Final Report to ATG & EC

April 19, 2022

Document the Development of CCPR Specifications per Statement of Effort

Caltrans will develop a non-Standard Special Provisions (nSSP) for a bituminous Cold Central-Plant Recycling (CCPR) process including the development of a procedure for mix design and testing. The final product will be a new nSSP, MPQP, and CTM.

Recycling is an increasingly important initiative for Caltrans. We can recycle existing asphalt on pavement rehabilitation and reconstruction projects that are located within urban areas with high RAP disposal costs or located outside a viable distance from asphalt plants to reduce costs, greenhouse (GHG) emissions, and construction-related trucking of materials. CCPR is an alternative recycling method that can be utilized when CIR and other sustainable rehabilitation methods may not be feasible or cost effective. Industry and Caltrans agree that pilot projects should be implemented by a future working group.

The CCPR Working Group has developed the following innovations:

1. Developed a specification that specifies construction material and construction equipment requirements, establishes Quality Control/Quality Assurance Plans and construction procedures. For now, this will be Section 30-7.
2. Established a standard Material Plant Quality Program (MPQP) calibration procedure for CCPR equipment to be added to the MPQP manual.
3. California Test Method 316 (CT-316) has been developed to describe the procedures for mixture design and testing for cold central plant recycling (CCPR) of asphalt pavements using bituminous recycling agents and additives.

This checklist is from the PMPC SOP page 28.

All Work Products shall have a final report. This final report shall include:

a. A copy of the scoping document. YES
b. Any updated scoping documents if applicable. YES, milestone extension
c. Any additional work plans developed. N/A
d. Results of research and testing. N/A
e. Recommendation Analysis. N/A
f. Comment/response matrix Attached
g. Decisions. N/A
h. Final Work Product (revised specification, test method, etc.). Attached are nSSP, CT-316, and MPQP
i. Next steps. Looking for pilot projects; stated above.

Final Report to ATG & EC

April 12, 2022

Document the Development of CCPR Specifications per Statement of Effort

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Recycling is an increasingly important initiative for Caltrans. We can recycle existing asphalt on pavement rehabilitation and reconstruction projects that are located within urban areas with high RAP disposal costs or located outside a viable distance from asphalt plants to reduce costs, greenhouse (GHG) emissions, and construction-related trucking of materials. CCPR is an alternative recycling method that can be utilized when CIR and other sustainable rehabilitation methods may not be feasible or cost effective. Industry and Caltrans agree that pilot projects should be implemented by a future working group.

The CCPR Working Group has developed the following innovations:

1. Developed a specification that specifies construction material and construction equipment requirements, establishes Quality Control/Quality Assurance Plans and construction procedures. For now, this will be Section 30-7.
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Pavement & Materials Partnering Committee
Work Product Scoping Document
Develop CCPR Specifications
April 1, 2021

Task Group

Recycling STG

Problem Process

☐ Annual
☐ Expedited
☒ Emerging Initiative

Title

Develop Cold Central Plant Recycling Specifications

Statement of Effort/Improvement

Caltrans will develop a non-Standard Special Provisions (nSSP) for a bituminous Cold Central-Plant Recycling (CCPR) process including the development of a procedure for mix design and testing. Although CCPR is not a new technology, it has not been used in Caltrans pavements. The final product will be a new nSSP, MPQP manual revisions, and CTM.

Purpose – The purpose of the Working Group is to develop a specification that specifies construction material and construction equipment requirements, establishes Quality Control/Quality Assurance Plans and construction procedures. Establish a standard Material Plant Quality Program (MPQP) calibration procedure for CCPR equipment to be added to the MPQP manual.

Background – Recycling is an increasingly important initiative for Caltrans. Recycling of existing asphalt on pavement rehabilitation and reconstruction projects can be facilitated on projects that are located outside of a viable distance from asphalt plants in efforts to reduce costs, greenhouse gas (GHG) emissions, and construction-related trucking of materials. CCPR is an alternative recycling method that can be utilized when PDR and other sustainable rehabilitation methods may not be feasible or cost effective. Industry and Caltrans agree that pilot projects will be placed on the Recycling STG bin list – to be implemented by a future working group.

Approach – A working group will be assembled by the Recycling STG and they will develop the specifications based on current technical knowledge.

1. Street Ready Assurance
   The CCPR specifications will be developed based on the merged foamed asphalt and emulsified asphalt partial depth recycling (PDR) specifications and modifications will be made to reflect the variations in construction methodology, application, and end-product capabilities of CCPR.

2. Performance Tracking/Management
   The Recycling STG will monitor feedback from the districts when the specification is approved for use as nSSP on a project.
   - Those from the working group will stay in communication with the district project team to inquire and receive feedback from construction personnel.

3. Consistently Implemented
   The working group will perform outreach to District Materials Engineers, District Maintenance Engineers, and Designers with the goal to provide them with current information.

Team Members (Indicate CT Chair and Industry Lead)

CT/Industry	Division/Firm Name	Member Name
CT – Chair (Working Group)	Office of Asphalt Pavements	Steve Lee
Industry Lead (Working Group)	Pavement Recycling Systems	Michael Concannon
Caltrans	Office of Asphalt Pavements	Saeed Pourtahmasb
Caltrans	METS	Sarah Hartz
Caltrans	Construction	Pete Spector
Industry	Western Emulsions	Kevin Donnelly
Industry	Graniterock	Anthony Silva
Industry	Pavement Engineering, Inc.	Brandon Rodebaugh

Objectives/Deliverables/Due Dates

Description:

1. Literature review to determine the state of the practice of CCPR & develop CCPR specifications. UCPRC will be consulted.
2. Draft Procedure for CCPR Equipment section in the MPQP Manual.
3. Develop CCPR mix design procedure and testing requirements.
4. Send updated nSSPs, MPQP manual section, and CTM to districts for review and comment.
5. Review final comments by districts and adjust nSSPs, CTM, and MPQP section if necessary.
6. Final nSSP, CTM, and MPQP manual section completed and approved by the working group.
7. Send nSSP, MPQP manual section, and CTM to the ATG for approval.
8. Final report and recommendations.

Details:

Milestones	Name - Responsible Party	Due Date (Start/Complete)
1. Literature Review & Develop Specifications	CT Chair and Industry Lead	April 1, 2021 to June 30, 2021
2. Draft MPQP manual section specific to CCPR Equipment	CT Construction and Industry Construction	April 1, 2021 to June 30, 2021
3. Develop Provisional CTM	CT METS and Aragon	April 1, 2021 to June 30, 2021
4. Circulate nSSPs, CTM, and MPQP manual section for review	CT Chair and Industry Lead	July 1, 2021 to July 31, 2021
5. Respond to comments and incorporate into nSSPs/CTM/MPQP procedure	CT Chair and Industry Lead	August 1, 2021 to August 31, 2021
6. Review and approve final nSSP/CTM/MPQP procedure.	CT Chair and Industry Lead	September 1, 2021 to September 30, 2021
7. Send nSSP/MPQP Procedure/CTM to ATG for approval.	CT Chair	October 1, 2021 to October 31, 2021

*Some milestones listed above may not be necessary

Resources To Develop and Implement

	Caltrans Hours	Industry Hours
Specification Writing/Review/Pilot Projects	OAP: 1.0 PY OCS: 0.6 PY METS: 0.6 PY	1.0 PY

Benefits

The benefits:

- Develop CCPR nSSP to make CCPR selection and construction easier for the engineer.
- Costs will become more competitive for Caltrans as competition opens.
- Promote more recycling strategies as directed by SB-1.
- Standardize and maintain quality standards for CCPR specification

Estimated Impact to Caltrans and Contractor

- District/HQ resources would remain the same or would be streamlined.
- No additional risks for Caltrans were identified.
- No additional risks for Contractors were identified.

Impediments to Completion of Deliverables

No foreseen impediments to completion.

Recommendation and Approval

This scoping document for "Develop Cold Central Plant Recycling Specifications" was prepared by the Recycling Subtask Group to address a priority issue with statewide significance and is within the Pavement & Materials Partnering Committee mission as described in the Pavement & Materials Partnering Committee Charter. The Subtask Group members have determined the scope, resources required and timeline for delivery of this project so that the deliverables are achievable. A signature here indicates that each Asphalt Task Group member and PMPC Executive Committee member is committed to providing the resources to support this effort within the prescribed timeframes. Furthermore, it is everyone's responsibility to ensure that the final effort/improvement will be:

1) Street-Ready,
2) Monitored and reported for performance,
3) Successfully implemented statewide as appropriate.

