a primary coarse aggregate or the fine aggregate is separated into 2 or more sizes, the proposed gradation shall consist of the gradation for each individual size, and the proposed proportions of each individual size, combined mathematically to indicate one proposed gradation. The proposed gradation shall meet the grading requirements shown in the table in this section, and shall show the percentage passing each of the sieve sizes used in determining the end result.

The Engineer may waive, in writing, the gradation requirements in this Section 90-3.01 and in Sections 90-3.02, "Coarse Aggregate Grading," 90-3.03, "Fine Aggregate Grading," and 90-3.04, "Combined Aggregate Gradings," if, in the Engineer's opinion, furnishing the gradation is not necessary for the type or amount of concrete work to be constructed.

Gradations proposed by the Contractor shall be within the following percentage passing limits:

Primary Aggregate Nominal Size	Sieve Size	Limits of Proposed Gradation
1-1/2" x 3/4"	1"	19 - 41
1" x No. 4	3/4"	52 - 85
1" x No. 4	3/8"	15 - 38
1/2" x No. 4	3/8"	40 - 78
3/8" x No. 8	3/8"	50 - 85
Fine Aggregate	No. 16	55 - 75
Fine Aggregate	No. 30	34 - 46
Fine Aggregate	No. 50	16 - 29

Should the Contractor change the source of supply, the Contractor shall submit in writing to the Engineer the new gradations before their intended use.

90-3.02 COARSE AGGREGATE GRADING

The grading requirements for coarse aggregates are shown in the following table for each size of coarse aggregate:

	Percentage Passing Primary Aggregate Nominal Sizes							
	1-1/2" x 3/4"		1" x No. 4		1/2" x No. 4		3/8" x No. 8	
Sieve Sizes	Operating Range	Contract Compliance	Operating Range	Contract Compliance	Operating Range	Contract Compliance	Operating Range	Contract Compliance
2"	100	100	—	—	—	—	—	—
1-1/2"	88 - 100	85 - 100	100	100	—	—	—	—
1"	X ±18	X ±25	88 - 100	86 - 100	—	—	—	—
3/4"	0 - 17	0 - 20	X ±15	X ±22	100	100	—	—
1/2"	—	—	—	—	82 - 100	80 - 100	100	100
3/8"	0 - 7	0 - 9	X ±15	X ±22	X ±15	X ±22	X ±15	X ±20
No. 4	—	—	0 - 16	0 - 18	0 - 15	0 - 18	0 - 25	0 - 28
No. 8	—	—	0 - 6	0 - 7	0 - 6	0 - 7	0 - 6	0 - 7

In the above table, the symbol X is the gradation that the Contractor proposes to furnish for the specific sieve size as provided in Section 90-3.01, "General."

Coarse aggregate for the 1-1/2 inch, maximum, combined aggregate grading as provided in Section 90-3.04, "Combined Aggregate Gradings," shall be furnished in 2 or more primary aggregate nominal sizes. Each primary aggregate nominal size may be separated into 2 sizes and stored separately, provided that the combined material conforms to the grading requirements for that particular primary aggregate nominal size.

When the one inch, maximum, combined aggregate grading as provided in Section 90-3.04, "Combined Aggregate Gradings," is to be used, the coarse aggregate may be separated into 2 sizes and stored separately, provided that the combined material shall conform to the grading requirements for the 1" x No. 4 primary aggregate nominal size.

90-3.03 FINE AGGREGATE GRADING

Fine aggregate shall be graded within the following limits:

	Percentage Passing	
Sieve Sizes	Operating Range	Contract Compliance
3/8"	100	100
No. 4	95 - 100	93 - 100
No. 8	65 - 95	61 - 99
No. 16	X ±10	X ±13
No. 30	X ±9	X ±12
No. 50	X ±6	X ±9
No. 100	2 - 12	1 - 15
No. 200	0 - 8	0 - 10

In the above table, the symbol X is the gradation that the Contractor proposes to furnish for the specific sieve size as provided in Section 90-3.01, "General."

In addition to the above required grading analysis, the distribution of the fine aggregate sizes shall be such that the difference between the total percentage passing the No. 16 sieve and the total percentage passing the No. 30 sieve shall be between 10 and 40, and the difference between the percentage passing the No. 30 and No. 50 sieves shall be between 10 and 40.

Fine aggregate may be separated into 2 or more sizes and stored separately, provided that the combined material conforms to the grading requirements specified in this Section 90-3.03.

90-3.04 COMBINED AGGREGATE GRADINGS

Combined aggregate grading limits shall be used only for the design of concrete mixes. Concrete mixes shall be designed so that aggregates are combined in proportions that shall produce a mixture within the grading limits for combined aggregates as specified herein.

The combined aggregate grading, except when otherwise specified in these specifications or the special provisions, shall be either the 1-1/2 inch, maximum grading, or the 1 inch, maximum grading, at the option of the Contractor.

Grading Limits of Combined Aggregates

Sieve Sizes	Percentage Passing			
	1-1/2" Max.	1" Max.	1/2" Max.	3/8" Max.
2"	100	—	—	—
1-1/2"	90 - 100	100	—	—
1"	50 - 86	90 - 100	—	—
3/4"	45 - 75	55 - 100	100	—
1/2"	—	—	90 - 100	100
3/8"	38 - 55	45 - 75	55 - 86	50 - 100
No. 4	30 - 45	35 - 60	45 - 63	45 - 63
No. 8	23 - 38	27 - 45	35 - 49	35 - 49
No. 16	17 - 33	20 - 35	25 - 37	25 - 37
No. 30	10 - 22	12 - 25	15 - 25	15 - 25
No. 50	4 - 10	5 - 15	5 - 15	5 - 15
No. 100	1 - 6	1 - 8	1 - 8	1 - 8
No. 200	0 - 3	0 - 4	0 - 4	0 - 4

Changes from one grading to another shall not be made during the progress of the work unless permitted by the Engineer.

90-4 ADMIXTURES

90-4.01 GENERAL

Admixtures used in portland cement concrete shall conform to and be used in conformance with the provisions in this Section 90-4 and the special provisions. Admixtures shall be used when specified or ordered by the Engineer and may be used at the Contractor's option as provided herein.

Chemical admixtures and air-entraining admixtures containing chlorides as Cl in excess of one percent by weight of admixture, as determined by California Test 415, shall not be used.

Admixtures shall be uniform in properties throughout their use in the work. Should it be found that an admixture as furnished is not uniform in properties, its use shall be discontinued.

If more than one admixture is used, the admixtures shall be compatible with each other so that the desirable effects of all admixtures used will be realized.

Chemical admixtures shall be used in conformance with the manufacturer's written recommendations. The manufacturer's written recommendations shall include a statement that the admixtures are compatible with the types and amounts of SCMs used.

90-4.02 MATERIALS

Admixture materials shall conform to the provisions in Section 90-2.04, "Admixture Materials."

90-4.03 ADMIXTURE APPROVAL

No admixture brand shall be used in the work unless it is on the Department's current list of approved brands for the type of admixture involved. Information regarding admixture qualification and placement on the Department's list can be obtained at the Transportation Laboratory.

If the Contractor proposes to use an admixture of a brand and type on the current list of approved admixture brands, the Contractor shall furnish a Certificate of Compliance from the manufacturer, as provided in Section 6-1.07, "Certificates of Compliance," certifying that the admixture furnished is the same as that previously approved. If a previously approved admixture is not accompanied by a Certificate of Compliance, the admixture shall not be used in the work until the Engineer has had sufficient time to make the appropriate tests and has approved the admixture for use. The Engineer may take samples for testing at any time, whether or not the admixture has been accompanied by a Certificate of Compliance.

90-4.04 REQUIRED USE OF CHEMICAL ADMIXTURES

If the use of a chemical admixture is specified, the admixture shall be used at the dosage specified, except that if no dosage is specified, the admixture shall be used at the dosage normally recommended by the manufacturer of the admixture.

90-4.05 OPTIONAL USE OF CHEMICAL ADMIXTURES

The Contractor may use Type A or F, water-reducing; Type B, retarding; or Type D or G, water-reducing and retarding admixtures as described in ASTM Designation: C 494 to conserve cementitious material or to facilitate any concrete construction application subject to the following conditions:

A. If a water-reducing admixture or a water-reducing and retarding admixture is used, the cementitious material content specified or ordered may be reduced by a maximum of 5 percent by weight, except that the resultant cementitious material content shall be not less than 505 pounds per cubic yard; and
B. When a reduction in cementitious material content is made, the dosage of admixture used shall be no less than the dosage used in determining approval of the admixture.

The Contractor may use Type S admixtures conforming to the requirements in ASTM Designation: C 494.

Unless otherwise specified, a Type C accelerating chemical admixture conforming to the requirements in ASTM Designation: C 494, may be used in portland cement concrete. Inclusion in the mix design submitted for approval will not be required provided that the admixture is added to counteract changing conditions that contribute to delayed setting of the portland cement concrete, and the use or change in dosage of the admixture is approved in writing by the Engineer.