Scoping Document Recommendation and Industry Concurrence by PMPC ATG:

Caltrans Name (Recommendation)	Date	Industry Name (Concurrence)	Date
Tom Pyle	4/6/21	Pat Imhoff	4/6/21
Tom Pyle, Caltrans Task Group Chair		Pat Imhoff, Industry Task Group Lead	
Ken Solak	4/6/21	Phil Reader	4/6/21
Ken Solak, Caltrans Task Group Member		Phil Reader, Industry Task Group Member	
Jeremy Peterson-Self	4/8/21	Dennis McElroy	4/6/21
Jeremy Peterson-Self, Caltrans Task Group Member		Dennis McElroy, Industry Task Group Member	
		Scott Dmytrow	4/6/21
		Scott Dmytrow, Industry Task Group Member	

Scoping Document Approval and Industry Concurrence by PMPC EC:

Caltrans Name (Approval)	Date	Industry Name (Concurrence)	Date
Shaila Chowdhury	4/23/21	Brandon Milar	4/23/21
Shaila Chowdhury – acting Chair Pavement Program		Brandon Milar, Industry PMPC Executive Committee	
Raymond A Tritt	4/22/21	Charles J. Rea	4/21/21
Raymond Tritt, acting Headquarters Construction		Charley Rea, Industry PMPC Executive Committee	
Kevin O'Keady	4/22/21	Tim Greutert	4/28/21
Kevin Keady, acting Structures Policy and Innovation		Tim Greutert, Materials Engineering and Testing Services	

Approval Date: 4/28/21

State of California
DEPARTMENT OF TRANSPORTATION

California State Transportation Agency

Memorandum

Making Conservation a California Way of Life

To: Asphalt Task Group
PMPC Asphalt Task Group (ATG) Chair
Supervising Transportation Engineer
Office of Asphalt Pavements
Pavement Program
Division of Maintenance

Date: November 3, 2021

From: ALLEN KING, PE
PMPC Recycling STG Chair
Senior Transportation Engineer
Office of Asphalt Pavements
Pavement Program

STEVE J. LEE, PE, PMP
CCPR Working Group Chair
Senior Transportation Engineer
Office of Asphalt Pavements
Pavement Program

Division of Maintenance Division of Maintenance

Subject: **MILESTONE EXTENSION FOR CCPR WORKING GROUP**

The purpose of this memorandum is to request a time extension for "Develop Cold Central Plant Recycling Specifications" milestones for the scoping document dated April 1, 2021.

Due to COVID-19 pandemic and stay at home orders, the scoping document was not approved until April 28, 2021. Furthermore, during the busy construction season, some of the working group members were not readily available. The first working group meeting started in July 2021.

This effort is more complex than originally planned; thus, it took more time and effort to do, especially the nSSP.

Since the milestones are consecutive, this will change all subsequent milestones. Below are the proposed changes with the old due dates crossed out for reference.

NO.	Milestones	Name - Responsible Party	Due Date (Start/Complete)
1	Literature Review & Develop Specifications	CT Chair and Industry Lead	March 1, 2021 to September 30, 2021
2	Draft MPQP section specific to CCPR Equipment	CT Construction and Industry Construction	March 1, 2021 to September 30, 2021
3	Develop Provisional CTM	CT METS and Industry	March 1, 2021 to September 30, 2021
4	Circulate nSSPs, CTM, and MPQP section for review	CT Chair and Industry Lead	July 1, 2021 to ~~October 31, 2021~~ November 30, 2021
5	Respond to comments and incorporate into nSSPs/CTM/MPQP procedure	CT Chair and Industry Lead	August 1, 2021 to ~~November 30, 2021~~ January 31, 2022
6	Review and approve final nSSP/CTM/MPQP procedure.	CT Chair and Industry Lead	September 1, 2021 to ~~December 31, 2021~~ February 14, 2022
7	Send nSSP/MPQP Procedure/CTM to ATG for approval.	CT Chair	October 1, 2021 to ~~January 31, 2022~~ February 28, 2022

CCPR Spec Draft Comment Resolution Form

No.	Section No.		Current Language	Comments/Suggested changes	Response	From
1	SSP language from Section 39	21/81.11	Haul planed material to the CCPR plant and use all as RAP ingredient in CCPR material	Should we include some language that requires any excess material to become the property of the contractor. Project Engineers can determine the volume of cold planing and the volume of placed CCPR. Will guidance be provided to estimate the swell factor from in place grinding to in place CCPR?	Added language: "Any excess material become the property of the contractor."	Pete Spector
2	30-5.01A	1/2	sts of: Screening and crushing; reconstitute as needed	The Basic Asphalt Recycling Manual (BARM) flowchart in Figure 12.2 includes and independent step for "Crush and/or Screen Rap This step may not be absolutely necessary for a CCPR project from a single source, but is absolutely necessary for multiple source stockpiles to assure uniformity in the stockpile. The specifications need to be very specific regarding this requirement. The BARM does not contain any specific guidance for stockpile sampling, but there exist guidelines for RAP in HMA which could be used as a guideline.	Screening is required.	Paul Curren
3	30-5.01A	1/2	CCPR consists of: Stockpile material at the project site	Stockpiling the mixed material is a significant unknown regarding the feasibility of implementation and the effects of stockpiling on materials properties. BARM only mentions stockpiling at the end of the first paragraph of section 124.. However, no guidance regarding; is provided nor is stockpiling mentioned in the placement sections. I recommend that stockpiling of mixed recycled material be prohibited until it can be demonstrated that it is feasible. This should be an element in the pilot projects. The BARM does not provide any guidelines regarding stockpiling provisions, so they would need to be developed.	See comment #55: changed to 1 hour	Paul Curren
4	30-5.01B	2/3	lot: 400 CY or fraction thereof of CCPR pavement constructed in the same day	At 0.25 foot depth, 293 tons is created in PDR. At 0.40 foor depth, 469 tons is created. 400 tons is a reasonable comparative frequency for materials produced, but it may be confusing relative to performing placement monitoring such as compaction testing. This might be more of a construction issue as the inspector would have to figure out test location based on tonnage, but this is normal for HMA, so it might not be a stretch for CCPR.	Acknowledged, no change necessary	Paul Curren
5	30-5.01C(3)	3/9	If additional materials are to be imported, these materials must be incorporated into the mix design testing	For proper implementation of either PDR or CCPR, it is vey important that a proper field and materials evaluation be performed to determine what other materials, other the those listed are to be used. Other materials may include aggregates such as base rock or supplemental fines. If used, how these are to be incorporated at the CCPR plant becomes important.	Added phrase: "in the same proportions as they will be incorporated in the field"	Paul Curren
6	30-5.01C(5)	3/11	For each lot, submit a report daily that includes the following items	CCPR differs for PDR inn that manufacturing is independent of field location. For reporting, these should be separated into a CCPR plant and field reports. This entire section will have to be rewritten if this path is chosen. Otherwise, it will be confusing regarding who report what the report.	Doing both CCPR plant and field reports are not necessary at this time. Reporting is at the discretion of the contractor as long as all information is provided.	Paul Curren
7	30-5.01C(5)	4/11	Water added for compaction	This becomes a trickier factor as placement is separated from processing, so there is a time delay in compaction. One concern (especially regarding stockpiling) is that compactability is highly dependent on moisture content at time of compaction. What happens when the material drys out in transport, placement or awaiting compaction? It is not possible to add surface water. This needs to be discussed and resolved.	CCPR plant is close to the job and can be shut down and restarted quickly. Material should be spread within 1-hour. If greater than 1-hour, corrective action should be addressed in the QC plan.	Paul Curren
8	30-5.01D(2)(b)	7/26	rdination of the following CCPR activities: CCPR plant activities including crushing, stock piling, reconstituting, mixing, stock piling	Same comment on stockpiling.	We could consider a maximum time on stockpiling. See above response.	Paul Curren
9	30-5.01D(2)(b)	7/28	n must address the elements affecting CCPR quality stock piling	Same concerns regarding stockpiling. Also see comments on moisture content.	We will review all language regarding stockpiling.	Paul Curren
10	30-5.01D(2)(d)	8/33	t Application rates for recycling agent, cement, and appropriate	See previous comment on filed moisture content during compaction.	See previous response on compaction.	Paul Curren
11	30-5.01D(2)(d)(i)(E)	11/48	Testing Frequency two test sites per sub lot ande no lot shall be represented by fewer than five test sites.	Why was this deleted. Important minimums for density testing.	Reverted back to original language.	Paul Curren
12	30-5.03A	18/78	provide 20 tons of commercial quality bituminous surfacing material onsite	Why was this deleted. Important contingency provision if significant field raveling problems occur.	If patching is necessary due to field raveling, CCPR material can be used. Therefore, cold mix is just an unnecessary cost.	Paul Curren
13	General Comment	Various	Wet field gradation (% passing) Sieve size 1-inch 3/4-inch	Wet Gradation (%Passing) on the No. 4 can be very inaccurate...Propose to remove Wet gradation requirement on the No. 4 sieve OR change to 1/2-inch or 3/8-inch.	No change, wet Gradation is a report only test and can still be used to identify changes in the material.	MCK Paving
14	30-5.01B	Page 2 of 29	**lot** Y or fraction thereof of CCPR pavement constructed in the same day. **sub-lot**: 40 CY or fraction thereof of PDR pavement constructed e day.	Is there 10 sublot in 1 lot? Or is there an error? And should PDR under the definition of sub-lot be CCPR?	Yes, should be 80 CY for sublot. Changed to CCPR.	MCK Paving
15	30-5.01C(5)	Page 4 of 29	Under item 7.2: Relative compaction under California Test 231 for lifts greater than 4-inches and relative compaction under California Test 375 for lifts less than or equal to 4-inches	Should we add in "base on CT 216"? Propose: "Relative compaction under CT 231 based on CT 216 for lifts greater than 4-inches..."	No change, target density based on breakover curve not CT 216, regardless of CT 375 or 231.	MCK Paving