90-4.06 REQUIRED USE OF AIR-ENTRAINING ADMIXTURES

When air-entrainment is specified or ordered by the Engineer, the air-entraining admixture shall be used in amounts to produce a concrete having the specified air content as determined by California Test 504.

90-4.07 OPTIONAL USE OF AIR-ENTRAINING ADMIXTURES

When air-entrainment has not been specified or ordered by the Engineer, the Contractor will be permitted to use an air-entraining admixture to facilitate the use of any construction procedure or equipment provided that the average air content, as determined by California Test 504, of 3 successive tests does not exceed 4 percent, and no single test value exceeds 5.5 percent. If the Contractor elects to use an air-entraining admixture in concrete for pavement, the Contractor shall so indicate at the time the Contractor designates the source of aggregate.

90-4.08 BLANK

90-4.09 BLANK

90-4.10 PROPORTIONING AND DISPENSING LIQUID ADMIXTURES

Chemical admixtures and air-entraining admixtures shall be dispensed in liquid form. Dispensers for liquid admixtures shall have sufficient capacity to measure at one time the prescribed quantity required for each batch of concrete. Each dispenser shall include a graduated measuring unit into which liquid admixtures are measured to within ±5 percent of the prescribed quantity for each batch. Dispensers shall be located and maintained so that the graduations can be accurately read from the point at which proportioning operations are controlled to permit a visual check of batching accuracy prior to discharge. Each measuring unit shall be clearly marked for the type and quantity of admixture.

Each liquid admixture dispensing system shall be equipped with a sampling device consisting of a valve located in a safe and readily accessible position such that a sample of the admixture may be withdrawn slowly by the Engineer.

If more than one liquid admixture is used in the concrete mix, each liquid admixture shall have a separate measuring unit and shall be dispensed by injecting equipment located in such a manner that the admixtures are not mixed at high concentrations and do not interfere with the effectiveness of each other. When air-entraining admixtures are used in conjunction with other liquid admixtures, the air-entraining admixture shall be the first to be incorporated into the mix, unless it is demonstrated that a different sequence improves performance.

When automatic proportioning devices are required for concrete pavement, dispensers for liquid admixtures shall operate automatically with the batching control equipment. The dispensers shall be equipped with an automatic warning system in good operating condition that will provide a visible or audible signal at the point at which proportioning operations are controlled when the quantity of admixture measured for each batch of concrete varies from the preselected dosage by more than 5 percent, or when the entire contents of the measuring unit are not emptied from the dispenser into each batch of concrete.

Unless liquid admixtures are added to premeasured water for the batch, their discharge into the batch shall be arranged to flow into the stream of water so that the admixtures are well dispersed throughout the batch, except that air-entraining admixtures may be dispensed directly into moist sand in the batching bins provided that adequate control of the air content of the concrete can be maintained.

Liquid admixtures requiring dosages greater than one-half gallon per cubic yard shall be considered to be water when determining the total amount of free water as specified in Section 90-6.06, "Amount of Water and Penetration."

90-4.11 BLANK

90-5 PROPORTIONING

90-5.01 STORAGE OF AGGREGATES

Aggregates shall be stored or stockpiled in such a manner that separation of coarse and fine particles of each size shall be avoided and the various sizes shall not become intermixed before proportioning.

Aggregates shall be stored or stockpiled and handled in a manner that prevent contamination by foreign materials. In addition, storage of aggregates at batching or mixing facilities that are erected subsequent to the award of the contract and that furnish concrete to the project shall conform to the following:

A. Intermingling of the different sizes of aggregates shall be positively prevented. The Contractor shall take the necessary measures to prevent intermingling. The preventive measures may include, but are not necessarily limited to, physical separation of stockpiles or construction of bulkheads of adequate length and height; and
B. Contamination of aggregates by contact with the ground shall be positively prevented. The Contractor shall take the necessary measures to prevent contamination. The preventive measures shall include, but are not necessarily limited to, placing aggregates on wooden platforms or on hardened surfaces consisting of portland cement concrete, asphalt concrete, or cement treated material.

In placing aggregates in storage or in moving the aggregates from storage to the weigh hopper of the batching plant, any method that may cause segregation, degradation, or the combining of materials of different gradings that will result in any size of aggregate at the weigh hopper failing to meet the grading requirements, shall be discontinued. Any method of handling aggregates that results in excessive breakage of particles shall be discontinued. The use of suitable devices to reduce impact of falling aggregates may be required by the Engineer.

90-5.02 PROPORTIONING DEVICES

Weighing, measuring, or metering devices used for proportioning materials shall conform to the requirements in Section 9-1.01, "Measurement of Quantities," and this Section 90-5.02. In addition, automatic weighing systems shall comply with the requirements for automatic proportioning devices in Section 90-5.03A, "Proportioning for Pavement." Automatic devices shall be automatic to the extent that the only manual operation required for proportioning the aggregates, cement, and SCM for one batch of concrete is a single operation of a switch or starter.

Proportioning devices shall be tested as frequently as the Engineer may deem necessary to ensure their accuracy.

Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the plant is in operation, the weight of each batch of material shall not vary from the weight designated by the Engineer by more than the tolerances specified herein.

Equipment for cumulative weighing of aggregate shall have a zero tolerance of ±0.5 percent of the designated total batch weight of the aggregate. For systems with individual weigh hoppers for the various sizes of aggregate, the zero tolerance shall be ±0.5 percent of the individual batch weight designated for each size of aggregate. Equipment for cumulative weighing of cement and SCM shall have a zero tolerance of ±0.5 percent of the designated total batch weight of the cement and SCM. Equipment for weighing cement or SCM separately shall have a zero tolerance of ±0.5 percent of their designated individual batch weights. Equipment for measuring water shall have a zero tolerance of ±0.5 percent of its designated weight or volume.

The weight indicated for any batch of material shall not vary from the preselected scale setting by more than the following:

A. Aggregate weighed cumulatively shall be within 1.0 percent of the designated total batch weight of the aggregate. Aggregates weighed individually shall be within 1.5 percent of their respective designated batch weights; and
B. Cement shall be 99 to 102 percent of its designated batch weight. When weighed individually, SCM shall be 99 to 102 percent of its designated batch weight. When SCM and cement are permitted to be weighed cumulatively, cement shall be weighed first to 99 to 102 percent of its designated batch weight, and the total for cement and SCM shall be 99 to 102 percent of the sum of their designated batch weights When a blended cement is used, the percentages of cement and SCM used for calculating batch weights shall be based on the percentage of SCM indicated in the Certificate of Compliance from the blended cement supplier; and
C. Water shall be within 1.5 percent of its designated weight or volume.

Each scale graduation shall be approximately 0.001 of the total capacity of the scale. The capacity of scales for weighing cement, SCM, or cement plus SCM and aggregates shall not exceed that of commercially available scales having single graduations indicating a weight not exceeding the maximum permissible weight variation above, except that no scale shall be required having a capacity of less than 1,000 pounds, with one pound graduations.

90-5.03 PROPORTIONING

Proportioning shall consist of dividing the aggregates into the specified sizes, each stored in a separate bin, and combining them with cementitious material and water as provided in these specifications. Aggregates shall be proportioned by weight.

At the time of batching, aggregates shall have been dried or drained sufficiently to result in a stable moisture content such that no visible separation of water from aggregate will take place during transportation from the proportioning plant to the point of mixing. In no event shall the free moisture content of the fine aggregate at the time of batching exceed 8 percent of its saturated, surface-dry weight.

Should separate supplies of aggregate material of the same size group, but of different moisture content or specific gravity or surface characteristics affecting workability, be available at the proportioning plant, withdrawals shall be made from one supply exclusively and the materials therein completely exhausted before starting upon another.

Bulk Type IP (MS) or Type IS (MS) cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the ingredients are released for discharge into the mixer.

Bulk cement and SCM may be weighed in separate, individual weigh hoppers or may be weighed in the same weigh hopper and shall be kept separate from the aggregates until the ingredients are released for discharge into the mixer. If the cement and SCM are weighed cumulatively, the cement shall be weighed first.

If cement and SCM are weighed in separate weigh hoppers, the weigh systems for the proportioning of the aggregate, the cement, and the SCM shall be individual and distinct from all other weigh systems. Each weigh system shall be equipped with a hopper, a lever system, and an indicator to constitute an individual and independent material-weighing device. The cement and the SCM shall be discharged into the mixer simultaneously with the aggregate.

The scales and weigh hoppers for bulk weighing cement, SCM, or cement plus SCM shall be separate and distinct from the aggregate weighing equipment.

For batches of one cubic yard or more, the batching equipment shall conform to one of the following combinations:

A. Separate boxes and separate scale and indicator for weighing each size of aggregate.
B. Single box and scale indicator for all aggregates.
C. Single box or separate boxes and automatic weighing mechanism for all aggregates.