No.	Section No.		Current Language	Comments/Suggested changes	Response	From
16	30-5.01C(7)		Submit samples of asphalt in 1-quart cans to the Engineer.	Should we add in "recycling agent"? Propose: "Submit samples of the asphalt **recycling agent** in..."	change to recycling agent	MCK Paving
17	30-5.01C(7)	Page 5 of 29	Within 10 business days after taking asphalt quality control samples, submit the test results for asphalt quality stics.	Should we add in "recycling agent"? Propose: "...days after taking the asphalt **recycling agent** quality control samples..."	change to recycling agent	MCK Paving
18	30-5.01C(9)		place wet density (g/cc)" row: California Test 375, Part rnia Test 231	Add in "/California Test 216": California Test 375, Part 4 or California Test 231**/California Test 216**"	no change, see comment 3	MCK Paving
19	30-5.01C(9)		ative Compaction (%)"California Test 375 or California	Add in "per California Test 216": California Test 375 or California Test 231 **per California Test 216**"	no change, see comment 3	MCK Paving
20	General Comment	Various	omment regarding Marshall Stability/Retained Stability ct Dry and Wet Tensile Strength	Should the Marshall Stability be only for the emulsified asphalt application and indirect tensile strength be for the foamed asphalt application?	No change, reasearch only to identify most appropriate test for each recycling agent.	MCK Paving
21	30-5.01D(2)(d)(i)(B) and 30-5.01C(7)	29 and page 5 of	Under section 30-5.01D(2)(d)(i)(B) vs. under section 30-5.01C(7) item 7.1.	Under 30-5.01D(2)(d)(i)(B) it says to submit 2 samples to the Engineer vs. 1 sample from section 30-5.01C(7). This item just need to be consistent. Either change section 30-5.01C(7) to 2 samples or vice versa.	No change, 30-5.01C(7) states samples	MCK Paving
22	Footnote b under Density Quality Testing Frequencies	29	[b]Fabricate 3 4-inch diameter specimens compacted under AASHTO T 245 at 75 blows per side or under AASHTO T312 at 30 gyrations. Fabrication of specimens must be completed within 2 hours after materials have been mixed.	Should we use the same procedures to compact the lab specimens from the field during production as what was used in the mix design development stage? Propose: fabricate three 4-inch diameter specimens compacted under AASHTO T 245 at 75 blows per side or under AASHTO T312 at 30 gyrations. Fabrication of specimens must be completed within 2 hours after materials have been mixed. **Compact lab specimens during production under the same procedures that was used for the mix design.**	Add text in bold. **Compact lab specimens during production under the same procedures that was used for the mix design.**	MCK Paving
23	Footnote c under Density Quality Testing Frequencies	Page 11 of 29	[c] mens after 104 degrees F curing to constant weight for 72 hours and allow the specimens to cool to room temperature.	Recommend ranges for curing temperature. Such as 100 +/- 5 degrees F (Range 95 to 105) or 104 +/- 5 degrees F (Range 99 to 109).	Possibly change test method to CT 316, consult with METS and UCPRC. (range is 104 ± 2°F)	MCK Paving
24	Footnote d under Density Quality Testing Frequencies	Page 11 of 29	[d]Use California Test 375 for 4 inches or less and California Test 231 for greater than 4 inches. The relative compaction is based on the break-over point. Verify break-over point once per day of production and when significant changes in material are	Add in "/California Test 216". Propose: "Use California Test 375 for 4 inches or less and California Test 231**/California Test 216** for greater than 4 inches..."	no change, see comment 3	MCK Paving
25	30-5.01D(3) Department Acceptance	29	[a]Fabricate 3 indirect tensile strength specimens under AASHTO T 245 or AASHTO T 312. Fabrication of indirect tensile strength specimens must be completed within 2 hours after materials have been mixed. Indirect tensile strength testing is only or acceptance of CCPR -FA. No indirect tensile strength testing is required for CCPR -EA.	Why are there no stability or strength requirement for CCPR-EA? If there are strength requirements for CCPR-FA there should be stability/strength requirements for CCPR-EA. If there are no stability/strength requirement for CCPR-EA there should be no strength requirements for CCPR-FA. I THINK WE SHOULD BE Consistent on this item. I think it is very important for stability and strength requirements for both the CCPR-EA and CCPR-FA. I understand that the strength/stability is required for the QC portion of the work and we will have information on it available....but to only required strengths for department acceptance on CCPR-FA seems like there are special treatments for the CCPR-EA vs. CCPR-FA process.	No change. Indirect wet tensile strength is report only. Caltrans does not have equipment to test stability but contractor is still required to submit both tests.	MCK Paving
26	30-5.01D(3) Department Acceptance	29	[b] pecimens at 100 degrees F for 72 hours and allow the specimens to cool to room temperature. Test 3 specimens for wet tensile strength under AASHTO T 283 after moisture ng.	Recommend ranges for curing temperature. Such as 100 +/- 5 degrees F (Range 95 to 105) or 104 +/- 5 degrees F (Range 99 to 109).	Possibly change test method to CT 316, consult with METS and UCPRC. (change range to 104 ± 2°F)	MCK Paving
27	30-5.01D(3) Department Acceptance	29	[a]Fabricate 3 indirect tensile strength specimens under AASHTO T 245 or AASHTO T 312. Fabrication of indirect tensile strength specimens must be completed within 2 hours after materials have been mixed. Indirect tensile strength testing is only or acceptance of CCPR -FA. No indirect tensile strength testing is required for CCPR -EA.	Again, we should mentioned that the test method/procedure to use during production should be based on what was used during the mix design process/stage.	Add: Compact lab specimens during production under the same procedures that was used for the mix design.	MCK Paving
28	30-5.01D(4)	29	You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result discrepancies. You and the Engineer may only dispute each other's test results if one party's test results pass and the other party's test results fail.	From my experience, with foamed asphalt specimens being fabricated, cured and testing perspective...the lab fabricated specimens does not represent the in-place strength/specimens. I recommend we add on this clause or something similar to this: "**If the laboratory fabricated specimens did not pass the strength test, in-place strength specimens will be verified based on random sampling locations within the lot. The specimens will be provided to the Engineer for verification. The Engineer or representative shall witness the extraction of the in-place specimens and testing. The Contractor may be present during the verification testing.**" We are human, laboratory fabricated specimens might be askew due to varying and various unknown reason. But to say this segment failed due to laboratory fabricated specimens on strengths and not verify what's in-place could cause unnecessary energy and funding.	No change. Language taken directly from Section 39.	MCK Paving
29	30-5.02F CCPR Mix Design	29	[a] meter mold compaction based on gyratory compactor at 30 gyrations.	In the Mix Design process, it states to use a gyratory compactor, which is AASHTO T312. However, throughout this document, choices are given to fabricate specimens under AASHTO T 245 (marshall compactor) or AASHTO T 312 (gyratory compactor). Should we add in marshall compactor with 75 blows on each side as well under this mix design section?	Added: or marshall compactor with 75 blows per side.	MCK Paving

No.	Section No.		Current Language	Comments/Suggested changes	Response	From
30	30-5.02F CCPR Mix Design	29	[b]Test specimens after 140 degrees F curing to constant weight between 16 hours and 48 hours.	Everywhere else I saw 104 or 100 degrees F not 140 degrees F. Typo? Also, would like to recommend temperature range verse a fixed value. Propose: Either 100 +/- 5 degrees F (Range 95 to 105) or 104 +/- 5 degrees F (Range 99 to 109).	Changed to 104 ± 2°F	MCK Paving
31	30-5.03D(1)	20	form CCPR activities under the following conditions: 5. Between 30 minutes before sunset and 30 minutes after sunrise EA.	We discussed removing language that specified that only FA could be used at night. This should be removed so as not to limit our abilities to use EA at night.	No changes for now. If there is a project where night time CCPR work is advantageous, a CCO can be considered.	Western Emulsions
32	30-5.01A	1/2	Stockpile material at the project site	Cn you stockpile the plant mixed material after adding cement, water, recycling agent, emulsion etc?	Must place material within 1-hour limit	Sri Holikatti
			sphaltic emulsion and sand cover	No surface/wearing layer?	Covered in Section 39 and project plans	Sri Holikatti
34	30-5.01C(6)	5/13	recycling agent and asphaltic emulsion	Are these different from one another? Elsewhere in the NSSP asphaltic emulsion is called recycling agent	Recycling agent goes into the CCPR. Asphaltic emulsion is the fog seal. See paragraphs 16-18.	Sri Holikatti
35	30-5.01D(2)(b)	7/28	Compaction and curing?	Is curing required? If yes, what is the curing time?	Depends on the project and contingency plan submitted by the contractor. See paragraphs 54-56 Department Acceptance. Yes, curing is required. Added to contractor's QC plan.	Sri Holikatti
36	30-5.01D(2)(d)(i)(D)	10/47	Marshall stability (min, lbs)	What compaction method is specified for Marshal specimen preparation?	Covered under CT-316	Sri Holikatti
37	30-5.01D(2)(d)(i)(E)	11/48	[b]Fabricate 3 4-inch diameter specimens compacted under AASHTO T 245 at 75 blows per side or under AASHTO T312 at 30 gyrations. Fabrication of specimens must be completed within 2 hours after materials have been mixed.	As for as possible use the same compaction method for both Marshal stability and relative compaction determination. Be Consistent!	Up to the contractor on the compaction method. Added: **Compact lab specimens during production under the same procedures that was used for the mix design.**	Sri Holikatti
38	30-5.01D(3)	12/55	Emulsified Recycling Agent	Let's use a consistent nomenclature.	Item 3 is for foam asphalt. Item 4 is for emulsified asphalt. Also see previous comment in paragraph 16.	Sri Holikatti
			hold be at least 3"	Did the WG review this thickness?	Should be at least 0.25 feet	Allen King
40	hidden text	1	304141A Cold Central Plant Recycling CUYD	How is the "fluff" factor taken into account? What should the contractor do with the extra recycled material if the elevations are to remain exactly the same? If they're allowed to increase the thickness, how does the designer calculate this increase in thickness?	No changes. Extra material becomes the property of the contractor, at the plant as well.	Allen King
41	30-5.01A	1/2	Stockpiling RAP	The term that was used instead of RAP was "in-place recycled material". RAP term should not be used in these specifications.	Stockpiling all materials along with any imported or local material	Allen King
			and crushing; reconstitute as needed	What does "reconstitute as needed" mean?	No changes	Allen King
			RAP material	The term that was used instead of RAP was "in-place recycled material".	Change to: the material	Allen King
			sphaltic emulsion and sand cover?	Why is there a question mark? Is this commentary that needs to be removed from the spec?	Remove flush coat	Allen King
45	30-5.01B	2/3	In place recycled pavement materal: the combination of processed in place asphalt pavement material with recycling	Should this definition be updated to include the use of off-site RAP? Or possibly leave this as "in-place recycled pavement material" and add in another definition for RAP that comes from off-site? There's a definition below for local CCPR material. Are these both needed?	Removed	Allen King
46	30-5.01B	2/3	Imported CCPR material: materials incorporated into CCPR not generated from project	Would a more accurate definition be "CCPR materials not generated from on-site project materials"? The way it's stated now seems to refer to RAP from off-site. Or possibly change the definition to "recycled pavement material incorporated into CCPR not generated from within project limits". These same comments apply to "local CCPR material" as well.	Changed to: **RAP or RAP and aggregate base incorporated into CCPR not generated from project**	Allen King
			ut	Plant layout and location	Yes, change made.	Allen King
48	30-5.01C(3)	3/9	al materials are to be imported, these materials must be incorporated into the mix design testing in the same proportions as they will be incorporated in the field.	Add additional descriptive words: If additional RAP or aggregate materials	Yes, change made.	Allen King
49	30-5.01C(4)	3/10	cy plan must include actions you will take to ensure the roadway will be open to traffic at the end of each work shift me	Where is this time specified?	changed to: **in accordance with Standard Specifications Section 12**	Allen King
			d time to test samples = 10 business days	What test method is this? This quality characteristic seems out of place.	Row deleted	Allen King
51	30-5.01D(2)(b)	7/26	planing plant activities including crushing, stock piling, ing	What does reconstitute mean? Maybe the definition of this should be in the definitions above so readers are clear on the meaning and intent.	No changes, see comment 42	Allen King
52	30-5.01D(2)(b)	7/26	ng, paving, compacting and finishing activities ~~are d~~	Why was this deleted? Coordination for CCPR is important.	No changes, wording is changed in same paragraph	Allen King
53	30-5.01D(4)	14/56	e Engineer may only dispute each other's test results if s test results pass and the other party's test results fail	Additional sentence needed to clarify time frame: Notify the Engineer within 5 business days of receiving a test result if you dispute the test result.	No changes, copied from Section 39	Allen King
54	30-5.02F	17/68	Raveling test at 50 °F (max, %)[e]	The superscripts should be in alphabetical order. Reorder so this is letter F and letter E is above.	No changes, superscripts are in order as they first appear.	Allen King
55	30-5.03A	18/78	no current language	There should be a time limit on when the material can be injected with recycling agent and when it needs to be in it's final location in the pavement structural section. I could not find that in the spec, please specify what this time limit is and what the contractor can do if the time limit has lapsed. Can they run it through the CCPR plant again? I'm guessing this time limit should be between 2 to 6 hours, but this will have to be determined by the working group.	Change to: **Trucks with smooth clean beds shall be used to haul the recycled asphalt concrete mixture to the placement area. The loaded trucks shall deliver the blended material into the paver within 1 hour of mixing or before the emulsion begins to break and set, whichever time is earlier.**	Allen King

No.	Section No.		Current Language	Comments/Suggested changes	Response	From
56	30-5.03B	19/81.1	CCPR RAP	What's the title name supposed to be here? This title is confusing.	Remove cold planing entirely from these specs; based on project by project case. Section 39 (cold planing portion) could be modified. Language deleted. NSSP needs to be developed.	Allen King
57	30-5.03B	19/81.5	old planing activities such that not more than __ has	How many days or hours? Did the WG discuss this?	Language deleted. NSSP needs to be developed.	Allen King
58	30-5.03B	19/81.7	old planing activities such that not more than __ has	How many days or hours? Did the WG discuss this?	Language deleted. NSSP needs to be developed.	Allen King
59	30-5.03B	20/81.9	old planing activities such that not more than __ has	How many days or hours? Did the WG discuss this?	Language deleted. NSSP needs to be developed.	Allen King
60	30-5.03B	20/81.10	old planing activities such that not more than __ has	How many days or hours? Did the WG discuss this?	Language deleted. NSSP needs to be developed.	Allen King
61	30-5.03D(8)	27/123	eted CCPR PDR surface must have an MRI of 90 in/mi	This should stay at 90 in/mi so that it's consistent with our most recent iteration of the asphalt smoothness spec formulas.	Yes, leave it as 90 for now.	Allen King
62	30-5	1/1	Replace section 30-5 with: 30-5 COLD CENTRAL RECYCLING	FYI…It is common for agencies to split up CCPR into two specifications. One for material placement and the other for just material.	The Department requires both materials and construction to be in one document. See this specification style guide: https://design.onramp.dot.ca.gov/downloads/design/files/occs/guides/ssg_02-14-20.pdf	Jason Dietz (FHWA)
63	30-5	1/1	Replace section 30-5 with: 30-5 COLD CENTRAL RECYCLING	Consists of: mixture of sized Reclaimed Asphalt Pavement, RAP, millings from existing asphalt pavement or existing stockpiles, asphalt emulsion, water and other additives. The mixture shall be produced at a nearby location, then paced and compacted to produce a recycled asphalt layer to the approved design properties.	No change, covered in definition below. Location determined by 1-hour time limit to place CCPR.	Jason Dietz (FHWA)
64	30-5.01A	1/2	RAP material with recycling agent, cement, and water	Is a process in which recycled asphalt concrete pavement is processed and stabilized?	No changes	Jason Dietz (FHWA)
65	30-5.01A	1/2	RAP material with recycling agent, cement, and water	Using foamed asphalt or emulsified asphalt?	Recycling agent is either FA or EA. Contractor has the option.	Jason Dietz (FHWA)
66	30-5.01A	1/2	CCPR shall not be used as a final riding surface	I would like to recommend Just-in-Time Training for this. With this one can mention that the engineer and contractor are required to attend JITT for CCPR and both shall mutually agree on the course instructor, course content and training site. The training class shall be conducted at a project location convenient for all project construction personnel responsible for CCPR operations and inspection to attend. The training shall be during normal working hours and be completed not more than 14 days prior to the start of CCPR operations.	This is covered in the prepave conference before the start of the project.	Jason Dietz (FHWA)
67	30-5.01B	2/3	In place recycled pavement material:	Shall conform to…of the specifications	Paragraph has been deleted	Jason Dietz (FHWA)
68	30-5.01B	2/3	where RAP or RAP and aggregate base is used	Why shown twice?	1. RAP 2. RAP and aggregate base These are different material.	Jason Dietz (FHWA)
69	30-5.01B	2/3	end of 30-5.01B	Recommend Job-Mix Formula section here. Starts off by mentioning a JMF for CCPR shall be submitted to the District Materials Engineer for approval at least 30 Days before the start of CCPR operations. Then discussion on gradation of each JMF shall fall within the bands shown in Table? Then discussion what the contactor shall establish. Following changes of JMF after first production lot. Then include something regarding if a change in source material.	See Mix Design section below. See also 30-5.01D(3) for gradation requirements (max size).	Jason Dietz (FHWA)
70	30-5.01C(1)	2/5	At least 20 days before starting CCPR work	The Contractor shall provide the Quality Control Plan and Job Mix Formula to the Department for approval at least 30 days before start of CCPR operations.	Given that material cannot be sampled until project starts, this would stretch out the overall project too much. Industry has also confirmed this.	Jason Dietz (FHWA)
71	30-5.01C(2)	2/5	Quality Control Plan	If JITT is provided, the quality control plan shall be submitted to the Engineer a minimum of five calendar days prior to the JITT. So should we provide any information on what should be in the Quality Control Plan like proposed CCPR mix design, a start to finish process description to include discussion on corrective action measures, a list of proposed equipment, a list of proposed QC tests and testing frequencies, and the curing methods and procedures applied to the CCPR. All QC test results shall be maintained during the duration of the contract and made available to the Engineer upon request. The following provides the type and minimum frequency for tests: 1) Depth of Laydown, 1 per 500 ft., 2) Pulverized Material Gradation, 1 per 1,000 tons of production, 3) Pulverized Material Moisture Content, 1 per 500 dons of production, 4) Asphalt Emulsion Content, 1 per 500 tons of production, 5) Water Content, 1 per 500 dons of production, and 6) Compacted In-place Field Density, 1 per 1,000 ft.	Covered in the Quality Control Reporting below.	Jason Dietz (FHWA)
72	30-5.01C(3)	3/8	Mix Design	Any reason why the CCPR Mix Design Criteria for Emulsified Asphalt Stabilized Materials and Foamed Asphalt Stabilized Materials is not included here instead of below?	See this specification style guide: https://design.onramp.dot.ca.gov/downloads/design/files/occs/guides/ssg_02-14-20.pdf. CT 316 covers both FA and EA.	Jason Dietz (FHWA)