In order to check the accuracy of batch weights, the gross weight and tare weight of batch trucks, truck mixers, truck agitators, and non-agitating hauling equipment shall be determined when ordered by the Engineer. The equipment shall be weighed on scales designated by the Engineer.

90-5.03A Proportioning For Pavement

Aggregates and bulk SCM for use in pavement shall be proportioned by weight by means of automatic proportioning devices of approved type conforming to these specifications.

The Contractor shall install and maintain in operating condition an electronically actuated moisture meter that will indicate, on a readily visible scale, changes in the moisture content of thefine aggregate as it is batched within a sensitivity of 0.5 percent by weight of the fine aggregate.

The batching of cement, SCM, or cement plus SCM and aggregate shall be interlocked so that a new batch cannot be started until all weigh hoppers are empty, the proportioning devices are within zero tolerance, and the discharge gates are closed. The interlock shall permit no part of the batch to be discharged until all aggregate hoppers and the cement and SCM hoppers or the cement plus SCM hopper are charged with weights that are within the tolerances specified in Section 90-5.02, "Proportioning Devices."

If interlocks are required for cement and SCM charging mechanisms and cement and SCM are weighed cumulatively, their charging mechanisms shall be interlocked to prevent the introduction of SCM until the weight of cement in the cement weigh hopper is within the tolerances specified in Section 90-5.02, "Proportioning Devices."

If concrete is completely mixed in stationary paving mixers, the SCMs shall be weighed in a separate weigh hopper and the SCM and cement shall be introduced simultaneously into the mixer proportionately with the aggregate. If the Contractor provides certification that the stationary mixer is capable of mixing the cement, SCM, aggregates, and water uniformly before discharge, weighing the SCM cumulatively with the cement is permitted. Certification shall contain the following:

A. Test results for 2 compressive strength test cylinders of concrete taken within the first one-third and 2 compressive strength test cylinders of concrete taken within the last one-third of the concrete discharged from a single batch from the stationary paving mixer. Strength tests and cylinder preparation will be in conformance with the provisions of Section 90-9, "Compressive Strength";
B. Calculations demonstrating that the difference in the averages of 2 compressive strengths taken in the first one-third is no greater than 7.5 percent different than the averages of 2 compressive strengths taken in the last one-third of the concrete discharged from a single batch from the stationary paving mixer. Strength tests and cylinder preparation will be in conformance with the provisions of Section 90-9, "Compressive Strength;" and
C. The mixer rotation speed and time of mixing before discharge that are required to produce a mix that meets the requirements above.

The discharge gate on the cement and SCM hoppers or the cement plus SCM hopper shall be designed to permit regulating the flow of cement, SCM, or cement plus SCM into the aggregate as directed by the Engineer.

If separate weigh boxes are used for each size of aggregate, the discharge gates shall permit regulating the flow of each size of aggregate as directed by the Engineer.

Material discharged from the several bins shall be controlled by gates or by mechanical conveyors. The means of withdrawal from the several bins, and of discharge from the weigh box, shall be interlocked so that not more than one bin can discharge at a time, and so that the weigh box cannot be tripped until the required quantity from each of the several bins has been deposited therein. Should a separate weigh box be used for each size of aggregate, all may be operated and discharged simultaneously.

If the discharge from the several bins is controlled by gates, each gate shall be actuated automatically so that the required mass is discharged into the weigh box, after which the gate shall automatically close and lock.

The automatic weighing system shall be designed so that all proportions required may be set on the weighing controller at the same time.

90-6 MIXING AND TRANSPORTING

90-6.01 GENERAL

Concrete shall be mixed in mechanically operated mixers, except that when permitted by the Engineer, batches not exceeding 1/3 cubic yard may be mixed by hand methods in conformance with the provisions in Section 90-6.05, "Hand-Mixing."

Equipment having components made of aluminum or magnesium alloys that would have contact with plastic concrete during mixing, transporting, or pumping of portland cement concrete shall not be used.

Concrete shall be homogeneous and thoroughly mixed, and there shall be no lumps or evidence of undispersed cementitious material.

Uniformity of concrete mixtures will be determined by differences in penetration as determined by California Test 533, or slump as determined by ASTM Designation: C 143, and by variations in the proportion of coarse aggregate as determined by California Test 529.

When the mix design specifies a penetration value, the difference in penetration, determined by comparing penetration tests on 2 samples of mixed concrete from the same batch or truck mixer load, shall not exceed 1/2 inch. When the mix design specifies a slump value, the difference in slump, determined by comparing slump tests on 2 samples of mixed concrete from the same batch or truck mixer load, shall not exceed the values given in the table below. Variation in the proportion of coarse aggregate will be determined by comparing the results of tests of 2 samples of mixed concrete from the same batch or truck mixer load and the difference between the 2 results shall not exceed 170 pounds per cubic yard of concrete.

Average Slump	Maximum Permissible Difference
Less than 4"	1"
4" to 6"	1-1/2"
Greater than 6" to 9"	2"

The Contractor shall furnish samples of the freshly mixed concrete and provide satisfactory facilities for obtaining the samples.

90-6.02 MACHINE MIXING

Concrete mixers may be of the revolving drum or the revolving blade type, and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. Mixers and agitators that have an accumulation of hard concrete or mortar shall not be used.

The temperature of mixed concrete, immediately before placing, shall be not less than 50 °F or more than 90 °F. Aggregates and water shall be heated or cooled as necessary to produce concrete within these temperature limits. Neither aggregates nor mixing water shall be heated to exceed 150 °F. If ice is used to cool the concrete, discharge of the mixer will not be permitted until all ice is melted.

The batch shall be so charged into the mixer that some water will enter in advance of cementitious materials and aggregates. All water shall be in the drum by the end of the first one-fourth of the specified mixing time.

Cementitious materials shall be batched and charged into the mixer by means that will not result either in loss of cementitious materials due to the effect of wind, in accumulation of cementitious materials on surfaces of conveyors or hoppers, or in other conditions that reduce or vary the required quantity of cementitious material in the concrete mixture.

Paving and stationary mixers shall be operated with an automatic timing device. The timing device and discharge mechanism shall be interlocked so that during normal operation no part of the batch will be discharged until the specified mixing time has elapsed.

The total elapsed time between the intermingling of damp aggregates and all cementitious materials and the start of mixing shall not exceed 30 minutes.

The size of batch shall not exceed the manufacturer's guaranteed capacity.

When producing concrete for pavement or base, suitable batch counters shall be installed and maintained in good operating condition at job site batching plants and stationary mixers. The batch counters shall indicate the exact number of batches proportioned and mixed.

Concrete shall be mixed and delivered to the job site by means of one of the following combinations of operations:

A. Mixed completely in a stationary mixer and the mixed concrete transported to the point of delivery in truck agitators or in nonagitating hauling equipment (central-mixed concrete).
B. Mixed partially in a stationary mixer, and the mixing completed in a truck mixer (shrink-mixed concrete).
C. Mixed completely in a truck mixer (transit-mixed concrete).
D. Mixed completely in a paving mixer.

Agitators may be truck mixers operating at agitating speed or truck agitators. Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates on which is plainly marked the various uses for which the equipment is designed, the manufacturer's guaranteed capacity of the drum or container in terms of the volume of mixed concrete and the speed of rotation of the mixing drum or blades.

Truck mixers shall be equipped with electrically or mechanically actuated revolution counters by which the number of revolutions of the drum or blades may readily be verified.

When shrink-mixed concrete is furnished, concrete that has been partially mixed at a central plant shall be transferred to a truck mixer and all requirements for transit-mixed concrete shall apply. No credit in the number of revolutions at mixing speed will be allowed for partial mixing in a central plant.

90-6.03 TRANSPORTING MIXED CONCRETE

Mixed concrete may be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturer of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable for adequate placement and consolidation in place, and provided the mixed concrete after hauling to the delivery point conforms to the provisions in Section 90-6.01, "General."

Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity and shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

Bodies of nonagitating hauling equipment shall be constructed so that leakage of the concrete mix, or any part thereof, will not occur at any time.

Concrete hauled in open-top vehicles shall be protected during hauling against rain or against exposure to the sun for more than 20 minutes when the ambient temperature exceeds 75 °F.

No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point.

The rate of discharge of mixed concrete from truck mixer-agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

If a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within 1.5 hours or before 250 revolutions of the drum or blades, whichever occurs first, after the introduction of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or if the temperature of the concrete is 85 °F or above, the time allowed may be less than 1.5 hours. If an admixture is used to retard the set time, the temperature of the concrete shall not exceed 85 °F, the time limit shall be 2 hours, and the revolution limitation shall be 300.

If nonagitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be completed within one hour after the addition of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 °F or above, the time between the introduction of cement to the aggregates and discharge shall not exceed 45 minutes.

Each load of concrete delivered at the job site shall be accompanied by a weighmaster certificate showing the mix identification number, nonrepeating load number, date and time at which the materials were batched, the total amount of water added to the load, and for transit-mixed concrete, the reading of the revolution counter at the time the truck mixer is charged with cement. This weighmaster certificate shall also show the actual scale weights (pounds) for the ingredients batched. Theoretical or target batch weights shall not be used as a substitute for actual scale weights.

Weighmaster certificates shall be provided in printed form, or if approved by the Engineer, the data may be submitted in electronic media. Electronic media shall be presented in a tab-delimited format on a CD or DVD. Captured data, for the ingredients represented by each batch shall be "line feed, carriage return" (LFCR) and "one line, separate record" with allowances for sufficient fields to satisfy the amount of data required by these specifications.

The Contractor may furnish a weighmaster certificate accompanied by a separate certificate that lists the actual batch weights or measurements for a load of concrete provided that both certificates are imprinted with the same nonrepeating load number that is unique to the contract and delivered to the jobsite with the load.

Weighmaster certificates furnished by the Contractor shall conform to the provisions in Section 9-1.01, "Measurement of Quantities."

90-6.04 TIME OR AMOUNT OF MIXING

Mixing of concrete in paving or stationary mixers shall continue for the required mixing time after all ingredients, except water and admixture, if added with the water, are in the mixing compartment of the mixer before any part of the batch is released. Transfer time in multiple drum mixers shall not be counted as part of the required mixing time.

The required mixing time, in paving or stationary mixers, of concrete used for concrete structures, except minor structures, shall be not less than 90 seconds or more than 5 minutes, except that when directed by the Engineer in writing, the requirements of the following paragraph shall apply.

The required mixing time, in paving or stationary mixers, except as provided in the preceding paragraph, shall be not less than 50 seconds or more than 5 minutes.

The minimum required revolutions at the mixing speed for transit-mixed concrete shall not be less than that recommended by the mixer manufacturer, but in no case shall the number of revolutions be less than that required to consistently produce concrete conforming to the provisions for uniformity in Section 90-6.01, "General."

When a high range water-reducing admixture is added to the concrete at the job site, the total number of revolutions shall not exceed 300.

90-6.05 HAND-MIXING

Hand-mixed concrete shall be made in batches of not more than 1/3 cubic yard and shall be mixed on a watertight, level platform. The proper amount of coarse aggregate shall be measured in measuring boxes and spread on the platform and the fine aggregate shall be spread on this layer, the 2 layers being not more than one foot in total depth. On this mixture shall be spread the dry cementitious materials and the whole mass turned no fewer than 2 times dry; then sufficient clean water shall be added, evenly distributed, and the whole mass again turned no fewer than 3 times, not including placing in the carriers or forms.

90-6.06 AMOUNT OF WATER AND PENETRATION

The amount of water used in concrete mixes shall be regulated so that the penetration of the concrete as determined by California Test 533 or the slump of the concrete as determined by ASTM Designation: C 143 is within the nominal values shown in the following table. When the penetration or slump of the concrete is found to exceed the nominal values listed, the mixture of subsequent batches shall be adjusted to reduce the penetration or slump to a value within the nominal range shown. Batches of concrete with a penetration or slump exceeding the maximum values listed shall not be used in the work. If Type F or Type G chemical admixtures are added to the mix, the penetration requirements shall not apply and the slump shall not exceed 9 inches after the chemical admixtures are added.

Type of Work	Nominal		Maximum	
	Penetration (inches)	Slump (inches)	Penetration (inches)	Slump (inches)
Concrete Pavement	0 - 1	—	1-1/2	—
Non-reinforced concrete facilities	0 – 1-1/2	—	2	—
Reinforced concrete structures				
Sections over 12 inches thick	0 – 1-1/2	—	2-1/2	—
Sections 12 inches thick or less	0 - 2	—	3	—
Concrete placed under water	—	6 - 8	—	9
Cast-in-place concrete piles	2-1/2 – 3-1/2	5 - 7	4	8

The amount of free water used in concrete shall not exceed 310 pounds per cubic yard, plus 20 pounds for each required 100 pounds of cementitious material in excess of 550 pounds per cubic yard.

The term free water is defined as the total water in the mixture minus the water absorbed by the aggregates in reaching a saturated surface-dry condition.

If there are adverse or difficult conditions that affect the placing of concrete, the above specified penetration and free water content limitations may be exceeded providing the Contractor is granted permission by the Engineer in writing to increase the cementitious material content per cubic yard of concrete. The increase in water and cementitious material shall be at a ratio not to exceed 30 pounds of water per added 100 pounds of cementitious material per cubic yard. Full compensation for additional cementitious material and water added under these conditions shall be considered as included in the contract price paid for the concrete work involved and no additional compensation will be allowed therefor.

The equipment for supplying water to the mixer shall be constructed and arranged so that the amount of water added can be measured accurately. Any method of discharging water into the mixer for a batch shall be accurate within 1.5 percent of the quantity of water required to be added to the mix for any position of the mixer. Tanks used to measure water shall be designed so that water cannot enter while water is being discharged into the mixer and discharge into the mixer shall be made rapidly in one operation without dribbling. All equipment shall be arranged so as to permit checking the amount of water delivered by discharging into measured containers.

90-7 CURING CONCRETE

90-7.01 METHODS OF CURING

Newly placed concrete shall be cured by the methods specified in this Section 90-7.01 and the special provisions.

90-7.01A Water Method

The concrete shall be kept continuously wet by the application of water for a minimum curing period of 7 days after the concrete has been placed.

Cotton mats, rugs, carpets, or earth or sand blankets may be used as a curing medium to retain the moisture during the curing period.

If a curing medium consisting of cotton mats, rugs, carpets, polyethylene sheeting, polyethylene sheeting on burlap, or earth or sand blankets is to be used to retain the moisture, the entire surface of the concrete shall be kept damp by applying water with a nozzle that so atomizes the flow that a mist and not a spray is formed, until the surface of the concrete is covered with the curing medium. The moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface. At the expiration of the curing period, the concrete surfaces shall be cleared of all curing media.

At the option of the Contractor, a curing medium consisting of white opaque polyethylene sheeting extruded onto burlap may be used to cure concrete structures. The polyethylene sheeting shall have a minimum thickness of 4-mil, and shall be extruded onto 10-ounce burlap.

At the option of the Contractor, a curing medium consisting of polyethylene sheeting may be used to cure concrete columns. The polyethylene sheeting shall have a minimum thickness of 10-mil achieved in a single layer of material.

If the Contractor chooses to use polyethylene sheeting or polyethylene sheeting on burlap as a curing medium, these media and any joints therein shall be secured as necessary to provide moisture retention and shall be within 3 inches of the concrete at all points along the surface being cured. When these media are used, the temperature of the concrete shall be monitored during curing. If the temperature of the concrete cannot be maintained below 140° F, use of these curing media shall be disallowed.

When concrete bridge decks and flat slabs are to be cured without the use of a curing medium, the entire surface of the bridge deck or slab shall be kept damp by the application of water with an atomizing nozzle as specified above, until the concrete has set, after which the entire surface of the concrete shall be sprinkled continuously with water for a period of not less than 7 days.

90-7.01B Curing Compound Method

Surfaces of the concrete that are exposed to the air shall be sprayed uniformly with a curing compound.

Curing compounds to be used shall be as follows:

1. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class B, except the resin type shall be poly-alpha-methylstyrene.
2. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class B.
3. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class A.
4. Nonpigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class B.
5. Nonpigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class A.
6. Nonpigmented curing compound with fugitive dye conforming to the requirements in ASTM Designation: C 309, Type 1-D, Class A.

The infrared scan for the dried vehicle from curing compound (1) shall match the infrared scan on file at the Transportation Laboratory.

The loss of water for each type of curing compound, when tested in conformance with the requirements in California Test 534, shall not be more than 0.28 pounds per square yard in 24 hours.

The curing compound to be used will be specified elsewhere in these specifications or in the special provisions.

If the use of curing compound is required or permitted elsewhere in these specifications or in the special provisions and no specific kind is specified, any of the curing compounds listed above may be used.

Curing compound shall be applied at a nominal rate of one gallon per 150 square feet, unless otherwise specified.

At any point, the application rate shall be within ±50 square feet per gallon of the nominal rate specified, and the average application rate shall be within ±25 square feet per gallon of the nominal rate specified when tested in conformance with the requirements in California Test 535. Runs, sags, thin areas, skips, or holidays in the applied curing compound shall be evidence that the application is not satisfactory.

Curing compounds shall be applied using power operated spray equipment. The power operated spraying equipment shall be equipped with an operational pressure gage and a means of controlling the pressure. Hand spraying of small and irregular areas that are not reasonably accessible to mechanical spraying equipment, in the opinion of the Engineer, may be permitted.

The curing compound shall be applied to the concrete following the surface finishing operation, immediately before the moisture sheen disappears from the surface, but before any drying shrinkage or craze cracks begin to appear. In the event of any drying or cracking of the surface, application of water with an atomizing nozzle as specified in Section 90-7.01A, "Water Method," shall be started immediately and shall be continued until application of the compound is resumed or started; however, the compound shall not be applied over any resulting freestanding water. Should the film of compound be damaged from any cause before the expiration of 7 days after the concrete is placed in the case of structures and 72 hours in the case of pavement, the damaged portion shall be repaired immediately with additional compound.