No.	Section No.		Current Language	Comments/Suggested changes	Response	From
73	30-5.01C(3)	3/9	Mix Design	Whom should be responsible for obtaining all samples required to develop the mix design? One sample per lane mile of planned CCPR shall be the minimum sampling frequency for mix design preparation.	The contractor is responsible.	Jason Dietz (FHWA)
74	30-5.01C(5)	4/11	For cement:	Dry powder or slurry? Minimum dry solids contents of ?	Cement should be dry, slurry not allowed.	Jason Dietz (FHWA)
75	30-5.01C(10)	6/21	smoothness payment adjustment request	Will the contractor be required to correct humps or depressions exceeding the tolerance?	Yes, should comply with smoothness in section 39.	Jason Dietz (FHWA)
76	30-5.01D(2)(b)	7/28	The QC plan must address the elements affecting CCPR quality including: Paving	What about procedures to protect stabilized material from receiving excessive moisture from weather events and correction actions when criteria are not met. What about a contingency plan including: Inclement weather Equipment breakdowns Materials shortages Deficient density of installed CCPRM Material doesn't break or cure in timely manner Gradation is outside tolerances Production modifications based on changes in ambient or material temperature. Short statement needs to be included.	The material still must meet curing requirements. Contractor is responsible to protect the mat. These are covered in other parts of this NSSP. Contingency Plan is still required and should cover these concerns.	Jason Dietz (FHWA)
77	30-5.01D(3)	12/54	Department Acceptance	Don't see moisture content being reported for each asphalt content test. Has anyone brought up marshall stability for compaction method used for design as well as dry indirect tensile strength? Lastly, no information regarding half life and expansion ration. Still no mention of moisture content.	Binder is paid by certified weight tags. See table and footnotes in this section. Half-life visually monitored during production, under QC section. Production continues based on acceptable Half-life and expansion ratio observation. MC test is not required for QC or QA.	Jason Dietz (FHWA)
78	30-5.01D(3)	12/55	Emulsified Recycling Agent	Why can't the contractor provide a computer printout of the stabilizing agent content percentage of the plant at the time of sampling with each gradation sample? Then verify if the rate varies from the approved JMF target.	Daily production logs are sufficient.	Jason Dietz (FHWA)
79	30-5.01D(3)	12/55	Asphaltic Emulsion Requirements, Sieve test (max, %)	No. 20 (850 µm), retained on sieve, %.What about Viscosity? Would recommend Viscosity, Saybolt Furol, @ 77F (25C), SFS AASHTO T 59 Min 20 Max 100. What about Storage Stability Test, 24 hr, %? Recommend this be included as well with a max of 1. Distillation Test, Residue by distillation, % with a min of 64.	This is for the fog seal not the recycling agent.	Jason Dietz (FHWA)
80	30-5.01D(3)	12/55	Asphaltic Emulsion Requirements, Penetration, @ 25 °C (mm) 90	There are folks that use 200 and a min of 50.	This is for the fog seal not the recycling agent.	Jason Dietz (FHWA)
81	30-5.01D(4)	14/57	e Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result ies	?	"You" is the contractor. This is standard language.	Jason Dietz (FHWA)
82	30-5.01D(4)	14/57	e Engineer may only dispute each other's test results if one party's test results pass and the other party's test results fail.	?	"You" is the contractor. This is standard language.	Jason Dietz (FHWA)
83	30-5.03B	19/81	Surface Preparation	What about areas of soft or yielding subgrade and if the CCPR mix is to be placed on a prepared subgrade or aggregate base? No mention here.	Included in the contingency plan and in subgrade preparation plans in other specification sections	Jason Dietz (FHWA)
84	39-3.04	20/81.7	old planing activities such that not more than ___ has elapsed between the time the pavement is cold planed and the ced.	The existing asphalt pavement shall be milled in accordance with ??? to the length, depth and width as shown on the plans or specifications. What if paving fabric is encountered? What about rubberized crack filler and loop wires removal?	A separate NSSP will be used to address cold planing.	Jason Dietz (FHWA)
85	30-5.03C	22/82	crushing, or sizing of recycled pavement material	Sizing Equipment right? Capable of sizing using scalping screen or crushing capabilities to reduce RAP…	Included in MPQP	Jason Dietz (FHWA)
86	30-5.03C	22/82	General	Additive Slurry Storage and Supply Equipment? Mixing and Proportioning Equipment? Hauling Equipment? Laydown Equipment?	Included in MPQP	Jason Dietz (FHWA)
87	30-5.03E	29/126	Remove excess sand from the pavement surface by sweeping before opening to traffic.	What about sufficient cure time so traffic will not initiate raveling or permanent deformation? Also, what about contractor maintaining the recycled pavement in a manner satisfactory to the Engineer until the surface course has been constructed?	Should be included in contractor's QC and contingency plan	Jason Dietz (FHWA)
88	30-5.03H	30/135	me equipment to establish the rolling pattern and break over curve for recompacting the CCPR PDR surface. ts must be authorized.	Recommend a new paragraph for Weather Restrictions. In addition, what about material sizing and stockpiling?	Material sizing covered in JMF. Stockpiling is limited to 1 hour.	Jason Dietz (FHWA)
89	30-5.03H	30/135	me equipment to establish the rolling pattern and break over curve for recompacting the CCPR PDR surface. ts must be authorized.	No mention of CCPR Surface Course?	Covered in other specs sections, usually HMA section 39	Jason Dietz (FHWA)

No.	Section No.		Current Language	Comments/Suggested changes	Response	From
90	30-5.04	30/136	Test strips are paid for as CCPR	Will the CCPR price include price adjustments? What is the maximum number of trial sections? What is CCPR material measured in? Most use tons of the completed sections and will be paid for at the Contact ton price. There is no mention of what will that include?	No price adjustments. If test strips fail, they are deemed noncompliant. For Design Guidance, use the following Bid Item: 304101A Cold Central Plant Recycling (CUYD). See 8th paragraph of Section 1-1.01 and Section 9 of the Standard Specs for remaining payment language. We do 1 test strip on the first day. See design guidance on page 1.	Jason Dietz (FHWA)
91	30-5.04	30/137	PAYMENT	What about the costs associated with aggregate? What about the cost associated with locations of failing subgrade? What about the cost associated with the use of Portland cement? What about the cost associated with mixing water for CCPR? What about cost associated with pulverizing, stabilizing, compacting, curing and maintenance of the CCPR? What about the cost associated with the CCPR mix design and quality control testing?	See design guidance on page 1.	Jason Dietz (FHWA)

DEPARTMENT OF TRANSPORTATION
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PROVISIONAL METHOD OF TEST FOR MIXTURE DESIGN AND TESTING OF COLD CENTRAL PLANT RECYCLING (CCPR) OF ASPHALT PAVEMENTS USING BITUMINOUS RECYCLING AGENTS AND ADDITIVES

A. SCOPE

This test method describes the procedures for mixture design and testing for cold central plant recycling (CCPR) of asphalt pavements using bituminous recycling agents and additives.

CCPR consists of recycled asphalt concrete produced in a central plant from stockpiled HMA millings, reclaimed asphalt pavement surfacing, and supplemental aggregates.

The values stated in either International System of Units (SI units) or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

B. REFERENCES

AASHTO R 68	Standard Practice for Preparation of Asphalt Mixtures by Means of the Marshall Apparatus
AASHTO R 76	Standard Practice for Reducing Samples of Aggregate to Testing Size
AASHTO T 11	Standard Method of Test for Materials Finer Than 75-micron (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T 27	Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
AASHTO T 49	Standard Method of Test for Penetration of Bituminous Materials
AASHTO T 59	Standard Method of Test for Emulsified Asphalts

AASHTO T 209	Standard Method of Test for Theoretical Maximum Specific Gravity (Gmm) and Density of Hot-Mix Asphalt (HMA)
AASHTO T 245	Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
AASHTO T 265	Standard Method of Test for Laboratory Determination of Moisture Content of Soils
AASHTO T 269	Standard Method of Test for Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
AASHTO T 283	Standard Method of Test for Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage
AASHTO T 308	Standard Method of Test for Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
AASHTO T 312	Standard Method of Test for Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
AASHTO T 315	Standard Method of Test for Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
AASHTO T 329	Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method
AASHTO T 331	Bulk Specific Gravity (Gmb) and Density of Compacted Hot Mix Asphalt (HMA) Using Automatic Vacuum Sealing Method
ASTM D2172	Standard Test Methods for Quantitative Extraction of Asphalt Binder from Asphalt Mixtures
ASTM D3203	Standard Test Method for Percent Air Voids in Compacted Asphalt Mixtures
ASTM D5404	Standard Practice for Recovery of Asphalt from Solution Using the Rotary Evaporator
ASTM D7196	Standard Test Method for Raveling of Cold-Mixed Emulsified Asphalt Samples
California Test 105	Calculations Pertaining to Gradings and Specific Gravities

California Test 125 Sampling Highway Materials and Products Used in the Roadway Structural Sections

California Test 216 Relative Compaction of Untreated and Treated Soils and Aggregates

California Test 226 Method of Test for Moisture Content of Soils and Aggregates by Oven Drying

C. SIGNIFICANCE AND USE

This method is used in the preparation of the mix design and testing for cold central plant recycling (CCPR) of asphalt pavements using bituminous recycling agents and additives. This method includes requirements for:

1. Obtaining samples
2. Preparing pavement samples
3. Residual asphalt determination for emulsified asphalt
4. Asphalt binder selection and foaming parameters for foamed asphalt
5. Optimum moisture content and maximum density determination
6. Optimum asphalt recycling agent content
7. Obtaining production samples for quality tests
8. Quality testing of production samples
9. Reporting of results

D. APPARATUS

1. Compaction Equipment:
   A. Gyratory Compactor - A gyratory compactor meeting the requirements of AASHTO T 312
   B. Marshall Compactor – A Marshall compactor meeting the requirements of AASHTO R 68
2. Loading frame - A mechanical or hydraulic testing machine as specified in AASHTO T 283 to provide a range of accurately controllable rates of vertical deformation, including 50 mm/min (2 in./min)
3. Balance - A balance or scale accurate to 0.1 g and having a minimum capacity of 5 kg conforming to AASHTO M 231, Class G2