At the time of use, compounds containing pigments shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. A paddle shall be used to loosen all settled pigment from the bottom of the container, and a power driven agitator shall be used to disperse the pigment uniformly throughout the vehicle.

Agitation shall not introduce air or other foreign substance into the curing compound.

The manufacturer shall include in the curing compound the necessary additives for control of sagging, pigment settling, leveling, de-emulsification, or other requisite qualities of a satisfactory working material. Pigmented curing compounds shall be manufactured so that the pigment does not settle badly, does not cake or thicken in the container, and does not become granular or curdled. Settlement of pigment shall be a thoroughly wetted, soft, mushy mass permitting the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with minimum resistance to the sideways manual motion of the paddle across the bottom of the container, to form a smooth uniform product of the proper consistency.

Curing compounds shall remain sprayable at temperatures above 40 °F and shall not be diluted or altered after manufacture.

The curing compound shall be packaged in clean 274-gallon totes, 55-gallon barrels or 5-gallon pails shall be supplied from a suitable storage tank located at the jobsite. The containers shall comply with "Title 49, Code of Federal Regulations, Hazardous Materials Regulations." The 274-gallon totes and the 55-gallon barrels shall have removable lids and airtight fasteners. The 5-gallon pails shall be round and have standard full open head and bail. Lids with bungholes will not be permitted. Settling or separation of solids in containers, except tanks, must be completely redispersed with low speed mixing prior to use, in conformance with these specifications and the manufacturer's recommendations. Mixing shall be accomplished either manually by use of a paddle or by use of a mixing blade driven by a drill motor, at low speed. Mixing blades shall be the type used for mixing paint. On-site storage tanks shall be kept clean and free of contaminants. Each tank shall have a permanent system designed to completely redisperse settled material without introducing air or other foreign substances.

Steel containers and lids shall be lined with a coating that will prevent destructive action by the compound or chemical agents in the air space above the compound. The coating shall not come off the container or lid as skins. Containers shall be filled in a manner that will prevent skinning. Plastic containers shall not react with the compound.

Each container shall be labeled with the manufacturer's name, kind of curing compound, batch number, volume, date of manufacture, and volatile organic compound (VOC) content. The label shall also warn that the curing compound containing pigment shall be well stirred before use. Precautions concerning the handling and the application of curing compound shall be shown on the label of the curing compound containers in conformance with the Construction Safety Orders and General Industry Safety Orders of the State.

Containers of curing compound shall be labeled to indicate that the contents fully comply with the rules and regulations concerning air pollution control in the State.

When the curing compound is shipped in tanks or tank trucks, a shipping invoice shall accompany each load. The invoice shall contain the same information as that required herein for container labels.

Curing compound will be sampled by the Engineer at the source of supply, at the job site, or at both locations.

Curing compound shall be formulated so as to maintain the specified properties for a minimum of one year. The Engineer may require additional testing before use to determine compliance with these specifications if the compound has not been used within one year or whenever the Engineer has reason to believe the compound is no longer satisfactory.

Tests will be conducted in conformance with the latest ASTM test methods and methods in use by the Transportation Laboratory.

90-7.01C Waterproof Membrane Method

The exposed finished surfaces of concrete shall be sprayed with water, using a nozzle that so atomizes the flow that a mist and not a spray is formed, until the concrete has set, after which the curing membrane, shall be placed. The curing membrane shall remain in place for a period of not less than 72 hours.

Sheeting material for curing concrete shall conform to the requirements in AASHTO Designation: M 171 for white reflective materials.

The sheeting material shall be fabricated into sheets of such width as to provide a complete cover for the entire concrete surface. Joints in the sheets shall be securely cemented together in such a manner as to provide a waterproof joint. The joint seams shall have a minimum lap of 0.33 foot.

The sheets shall be securely weighted down by placing a bank of earth on the edges of the sheets or by other means satisfactory to the Engineer.

Should any portion of the sheets be broken or damaged before the expiration of 72 hours after being placed, the broken or damaged portions shall be immediately repaired with new sheets properly cemented into place.

Sections of membrane that have lost their waterproof qualities or have been damaged to such an extent as to render them unfit for curing the concrete shall not be used.

90-7.01D Forms-In-Place Method

Formed surfaces of concrete may be cured by retaining the forms in place. The forms shall remain in place for a minimum period of 7 days after the concrete has been placed, except that for members over 20 inches in least dimension the forms shall remain in place for a minimum period of 5 days.

Joints in the forms and the joints between the end of forms and concrete shall be kept moisture tight during the curing period. Cracks in the forms and cracks between the forms and the concrete shall be resealed by methods subject to the approval of the Engineer.

90-7.02 BLANK

90-7.03 CURING STRUCTURES

Newly placed concrete for cast-in-place structures, other than highway bridge decks, shall be cured by the water method, the forms-in-place method, or, as permitted herein, by the curing compound method, in conformance with the provisions in Section 90-7.01, "Methods of Curing."

The curing compound method using a pigmented curing compound may be used on concrete surfaces of construction joints, surfaces that are to be buried underground, and surfaces where only ordinary surface finish is to be applied and on which a uniform color is not required and that will not be visible from a public traveled way. If the Contractor elects to use the curing compound method on the bottom slab of box girder spans, the curing compound shall be curing compound (1).

The top surface of highway bridge decks shall be cured by both the curing compound method and the water method. The curing compound shall be curing compound (1).

Concrete surfaces of minor structures, as defined in Section 51-1.02, "Minor Structures," shall be cured by the water method, the forms-in-place method or the curing compound method.

When deemed necessary by the Engineer during periods of hot weather, water shall be applied to concrete surfaces being cured by the curing compound method or by the forms-in-place method, until the Engineer determines that a cooling effect is no longer required. Application of water for this purpose will be paid for as extra work as provided in Section 4-1.03D, "Extra Work."

90-7.04 CURING PRECAST CONCRETE MEMBERS

Precast concrete members shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing." Curing shall be provided for the minimum time specified for each method or until the concrete reaches its design strength, whichever is less. Steam curing may also be used for precast members and shall conform to the following provisions:

A. After placement of the concrete, members shall be held for a minimum 4-hour presteaming period. If the ambient air temperature is below 50 °F, steam shall be applied during the presteaming period to hold the air surrounding the member at a temperature between 50 °F and 90 °F.
B. To prevent moisture loss on exposed surfaces during the presteaming period, members shall be covered as soon as possible after casting or the exposed surfaces shall be kept wet by fog spray or wet blankets.
C. Enclosures for steam curing shall allow free circulation of steam about the member and shall be constructed to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar flexible covers will be permitted, provided they are kept in good repair and secured in such a manner as to prevent the loss of steam and moisture.
D. Steam at the jets shall be at low pressure and in a saturated condition. Steam jets shall not impinge directly on the concrete, test cylinders, or forms. During application of the steam, the temperature rise within the enclosure shall not exceed 40 °F per hour. The curing temperature throughout the enclosure shall not exceed 150 °F and shall be maintained at a constant level for a sufficient time necessary to develop the required transfer strength. Control cylinders shall be covered to prevent moisture loss and shall be placed in a location where temperature is representative of the average temperature of the enclosure.
E. Temperature recording devices that will provide an accurate, continuous, permanent record of the curing temperature shall be provided. A minimum of one temperature recording device per 200 feet of continuous bed length will be required for checking temperature.
F. Members in pretension beds shall be detensioned immediately after the termination of steam curing while the concrete and forms are still warm, or the temperature under the enclosure shall be maintained above 60 °F until the stress is transferred to the concrete.
G. Curing of precast concrete will be considered completed after termination of the steam curing cycle.

90-7.05 CURING PRECAST PRESTRESSED CONCRETE PILES

Newly placed concrete for precast prestressed concrete piles shall be cured in conformance with the provisions in Section 90-7.04, "Curing Precast Concrete Members," except that piles in a corrosive environment shall be cured as follows:

A. Piles shall be either steam cured or water cured. If water curing is used, the piles shall be kept continuously wet by the application of water in conformance with the provisions in Section 90-7.01A, "Water Method."
B. If steam curing is used, the steam curing provisions in Section 90-7.04, "Curing Precast Concrete Members," shall apply except that the piles shall be kept continuously wet for their entire length for a period of not less than 3 days, including the holding and steam curing periods.

90-7.06 CURING SLOPE PROTECTION

Concrete slope protection shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing."

Concreted-rock slope protection shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing," with a blanket of earth kept wet for 72 hours, or by sprinkling with a fine spray of water every 2 hours during the daytime for a period of 3 days.

90-7.07 CURING MISCELLANEOUS CONCRETE WORK

Exposed surfaces of curbs shall be cured by pigmented curing compounds as specified in Section 90-7.01B, "Curing Compound Method."

Concrete sidewalks, gutter depressions, island paving, curb ramps, driveways, and other miscellaneous concrete areas shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing."

Shotcrete shall be cured for at least 72 hours by spraying with water, by a moist earth blanket, or by any of the methods provided in Section 90-7.01, "Methods of Curing."

Mortar and grout shall be cured by keeping the surface damp for 3 days.

After placing, the exposed surfaces of sign structure foundations, including pedestal portions, if constructed, shall be cured for at least 72 hours by spraying with water, by a moist earth blanket, or by any of the methods provided in Section 90-7.01, "Methods of Curing."

90-8 PROTECTING CONCRETE

90-8.01 GENERAL

In addition to the provisions in Section 7-1.16, "Contractor's Responsibility for the Work and Materials," the Contractor shall protect concrete as provided in this Section 90-8. If required by the Engineer, the Contractor shall submit a written outline of the proposed methods for protecting the concrete.

The Contractor shall protect concrete from damage from any cause, which shall include, but not be limited to: rain, heat, cold, wind, Contractor's actions, and actions of others.

Concrete shall not be placed on frozen or ice-coated ground or subgrade nor on ice-coated forms, reinforcing steel, structural steel, conduits, precast members, or construction joints.

Under rainy conditions, placing of concrete shall be stopped before the quantity of surface water is sufficient to damage surface mortar or cause a flow or wash of the concrete surface, unless the Contractor provides adequate protection against damage.

Concrete that has been frozen or damaged by other causes, as determined by the Engineer, shall be removed and replaced by the Contractor at the Contractor's expense.

90-8.02 PROTECTING CONCRETE STRUCTURES

Structure concrete and shotcrete used as structure concrete shall be maintained at a temperature of not less than 45 °F for 72 hours after placing and at not less than 40 °F for an additional 4 days.

90-9 COMPRESSIVE STRENGTH

90-9.01 GENERAL

Concrete compressive strength requirements consist of a minimum strength that shall be attained before various loads or stresses are applied to the concrete and, for concrete designated bycompressive strength, a minimum strength at the age of 28 days or at the age otherwise allowed in Section 90-1.01, "Description." The various strengths required are specified in these specifications or the special provisions or are shown on the plans.

The compressive strength of concrete will be determined from test cylinders that have been fabricated from concrete sampled in conformance with the requirements of California Test 539. Test cylinders will be molded and initially field cured in conformance with California Test 540. Test cylinders will be cured and tested after receipt at the testing laboratory in conformance with the requirements of California Test 521. A strength test shall consist of the average strength of 2 cylinders fabricated from material taken from a single load of concrete, except that, if any cylinder should show evidence of improper sampling, molding, or testing, that cylinder shall be discarded and the strength test shall consist of the strength of the remaining cylinder.

When concrete compressive strength is specified as a prerequisite to applying loads or stresses to a concrete structure or member, test cylinders for other than steam cured concrete will be cured in conformance with Method 1 of California Test 540. The compressive strength of concrete determined for these purposes will be evaluated on the basis of individual tests.

When concrete is designated by compressive strength rather than by cementitious material content, the concrete strength to be used as a basis for acceptance of other than steam cured concrete will be determined from cylinders cured in conformance with Method 1 of California Test 540. If the result of a single compressive strength test at the maximum age specified or allowed is below the specified strength but is 95 percent or more of the specified strength, the Contractor shall make corrective changes, subject to approval of the Engineer, in the mix proportions or in the concrete fabrication procedures, before placing additional concrete, and shall pay to the State $10 for each in-place cubic yard of concrete represented by the deficient test. If the result of a single compressive strength test at the maximum age specified or allowed is below 95 percent of the specified strength, but is 85 percent or more of the specified strength, the Contractor shall make the corrective changes specified above, and shall pay to the State $15 for each in-place cubic yard of concrete represented by the deficient test. In addition, such corrective changes shall be made when the compressive strength of concrete tested at 7 days indicates, in the judgment of the Engineer, that the concrete will not attain the required compressive strength at the maximum age specified or allowed. Concrete represented by a single test that indicates a compressive strength of less than 85 percent of the specified 28-day compressive strength will be rejected in conformance with the provisions in Section 6-1.04, "Defective Materials."

If the test result indicates that the compressive strength at the maximum age specified or allowed is below the specified strength, but is 85 percent or more of the specified strength, payments to the State as required above shall be made, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength of the concrete placed in the work meets or exceeds the specified 28-day compressive strength. If the test result indicates a compressive strength at the maximum age specified or allowed below 85 percent, the concrete represented by that test will be rejected, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength and quality of the concrete placed in the work are acceptable. If the evidence consists of tests made on cores taken from the work, the cores shall be obtained and tested in conformance with the requirements in ASTM Designation: C 42.

No single compressive strength test shall represent more than 320 cubic yards.

If a precast concrete member is steam cured, the compressive strength of the concrete will be determined from test cylinders that have been handled and stored in conformance with Method 3 of California Test 540. The compressive strength of steam cured concrete will be evaluated on the basis of individual tests representing specific portions of production. If the concrete is designated by 28-day compressive strength rather than by cementitious material content, the concrete shall be considered to be acceptable whenever its compressive strength reaches the specified 28-day compressive strength provided that strength is reached in not more than the maximum number of days specified or allowed after the member is cast.

When concrete is specified by compressive strength, prequalification of materials, mix proportions, mixing equipment, and procedures proposed for use will be required prior to placement of the concrete. Prequalification shall be accomplished by the submission of acceptable certified test data or trial batch reports by the Contractor. Prequalification data shall be based on the use of materials, mix proportions, mixing equipment, procedures, and size of batch proposed for use in the work.

Certified test data, in order to be acceptable, shall indicate that not less than 90 percent of at least 20 consecutive tests exceed the specified strength at the maximum number of days specified or allowed, and none of those tests are less than 95 percent of specified strength. Strength tests included in the data shall be the most recent tests made on concrete of the proposed mix design and all shall have been made within one year of the proposed use of the concrete.

Trial batch test reports, in order to be acceptable, shall indicate that the average compressive strength of 5 consecutive concrete cylinders, taken from a single batch, at not more than 28 days (or the maximum age allowed) after molding shall be at least 580 pounds per square inch greater than the specified 28-day compressive strength, and no individual cylinder shall have a strength less than the specified strength at the maximum age specified or allowed. Data contained in the report shall be from trial batches that were produced within one year of the proposed use of specified strength concrete in the project. Whenever air-entrainment is required, the air content of trial batches shall be equal to or greater than the air content specified for the concrete without reduction due to tolerances.

Tests shall be performed in conformance with either the appropriate California Test methods or the comparable ASTM test methods. Equipment employed in testing shall be in good condition and shall be properly calibrated. If the tests are performed during the life of the contract, the Engineer shall be notified sufficiently in advance of performing the tests in order to witness the test procedures.

The certified test data and trial batch test reports shall include the following information:

A. Date of mixing.
B. Mixing equipment and procedures used.
C. The size of batch in cubic yards and the weight, type, and source of all ingredients used.
D. Penetration or slump (if the concrete will be placed under water or placed in cast-in-place concrete piles) of the concrete.
E. The air content of the concrete if an air-entraining admixture is used.
F. The age at time of testing and strength of all concrete cylinders tested.

Certified test data and trial batch test reports shall be signed by an official of the firm that performed the tests.

When approved by the Engineer, concrete from trial batches may be used in the work at locations where concrete of a lower quality is required and the concrete will be paid for as the type of concrete required at that location.

After materials, mix proportions, mixing equipment, and procedures for concrete have been prequalified for use, additional prequalification by testing of trial batches will be required prior to making changes that, in the judgment of the Engineer, could result in a strength of concrete below that specified.

The Contractor's attention is directed to the time required to test trial batches and the Contractor shall be responsible for production of trial batches at a sufficiently early date so that the progress of the work is not delayed.

When precast concrete members are manufactured at the plant of an established manufacturer of precast concrete members, the mix proportions of the concrete shall be determined by the Contractor, and a trial batch and prequalification of the materials, mix proportions, mixing equipment, and procedures will not be required.

90-10 MINOR CONCRETE

90-10.01 GENERAL

Concrete for minor structures, slope paving, curbs, sidewalks and other concrete work, when designated as minor concrete on the plans, in the specifications, or in the contract item, shall conform to the provisions specified herein.

The Engineer, at the Engineer's discretion, will inspect and test the facilities, materials and methods for producing the concrete to ensure that minor concrete of the quality suitable for use in the work is obtained.

Before using minor concrete or in advance of revising the mix proportions, the Contractor shall submit in writing to the Engineer a copy of the mix design. When required by the following table, the Contractor shall include compressive strength test results verifying the minimum specified compressive strength:

SCM	Test Submittal Required
Fly Ash used alone	When portland cement content<350 lbs/cy
GGBFS used alone	When portland cement content <250 lbs/cy
Natural Pozzolan used alone	When portland cement content <350 lbs/cy
More than 1 SCM	Always

Tests shall be performed by an ACI certified technician.