4. Sieves - Woven-wire cloth sieves that meet the designations required by the specifications and have square openings conforming to AASHTO M 92. Sieves: 1.5 in., 1.25 in., 1.0 in., 0.75 in., 0.5 in., #4, #8, #30, and #200
5. Metal Pans - Pans having a surface area of 75 to 100 in.^{2}, approximately 2 in. deep
6. Sieve Shaker - Any mechanical sieve shaking device that meets AASHTO T 27 requirements
7. Mixer - A pugmill style mixer capable of mixing up to 30 kg (66 lbs.) of aggregate, sand, and fines as included in the sample of asphalt pavement and base material collected from the job site. The mixer shall also be able to provide an evenly distributed emulsion-coated or foamed asphalt material after 2 minutes of mixing
8. Ovens - A forced draft oven with free circulation of air capable of maintaining a range of temperatures between 40° ± 0.5°C and 60° ± 1°C (104° ± 1°F and 140° ± 2°F)
9. Water Bath - A water bath of sufficient size for immersing samples with a 100-mm (4 in.) water cover that can be maintained at 25° ± 1°C (77° ± 2°F) by suitable methods
10. Water Bath - A water bath of sufficient size for immersing samples with a 100-mm (4 in.) water cover that can be maintained at 40° ± 1°C (104° ± 2°F) by suitable methods
11. Calipers - Calipers with accuracy to measure the length and diameter of test specimens to the nearest 0.01 mm (0.0004 in.)
12. Thermometer - Thermometer capable of measuring temperatures from 0°C to 50°C (32°F to 122°F)
13. Containers - Airtight containers capable of holding 1.5 kg to 25 kg (3 lbs. to 55 lbs.) of recycled pavement materials
14. Breaking Head Apparatus - A Marshall testing jig meeting the requirements of AASHTO T 245
15. Steel loading strips with a concave surface having a radius of curvature equal to the nominal radius of the test specimen. For specimens 100 mm (4 in.) in diameter, the loading strips shall be 12.7 mm (0.5 in.) wide. The length of the loading strips shall exceed the thickness of the specimens. The edges of the loading strips shall be rounded to the appropriate radius of curvature by grinding

16. Vacuum Container - A vacuum container meeting the requirements of AASHTO T 209

17. Asphalt Foaming Equipment (additional): The laboratory material production method should closely simulate full-scale foamed asphalt production. Laboratory equipment should be capable of producing foamed asphalt at a rate from 50 g to 100 g per second. The laboratory equipment should have a thermostatically controlled chamber or vessel capable of holding at least 10 kg (22 lbs.) of asphalt binder at a temperature from 140°C to 180°C (285°F to 356°F). The laboratory equipment should have a compressed air supply capable of delivering up to 690 kPa (100 psi). The laboratory equipment should have a system for adding up to 5% cold water by weight of asphalt binder.

E. MATERIALS

1. Existing asphalt pavement samples for CCPR projects, stockpile millings or reclaimed asphalt pavement.
2. Supplemental aggregates if required in the design
3. Bituminous recycling agent shall be emulsified asphalt or PG graded asphalt binder
4. Additives shall be cement or lime
5. Water

F. OBTAINING SAMPLES

Samples may be obtained from existing pavements to be recycled, stockpiles of cold milled pavements, reclaimed asphalt concrete pavements, and supplemental aggregates.

F-1 EXISTING PAVEMENT TO BE RECYCLED

Obtain existing pavement materials for each mix design as required in the specifications. Samples shall be collected from a minimum of three locations. Samples shall be obtained per specification requirements or in absences thereof, equally spaced along the length of the pavement to be recycled.

Obtain reclaimed asphalt pavement samples from identified representative areas of the project by taking cores or removing slabs to the depth specified for in-place recycling shown in the project plans. Obtain approximately 450 lbs. of sample ~~is~~ to be used for mix design.

The approximate number of cores required for each mix design based on the specified partial recycling depth is indicated in the following table:

Minimum Number of Cores required for 450 lbs. of sample based on CCPR depth				
CCPR depth (ft)	0.25	0.30	0.35	0.40
6 in. Diameter Core	66	55	47	41
8 in. Diameter Core	37	31	26	23

The approximate total area of pavement slabs required for each mix design based on the specified partial recycling depth is indicated in the following table:

Total Pavement Slab Area required for 450 lbs. of sample based on CCPR depth				
CCPR depth (ft)	.25	.30	.35	.40
Minimum Slab Area (sf)	14	12	10	8

Only the portion of the core representing the specified depth of the CCPR shall be used. The excess material beyond the specified depth shall be removed by sawcutting. Slabs shall be reduced in size by sawcutting into sizes which can have excess thickness accurately removed by sawcut. It is recommended that slabs be sawcut into smaller sizes in the field for easier handling.

If premilling is specified above the CCPR depth, the depth of milling shall be removed using the same process for removing excess material below the CCPR depth.

Samples may also be obtained by milling the existing asphalt pavement. Milling depth must be consistent with the project design and milling speed must be the same as that typically followed on recycling projects to ensure that a representative grading is achieved. Use a milling machine with the same tooth configuration as the milling machine to be utilized during production.

All samples shall be properly labeled regarding location, sampling date, etc. Multiple cores from the same location may be grouped, packaged, and stored together.

F-2 EXISTING STOCKPILES OF COLD MILLED ASPHALT CONCRETE

Examine stockpiles to assure the absence of any materials other than asphalt concrete. Other materials include, but are not limited to concrete, base rock,

native soils, organic material, refuse, etc. Any materials other than asphalt concrete shall be completely separated from the stockpile prior to sampling and processing.

When paving fabric is encountered, no fabric piece incorporated into the recycled sample shall have any dimension exceeding a length of 2-inches.

Sample stockpile in accordance with CT 125, Appendix A, at a minimum of six locations representing approximately equal portions of the stockpile.

F-3 RECLAIMED ASPHALT CONCRETE PAVEMENT

Examine stockpiles to assure the absence of any materials other than asphalt concrete. Other materials include, but are not limited to concrete, base rock, native soils, organic material, refuse, etc. Any materials other than asphalt concrete shall be completely separated from the stockpile prior to sampling and processing.

Carefully select representative samples.

Sample stockpile in accordance with CT 125, Appendix A, at a minimum of six locations representing approximately equal portions of the stockpile.

G. PREPARING PAVEMENT SAMPLES

The suggested sample weights in this procedure are approximate and they may be increased or decreased as necessary to complete the testing described herein.

1. Break down or crush the asphalt pavement cores or slabs using a jaw crusher capable of crushing material passing the 1 in. sieve. Cold planed material shall be screened as required for the mix design.

2. Obtain sufficient samples of the crushed asphalt concrete for the mix design testing required.

3. Obtain representative samples of any required supplemental materials that will be added during the recycling process (i.e., aggregate or supplemental fines to improve gradation).

4. Dry the sampled materials to a constant weight in accordance with AASHTO T 329 at 60° ± 1°C (140° ± 2°F). If the asphalt concrete samples were obtained by crushing cores or slabs, dry the asphalt concrete and unbound materials separately.

5. For CCPR projects with supplemental materials, split portions of the crushed asphalt concrete and blend in proportion to, recycling depth, and in situ density. The combined material is considered as the "recycled material".

6. Perform a sieve analysis on the prepared material in accordance with AASHTO T 11 and AASHTO T 27. The final gradation must meet the gradations shown in the following table:

Sieve	% Passing	
	Medium Gradation	**Coarse Gradation**
1.25"	100	100
1.0"	98 – 100	98 – 100
0.75"	93 – 97	83 – 87
#4	48 – 52	38 – 42
#8	35 – 40	25 – 30
#30	8 – 12	3 – 7
#200	1 – 3	0.5 – 2

7. If the gradation does not meet the gradation in Step 6, follow Asphalt Institute MS-2 Guidelines for fractioning materials. Adjust the fractionated material so the final gradation meets the above gradations.

8. Split out a minimum of two 10 kg (22 lbs.) and seven (for emulsified asphalt) or six (for foamed asphalt) 25 kg (55 lbs.) portions of the recycled material to complete the testing described below.

H. RESIDUAL ASPHALT DETERMINATION FOR EMULSIFIED ASPHALT

The emulsified asphalt used in the mix design shall be as required in the project specifications and shall meet the requirements of Section 94-1.02E of the Standard Specifications.

Laboratory production of the emulsified asphalt mixes must use the same emulsified asphalt from the same supplier that will be used during construction, as chosen by the contractor. If the residual asphalt content is not provided by the manufacturer, determine the residual asphalt content according to AASHTO T 59.