90-10.02 MATERIALS

Minor concrete shall conform to the following requirements:

90-10.02A Cementitious Material

Cementitious material shall conform to the provisions in Section 90-1.01, "Description," and 90-2, "Materials."

90-10.02B Aggregate

Aggregate shall be clean and free from deleterious coatings, clay balls, roots, and other extraneous materials.

Use of crushed concrete or reclaimed aggregate is acceptable only if the aggregate satisfies all aggregate requirements.

The Contractor shall submit to the Engineer for approval, a grading of the combined aggregate proposed for use in the minor concrete. After acceptance of the grading, aggregate furnished for minor concrete shall conform to that grading, unless a change is authorized in writing by the Engineer.

The Engineer may require the Contractor to furnish periodic test reports of the aggregate grading furnished. The maximum size of aggregate used shall be at the option of the Contractor, but in no case shall the maximum size be larger than 1-1/2-inch or smaller than 3/4 inch.

The Engineer may waive, in writing, the gradation requirements in this Section 90-10.02B, if, in the Engineer's opinion, the furnishing of the gradation is not necessary for the type or amount of concrete work to be constructed.

90-10.02C Water

Water used for washing, mixing, and curing shall be free from oil, salts, and other impurities that would discolor or etch the surface or have an adverse affect on the quality of the concrete.

90-10.02D Admixtures

The use of admixtures shall conform to the provisions in Section 90-4, "Admixtures."

90-10.03 PRODUCTION

Cementitious material, water, aggregate, and admixtures shall be stored, proportioned, mixed, transported, and discharged in conformance with recognized standards of good practice that will result in concrete that is thoroughly and uniformly mixed, that is suitable for the use intended, and that conforms to requirements specified herein. Recognized standards of good practice are outlined in various industry publications such as are issued by American Concrete Institute, AASHTO, or the Department.

The cementitious material content of minor concrete shall conform to the provisions in Section 90-1.01, "Description."

The amount of water used shall result in a consistency of concrete conforming to the provisions in Section 90-6.06, "Amount of Water and Penetration." Additional mixing water shall not be incorporated into the concrete during hauling or after arrival at the delivery point, unless authorized by the Engineer.

Discharge of ready-mixed concrete from the transporting vehicle shall be made while the concrete is still plastic and before stiffening occurs. An elapsed time of 1.5 hours (one hour in non-agitating hauling equipment), or more than 250 revolutions of the drum or blades, after the introduction of the cementitious material to the aggregates, or a temperature of concrete of more than 90 °F will be considered conditions contributing to the quick stiffening of concrete. The Contractor shall take whatever action is necessary to eliminate quick stiffening, except that the addition of water will not be permitted.

The required mixing time in stationary mixers shall be not less than 50 seconds or more than 5 minutes.

The minimum required revolutions at mixing speed for transit-mixed concrete shall be not less than that recommended by the mixer manufacturer, and shall be increased, if necessary, to produce thoroughly and uniformly mixed concrete.

When a high range water-reducing admixture is added to the concrete at the job site, the total number of revolutions shall not exceed 300.

Each load of ready-mixed concrete shall be accompanied by a weighmaster certificate that shall be delivered to the Engineer at the discharge location of the concrete, unless otherwise directed by the Engineer. The weighmaster certificate shall be clearly marked with the date and time of day when the load left the batching plant and, if hauled in truck mixers or agitators, the time the mixing cycle started.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," shall be furnished to the Engineer, prior to placing minor concrete from a source not previously used on the contract, stating that minor concrete to be furnished meets contract requirements, including minimum cementitious material content specified.

90-10.04 CURING MINOR CONCRETE

Curing minor concrete shall conform to the provisions in Section 90-7, "Curing Concrete."

90-10.05 PROTECTING MINOR CONCRETE

Protecting minor concrete shall conform to the provisions in Section 90-8, "Protecting Concrete," except the concrete shall be maintained at a temperature of not less than 40 °F for 72 hours after placing.

90-10.06 MEASUREMENT AND PAYMENT

Minor concrete will be measured and paid for in conformance with the provisions specified in the various sections of these specifications covering concrete construction when minor concrete is specified in the specifications, shown on the plans, or indicated by contract item in the Engineer's Estimate.

90-11 MEASUREMENT AND PAYMENT

90-11.01 MEASUREMENT

Portland cement concrete will be measured in conformance with the provisions specified in the various sections of these specifications covering construction requiring concrete.

For concrete measured at the mixer, the volume in cubic feet shall be computed as the total weight of the batch in pounds divided by the density of the concrete in pounds per cubic foot. The total weight of the batch shall be calculated as the sum of all materials, including water, entering the batch. The density of the concrete will be determined in conformance with the requirements in California Test 518.

90-11.02 PAYMENT

Portland cement concrete will be paid for in conformance with the provisions specified in the various sections of these specifications covering construction requiring concrete.

Full compensation for furnishing and incorporating admixtures required by these specifications or the special provisions will be considered as included in the contract prices paid for the concrete involved and no additional compensation will be allowed therefor.

Should the Engineer order the Contractor to incorporate any admixtures in the concrete when their use is not required by these specifications or the special provisions, furnishing the admixtures and adding them to the concrete will be paid for as extra work as provided in Section 4-1.03D, "Extra Work."

Should the Contractor use admixtures in conformance with the provisions in Section 90-4.05, "Optional Use of Chemical Admixtures," or Section 90-4.07, "Optional Use of Air-entraining Admixtures," or should the Contractor request and obtain permission to use other admixtures for the Contractor's benefit, the Contractor shall furnish those admixtures and incorporate them into the concrete at the Contractor's expense and no additional compensation will be allowed therefor.

^^

SECTION 91 PAINT

(Issued 05-1-06)

Replace Section 91-3 with:

91-3 PAINTS FOR TIMBER

91-3.01 WOOD PRIMER, LATEX-BASE

Classification:

This specification covers a ready-mixed priming paint for use on unpainted wood or exterior woodwork. It shall conform with the requirements in the Detailed Performance Standards of the Master Painters Institute (MPI) for exterior wood primers, and be listed on the Exterior Latex Wood Primer MPI List Number 6.

91-3.02 PAINT; LATEX-BASE FOR EXTERIOR WOOD, WHITE AND TINTS

Classification:

This specification covers a ready-mixed paint for use on wood surfaces subject to outside exposures. This paint shall conform to the requirements in the Detailed Performance Standards of the Master Painters Institute (MPI) for Paint, Latex, Exterior, and shall be listed on the following MPI Approved Products List:

A. Exterior Latex, Flat MPI Gloss Level 1, MPI List Number 10.
B. Exterior Latex, Semi-Gloss, MPI Gloss Level 5, MPI List Number 11.
C. Exterior Latex, Gloss, MPI Gloss Level 6, MPI List Number 119.

Unpainted wood shall first be primed with wood primer conforming to the provisions in Section 91-3.01, "Wood Primer, Latex-Base."

Replace Section 91-4 with:

91-4 MISCELLANEOUS PAINTS

91-4.01 THROUGH 91-4.04 (BLANK)

91-4.05 PAINT; ACRYLIC EMULSION, EXTERIOR WHITE AND LIGHT AND MEDIUM TINTS

Classification:

This specification covers an acrylic emulsion paint designed for use on exterior masonry. This paint shall conform to the requirements in the Detailed Performance Standards of the Master Painters Institute (MPI) for Paint, Latex, Exterior, and shall be listed on the following MPI Approved Products Lists:

A. Exterior Latex, Flat MPI Gloss Level 1, MPI List Number 10.
B. Exterior Latex, Semi-Gloss, MPI Gloss Level 5, MPI List Number 11.
C. Exterior Latex, Gloss, MPI Gloss Level 6, MPI List Number 119.

This paint may be tinted by using "universal" or "all purpose" concentrates.

^^

SECTION 92 ASPHALTS
(Issued 03-21-08)

Replace Section 92 with:

SECTION 92 ASPHALTS

92-1.01 DESCRIPTION

Asphalt is refined petroleum or a mixture of refined liquid asphalt and refined solid asphalt that are prepared from crude petroleum. Asphalt is:

1. Free from residues caused by the artificial distillation of coal, coal tar, or paraffin
2. Free from water
3. Homogeneous

92-1.02 MATERIALS

GENERAL

Furnish asphalt under the Department's "Certification Program for Suppliers of Asphalt." The Department maintains the program requirements, procedures, and a list of approved suppliers at:

http://www.dot.ca.gov/hq/esc/Translab/fpm/fpmcoc.htm

Transport, store, use, and dispose of asphalt safely.
Prevent the formation of carbonized particles caused by overheating asphalt during manufacturing or construction.

GRADES

Performance graded (PG) asphalt binder is:

Performance Graded Asphalt Binder

Property	AASHTO Test Method	Specification Grade				
		PG 58-22 [a]	PG 64-10	PG 64-16	PG 64-28	PG 70-10
Original Binder						
Flash Point, Minimum °C	T 48	230	230	230	230	230
Solubility, Minimum % [b]	T 44	99	99	99	99	99
Viscosity at 135°C, [c] Maximum, Pa·s	T 316	3.0	3.0	3.0	3.0	3.0
Dynamic Shear, Test Temp. at 10 rad/s, °C	T 315	58	64	64	64	70
Minimum G*/sin(delta), kPa		1.00	1.00	1.00	1.00	1.00
RTFO Test, [e] Mass Loss, Maximum, %	T 240	1.00	1.00	1.00	1.00	1.00
RTFO Test Aged Binder						
Dynamic Shear, Test Temp. at 10 rad/s, °C	T 315	58	64	64	64	70
Minimum G*/sin(delta), kPa		2.20	2.20	2.20	2.20	2.20
Ductility at 25°C Minimum, cm	T 51	75	75	75	75	75
PAV [f] Aging, Temperature, °C	R 28	100	100	100	100	110
RTFO Test and PAV Aged Binder						
Dynamic Shear, Test Temp. at 10 rad/s, °C	T 315	22 [d]	31 [d]	28 [d]	22 [d]	34 [d]
Maximum G*sin(delta), kPa		5000	5000	5000	5000	5000
Creep Stiffness, Test Temperature, °C	T 313	-12	0	-6	-18	0
Maximum S-value, Mpa		300	300	300	300	300
Minimum M-value		0.300	0.300	0.300	0.300	0.300

Notes:

a. Use as asphalt rubber base stock for high mountain and high desert area.

b. The Engineer waives this specification if the supplier is a Quality Supplier as defined by the Department's "Certification Program for Suppliers of Asphalt."

c. The Engineer waives this specification if the supplier certifies the asphalt binder can be adequately pumped and mixed at temperatures meeting applicable safety standards.

d. Test the sample at 3°C higher if it fails at the specified test temperature. G*sin(delta) remains 5000 kPa maximum.

e. "RTFO Test" means the asphaltic residue obtained using the Rolling Thin Film Oven Test, AASHTO Test Method T 240 or ASTM Designation: D 2872. The residue from mass change determination may be used for other tests.

f. "PAV" means Pressurized Aging Vessel.

Performance graded polymer modified asphalt binder (PG Polymer Modified) is:

Performance Graded Polymer Modified Asphalt Binder [a]

Property	AASHTO Test Method	Specification Grade		
		PG 58-34 PM	PG 64-28 PM	PG 76-22 PM
Original Binder				
Flash Point, Minimum °C	T 48	230	230	230
Solubility, Minimum % [b]	T 44[c]	98.5	98.5	98.5
Viscosity at 135°C, [d] Maximum, Pa·s	T 316	3.0	3.0	3.0
Dynamic Shear, Test Temp. at 10 rad/s, °C Minimum G*/sin(delta), kPa	T 315	58 1.00	64 1.00	76 1.00
RTFO Test , Mass Loss, Maximum, %	T 240	1.00	1.00	1.00
RTFO Test Aged Binder				
Dynamic Shear, Test Temp. at 10 rad/s, °C Minimum G*/sin(delta), kPa	T 315	58 2.20	64 2.20	76 2.20
Dynamic Shear, Test Temp. at 10 rad/s, °C Maximum (delta), %	T 315	Note e 80	Note e 80	Note e 80
Elastic Recovery[f], Test Temp., °C Minimum recovery, %	T 301	25 75	25 75	25 65
PAV[g] Aging, Temperature, °C	R 28	100	100	110
RTFO Test and PAV Aged Binder				
Dynamic Shear, Test Temp. at 10 rad/s, °C Maximum G*sin(delta), kPa	T 315	16 5000	22 5000	31 5000
Creep Stiffness, Test Temperature, °C Maximum S-value, MPa Minimum M-value	T 313	-24 300 0.300	-18 300 0.300	-12 300 0.300

Notes:

a. Do not modify PG Polymer Modified using acid modification.

b. The Engineer waives this specification if the supplier is a Quality Supplier as defined by the Department's "Certification Program for Suppliers of Asphalt."

c. The Department allows ASTM D 5546 instead of AASHTO T 44

d. The Engineer waives this specification if the supplier certifies the asphalt binder can be adequately pumped and mixed at temperatures meeting applicable safety standards.

e. Test temperature is the temperature at which G*/sin(delta) is 2.2 kPa. A graph of log G*/sin(delta) plotted against temperature may be used to determine the test temperature when G*/sin(delta) is 2.2 kPa. A graph of (delta) versus temperature may be used to determine delta at the temperature when G*/sin(delta) is 2.2 kPa. The Engineer also accepts direct measurement of (delta) at the temperature when G*/sin(delta) is 2.2 kPa.

f. Tests without a force ductility clamp may be performed.

g. "PAV" means Pressurized Aging Vessel.

SAMPLING

Provide a sampling device in the asphalt feed line connecting the plant storage tanks to the asphalt weighing system or spray bar. Make the sampling device accessible between 24 and 30 inches above the platform. Provide a receptacle for flushing the sampling device.

Include with the sampling device a valve:

1. Between 1/2 and 3/4 inch in diameter
2. Manufactured in a manner that a one-quart sample may be taken slowly at any time during plant operations
3. Maintained in good condition

Replace failed valves.

In the Engineer's presence, take 2 one-quart samples per operating day. Provide round, friction top, one-quart containers for storing samples.

92-1.03 EXECUTION

If asphalt is applied, you must comply with the heating and application specifications for liquid asphalt in Section 93, "Liquid Asphalts."

92-1.04 MEASUREMENT

If the contract work item for asphalt is paid by weight, the Department measures asphalt tons by complying with the specifications for weight determination of liquid asphalt in Section 93, "Liquid Asphalts."

The Engineer determines the asphalt weight from volumetric measurements if you:

1. Use a partial asphalt load
2. Use asphalt at a location other than a mixing plant and no scales within 20 miles are available and suitable
3. Deliver asphalt in either of the following:

    3.1. A calibrated truck with each tank accompanied by its measuring stick and calibration card
    3.2. A truck equipped with a calibrated thermometer that determines the asphalt temperature at the delivery time and with a vehicle tank meter complying with the specifications for weighing, measuring, and metering devices in Section 9-1.01, "Measurement of Quantities"

If you furnish hot mix asphalt from a mixing plant producing material for only one project, the Engineer determines the asphalt quantity by measuring the volume in the tank at the project's start and end provided the tank is calibrated and equipped with its measuring stick and calibration card.

The Engineer determines pay quantities from volumetric measurements as follows:

1. Before converting the volume to weight, the Engineer reduces the measured volume to that which the asphalt would occupy at 60 °F.
2. The Engineer uses 235 gallons per ton and 8.51 pounds per gallon for the average weight and volume for PG and PG Polymer Modified asphalt grades at 60 °F.
3. The Engineer uses the Conversion Table in Section 93, "Liquid Asphalts."

^^

SECTION 93 LIQUID ASPHALTS
(Issued 11-03-06)

In Section 93-1.04 replace the 9th paragraph with:

The following Legend and Conversion Table is to be used for converting volumes of liquid asphalt products, Grades 70 to 3000, inclusive, and paving asphalt Grades PG 58-22, PG 64-10, PG 64-16, PG 64-28, and PG 70-10, and Grades PG 58-34 PM, PG 64-28 PM, and PG 76-22 PM.

^^

SECTION 95 EPOXY
(Issued 06-05-09)

Replace the table in Section 95-2.11 with:

Characteristics of Adhesive:

Test[a]	California Test	Requirement
Brookfield Viscosity, No. 3 Spindle at 20 rpm, Poise at 77°F	434, Part 4	0.9 max.
Gel time, minutes	434, Part 1	2 to 15
Slant Shear Strength on Dry Concrete, psi, after 4 days of cure in air at 77° F ±2° F	434, Part 5[b]	3,000 min.
Slant Shear Strength on Wet Concrete, psi, after 4 days of cure in air at 77° F ±2° F	434, Part 5[b]	1,700 min.
Tensile Strength, psi	434, Part 7, except test after 4 days of cure at 77° F ±2° F	4,500 min.
Elongation, %	434, Part 7, except test after 4 days of cure at 77° F ±2° F	10 max.

[a] The mixing ratio used will be that recommended by the manufacturer.
[b] For slant shear strength on concrete, delete Sections B-1 and B-5 of California Test 434, Part 5. For dry concrete, use Step "2" below only. For wet concrete, use both Steps "1" & "2":

1. Soak blocks in water for 24 hours at 77° F ±2° F. Remove and wipe off excess water.
2. Mix epoxy as described in California Test 434, Part 1, and apply a coat approximately 0.010-inch thick to each diagonal surface. Place four 0.125-inch square pieces of shim stock 0.012-inch thick on one block to control final film thickness. Before pressing the coated surfaces together, leave the blocks so that the coated surfaces are horizontal until the epoxy reacts slightly to prevent excessive flow.