I. ASPHALT BINDER SELECTION AND FOAMING PARAMETERS FOR FOAMED ASPHALT

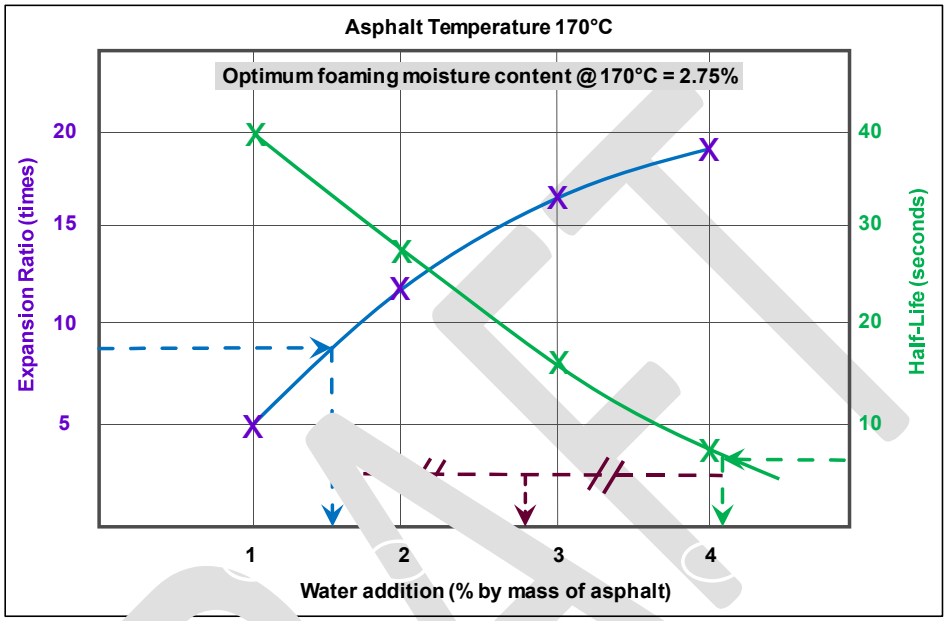
The asphalt binder used as a recycling agent shall conform to the requirements of the project specifications and shall conform to Section 92 of the Standard Specifications.

Laboratory production of the foamed asphalt must use the same asphalt binder that will be used during construction, including grade as specified in the project's special provisions and asphalt supplier as chosen by the contractor.

1. Prepare and calibrate laboratory asphalt foaming equipment in compliance with the manufacturer's instructions.
2. Load the asphalt binder into the laboratory foaming equipment and allow the unit to equilibrate temperature for a minimum of 1 hour and a maximum of 4 hours.
3. Select between 3 to 5 asphalt temperatures, depending on the familiarity with the binder source, at 10°C (18°F) increments bracketing the expected optimum temperature. The expected optimum temperature can be determined based on previous experience or a temperature of 160°C (320°F) can be used.
4. For each asphalt temperature, use at least 3 foamed asphalt water percentages between 1.0% and 4.0% in the laboratory asphalt foaming equipment to determine:
    A. Expansion ratio - The ratio of maximum volume of foamed asphalt relative to the original volume of asphalt. Determine the height of 500 g of neat binder as the baseline. Measure the peak height of the asphalt during foaming and divide by the baseline height to determine the expansion ratio.
    B. Half-life - The time measured in seconds for the foamed asphalt to subside to half of the maximum volume from the time the foam nozzle shuts off.

Note: The required minimum half-life and expansion ratio will depend on the likely recycled material temperature during construction. If recycling operations will be carried out when the material temperature is above 15°C (60°F), select a water percentage with a minimum expansion ratio of 8:1 and a half-life of at least 6 seconds. If colder temperatures are anticipated (between 10°C and 15°C [50°F and 60°F]), select the asphalt temperature and water percentage with a minimum expansion ratio of 10:1 and half-life of at least 8 seconds.

5. Plot the expansion ratio (primary y-axis) and the half-life (secondary y-axis) for each test temperature used. On each plot, mark the moisture contents required to meet the minimum expansion ratio and half-life requirements. The optimum foaming water content will be the midpoint between these two marks (example in the figure below shows the optimum foaming water content is 2.75%).



6. Choose the temperature and foaming water combination that provides an optimal expansion ratio and half-life for the mix design. If there are not at least two tests performed at temperatures above and below the determined optimum, repeat steps 2 to 5 increasing or decreasing the temperature in 10°C (18°F) increments.

7. If the expansion and half-life at the optimum foamed asphalt water percentage at the optimum temperature do not meet these requirements, select the temperature and foamed asphalt water percentage with the highest expansion ratio and half-life combination. Report all results.

J. OPTIMUM MOISTURE CONTENT AND MAXIMUM DENSITY DETERMINATION

Determine the optimum moisture content and maximum density using one of the following methods:

Method A - Preferred

1. Using a portion of the recycled aggregates, thoroughly mix the prepared materials with the additive as prescribed by the special provisions. (e.g., maximum 1.0% of Type II/V portland cement).

2. Pass the entire sample through a 0.75 in. sieve. Make a note of the percentage of material retained on the 0.75 in. sieve and then discard it.
3. Separate out 6 samples of 1,150 g (for 4 in. diameter mold) of material.
4. Add the starting moisture content to the first split sample and mix thoroughly. Choose a starting moisture content based on experience. For CCPR materials, the starting moisture content is typically around 3 percent.
5. Place a paper disk in the bottom of a mold. Do not pre-heat the molds.
6. Add the sample to a mold and rod the material 10 to 15 times with a 5/8 in. rod in a circular motion, making sure to evenly distribute the rodding across the entire sample.
7. Place a paper disk on top of the rodded sample. Compact the specimen at room temperature (25° ± 2°C [77° ± 4°F]) using one of the following methods:
    A. Gyration (AASHTO T 312; 30 gyrations [600 kPa at 1.16°] in a 100 mm diameter mold).
    B. Marshall (AASHTO T 245; 75 blows per face, in a 4 in. diameter mold).
8. Gently extrude the specimen from the mold and record the mass, height, and diameter of the specimen.
9. Clearly number each specimen.
10. Calculate the bulk density of the specimen using ASTM D3203, Section 6.2. Determine the moisture content per California Test 226.
11. Plot bulk dry density versus moisture content on a graph.
12. Repeat the steps 3 through 10 above on the remaining samples, adding 0.5 to 1.0% moisture by dry weight of recycled materials. A curve is developed indicating the material drops in bulk density with at least two successive moisture content increases. Develop a bulk density versus moisture content curve by plotting successive specimen data until all six specimens are done or until a curve is developed indicating a drop in bulk density.
13. Using the moisture-density relationship, determine the optimum moisture content and maximum dry density from the established curve.
14. Use this optimum moisture content and density for specimen preparation.
15. For emulsified asphalt, determine the water content required to reach optimum moisture content using the following equation:

Water content (%) = a – (b – c)

Where:

a = optimum moisture content as a percentage of the weight of dry aggregate
b = estimated emulsified asphalt content as a percentage of the weight of dry aggregate. The final value is determined on completion of the mix design.
c = residual asphalt content, determined in Section H, as a percentage of the weight of dry aggregate

Method B - Alternative

1. Repeat steps 1 and 2 as described in Method A.
2. Determine the optimum moisture content and maximum density of the prepared mixture according to California Test 216.
3. Use this optimum moisture content and density for specimen preparation.
4. For emulsified asphalt, determine the water content required to reach optimum moisture content using the following equation:

Water content (%) = a – (b – c)

Where:

a = optimum moisture content as a percentage of the weight of dry aggregate
b = estimated emulsified asphalt content as a percentage of the weight of dry aggregate. The final value is determined on completion of the mix design.
c = residual asphalt content, determined in Section H, as a percentage of the weight of dry aggregate

K. SPECIMEN PREPARATION PROCEDURE FOR EMULSIFIED ASPHALT

Prepare specimens for determining the optimum emulsified asphalt residue content by the Marshall stability method or by the indirect tensile strength method. Use the specified additive and additive content. If specimens are being prepared for "Report Only Indirect Tensile Strength Test" purposes, then follow the procedure in Section L.

1. Pass the entire sample through a 0.75 in. sieve. Record the percentage of oversized material and then discard it.
2. Quarter the material into 4 bulk samples. This requires approximately 25 kg (55 lbs.) of material.

3. Determine an appropriate range of residual asphalt contents by mass of dry aggregate to assess the mix design. For example: 2.1%, 2.3%, 2.5%, and 2.7% or 2.0%, 2.5%, 3.0%, and 3.5%.
4. Place one bulk sample into the pug mill, add the additive at the selected rate by weight of the dry aggregate (do not exceed 1%), and the water content calculated in Section J.
5. Add the first emulsified asphalt residue content determined in step 3 before mixing.
6. Mix the material for 4 minutes.
7. Remove the material from the pug mill and place into a bowl, covered by a lid or damp cloth to prevent evaporation of the mixing moisture.
8. Determine the mass of wet material needed to achieve the maximum dry density of the mix as determined in Section J to conform with the height requirements of AASHTO T 245.
9. Split the processed material into 8 samples at the mass determined and place each into a covered container to prevent evaporation of the mixing moisture. Place any unused material into a covered container.
10. Place a paper disk in the bottom of a mold. Do not pre-heat the molds.
11. Add one of the split samples into a mold and rod the material 10 to 15 times with a 5/8 in. rod in a circular motion, making sure to evenly distribute the rodding across the entire sample.
12. Place a paper disk on top of the rodded sample. Compact the specimen at room temperature (25° ± 2°C [77° ± 4°F]) using one of the following methods:
    A. Gyration (AASHTO T 312; 30 gyrations [600 kPa at 1.16°] in a 100 mm diameter mold).
    B. Marshall (AASHTO T 245; 75 blows per face, in a 4 in. diameter mold).
13. The target final specimen height should be 63.5 ± 2.5 mm (2.5 ± 0.1 in.).
14. Gently extrude the specimen from the mold and record the mass of the specimen.
15. Repeat steps 10 through 14 six additional times within 30 minutes of adding the water portion to the recycled material and additive.
16. Number each specimen clearly.
17. Repeat steps 4 through 16 three times with the three remaining emulsified asphalt residue contents.

18. Cure the compacted specimens and one remaining uncompacted sample in a forced draft oven at 40° ± 1°C (104° ± 2°F) for 72 hours. If, after the 72-hour cure, the specimens have not reached constant mass (0.05% change in 2 hours), allow the samples to continue to cure until constant mass is reached checking each additional hour. Record the additional time required for cure.

Note: During curing, specimens must not be stacked or touching, and allowance must be made for air circulation around each specimen.

19. Remove the specimens from the oven and allow to cool to ambient temperature (25° ± 2°C [77° ± 4°F]). When cooled, record the mass, diameter, and height of each specimen according to AASHTO T 269.

20. Determine the maximum theoretical specific gravity of the uncompacted sample according to AASHTO T 209. Determine air voids in accordance with ASTM D3203.

L. SPECIMEN PREPARATION PROCEDURE FOR "REPORT ONLY" INDIRECT TENSILE STRENGTH TESTS FOR EMULSIFIED ASPHALT

1. Prepare 1 bulk sample. This requires approximately 6 kg (13 lbs.) of material.

2. Place the bulk sample into the pug mill, add the additive at the selected rate by weight of the dry aggregate (do not exceed 1%), and the water content calculated in Section J.

3. Add the optimum emulsified asphalt residue content determined in Section M, Step 6 below.

4. Complete Steps 6 through 16 in Section K.

5. Complete Steps 18 through 20 in Section K.

M. SPECIMEN PREPARATION PROCEDURE FOR FOAMED ASPHALT

Prepare specimens for determining the optimum foamed asphalt content by the indirect tensile strength or Marshall stability method. Use the specified additive and additive content. If specimens are being prepared for "Report Only Marshall Stability Tests" purposes, then follow the procedure in Section N.

1. Pass the entire sample through a 0.75 in. sieve. Record the percentage of oversized material and then discard it.

2. Quarter the material into 4 bulk samples. This requires approximately 25 kg (55 lbs.) of material.

3. Determine an appropriate range of foamed asphalt contents by mass of dry aggregate to assess in the mix design. For example, 2.1%, 2.3%, 2.5%, and 2.7% or 2.0%, 2.5%, 3.0%, and 3.5%.

4. Place one bulk sample into the pug mill, add the additive at the selected rate by weight of the dry aggregate (do not exceed 1%), and 75% of the water content calculated in Section J.

5. Mix the material for 3 minutes.

6. Add the first foamed asphalt content determined in step 3 while mixing and continue mixing for 30 seconds after the asphalt nozzle has switched off. Add the remaining 25% water to achieve the optimum moisture content and mix for an additional 30 seconds.

7. Remove the material from the pug mill and place into a bowl, covered by a lid or damp cloth to prevent evaporation of the mixing moisture.

8. Determine the mass of wet material needed to achieve the maximum dry density of the mix as determined in Section J to conform with the height requirements of AASHTO T 245.

9. Split the processed material into 8 samples at the mass determined and place each into a covered container to prevent evaporation of the mixing moisture. Place any unused material into a covered container.

10. Place a paper disk in the bottom of a mold. Do not pre-heat the molds.

11. Add one of the split samples into a mold and rod the material 10 to 15 times with a 5/8 in. rod in a circular motion, making sure to evenly distribute the rodding across the entire sample.

12. Place a paper disk on top of the rodded sample. Compact the specimen at room temperature (25° ± 2°C [77° ± 4°F]) using one of the following methods:

    A. Gyration (AASHTO T 312; 30 gyrations [600 kPa at 1.16°] in a 100 mm diameter mold).

    B. Marshall (AASHTO T 245; 75 blows per face, in a 4 in. diameter mold).

13. The target final specimen height should be 63.5 ± 2.5 mm (2.5 ± 0.1 in.).

14. Gently extrude the specimen from the mold and record the mass of the specimen.

15. Repeat steps 10 through 14 six additional times, and within 30 minutes of adding the water portion to the recycled material and additive.

16. Number each specimen clearly.

17. Repeat steps 4 through 16 three times with the three remaining foamed asphalt contents.

18. Cure the compacted specimens and one remaining uncompacted sample in a forced draft oven at 40° ± 1°C (104° ± 2°F) for 72 hours. If after the 72-hour cure, the specimens have not reached constant mass (0.05% change in 2 hours), allow the samples to continue to cure until constant mass is reached checking each additional hour. Record the additional time required for cure.

Note: During curing, specimens must not be stacked or touching, and allowance must be made for air circulation around each specimen.

19. Remove the specimens from the oven and allow to cool to ambient temperature (25° ± 2°C [77° ± 4°F]). When cooled, record the mass, diameter, and height of each specimen according to ASTM D3203.

20. Determine the maximum theoretical specific gravity of the uncompacted sample according to AASHTO T 209. Determine air voids in accordance with ASTM D3203.

N. SPECIMEN PREPARATION PROCEDURE FOR "REPORT ONLY" MARSHALL STABILITY TESTS FOR FOAMED ASPHALT

1. Prepare 1 bulk sample. This requires approximately 6 kg (13 lbs.) of material.

2. Place the bulk sample into the pug mill, add the additive at the selected rate by weight of the dry aggregate (do not exceed 1%), and 75% of the water content calculated in Section J.

3. Add the optimum foamed asphalt content determined in Section Q, Step 6 below.

4. Complete Steps 5 through 16 in Section M.

5. Complete Steps 18 through 20 in Section M.

O. DETERMINING OPTIMUM EMULSIFIED ASPHALT RESIDUE CONTENT USING MARSHALL STABILITY

Determine the optimum emulsified asphalt residue content by the Marshall stability and retained Marshall stability.

1. Use the specimens prepared in Section K.

2. Randomly separate the 7 specimens from each emulsified asphalt residue content into 2 groups of 3 specimens each plus one and condition them as follows:

A. For the dry test and one remaining specimen: Place specimens in a conditioning chamber or temperature-controlled room at 25° ± 2°C (77° ± 4°F) for 22 hours. Transfer the specimens to a second conditioning chamber set at 40° ± 1°C (104° ± 2°F) for 2 hours. Alternatively, place the specimens into individual impermeable plastic bags, seal them, and then place them in a water bath at 40° ± 1°C (104° ± 2°F) for 2 hours.

B. For the wet test: Place specimens on a rack in a water bath with a temperature of 25° ± 2°C (77° ± 4°F) for 23 hours. Transfer the specimens to a second water bath with a temperature of 40° ± 1°C (104° ± 2°F) for 1 hour. Remove the specimens from the water and damp dry them according to AASHTO T 166.

Note: Water level must be a minimum of 100 mm (4 in.) above the top of the specimens and specimens must not be stacked or touching.

3. Determine the Marshall stability of the three dry-test and three wet-test specimens according to AASHTO T 245. Record the peak breaking loads. Record the internal temperature of each specimen with an infrared thermometer. Determine the moisture content of one randomly selected dry and wet specimen from each mix according to AASHTO T 265.
4. Calculate the average wet Marshall stability ($MStab_{wet}$) and dry Marshall stability ($MStab_{dry}$) of each subset and record the results.
5. Calculate the retained Marshall stability of each subset and record the results:

Retained Marshall stability = $MStab_{wet}$ / $MStab_{dry}$

6. Select an emulsified asphalt residue content that exceeds the minimum specified $MStab_{dry}$ result that also meets the retained Marshall stability requirement.
7. Determine the bulk specific gravity of the one remaining untested specimen according to ASTM D3203 (specimen dimensions) or AASHTO T 331.
8. Do not adjust the additive content above 1% to achieve the Marshall stability requirements.

Note 1: If the minimum Marshall stability cannot be achieved with any of the emulsified asphalt residue contents and 1% additive, the gradation should be checked and adjusted, and the testing repeated.

Note 2: If the $MStab_{wet}$ result meets the specified minimum, but the retained Marshall stability does not, this may indicate that the additive is dominating the result.

P. DETERMINING THE MARSHALL STABILITY OF FOAMED ASPHALT SPECIMENS FOR "REPORT ONLY" PURPOSES

Determine the Marshall stability and retained Marshall stability of foamed asphalt specimens for "Report Only" purposes.

1. Use the specimens prepared in Section N.
2. Randomly separate the 7 specimens from each emulsified asphalt residue content into 2 groups of 3 specimens each plus one and condition them as follows:

   A. For the dry test and one remaining specimen: Place specimens in a conditioning chamber or temperature-controlled room at 25° ± 2°C (77° ± 4°F) for 22 hours. Transfer the specimens to a second conditioning chamber set at 40° ± 1°C (104° ± 2°F) for 2 hours. Alternatively, place the specimens into individual impermeable plastic bags, seal them, and then place them in a water bath at 40° ± 1°C (104° ± 2°F) for 2 hours.

   B. For the wet test: Place specimens on a rack in a water bath with a temperature of 25° ± 2°C (77° ± 4°F) for 23 hours. Transfer the specimens to a second water bath with a temperature of 40° ± 1°C (104° ± 2°F) for 1 hour. Remove the specimens from the water and damp dry them according to AASHTO T 166.

Note: Water level must be a minimum of 100 mm (4.0 in.) above the top of the specimens and specimens must not be stacked or touching.

3. Determine the Marshall stability of the three dry-test and three wet-test specimens according to AASHTO T 245. Record the peak breaking loads. Record the internal temperature of each specimen with an infrared thermometer. Determine the moisture content of one randomly selected dry and wet specimen from each mix according to AASHTO T 265.
4. Calculate the average wet Marshall stability ($MStab_{wet}$) and dry Marshall stability ($MStab_{dry}$) and record the results.
5. Calculate the retained Marshall stability and record the results:

$$\text{Retained Marshall stability} = MStab_{wet} / MStab_{dry}$$

6. Determine the bulk specific gravity of the one remaining untested specimen according to ASTM D3203 (specimen dimensions) or AASHTO T 331.

Q. DETERMINING OPTIMUM FOAMED ASPHALT CONTENT USING INDIRECT TENSILE STRENGTH

Determine the optimum foamed asphalt content by the indirect tensile break strength and tensile strength ratio.

1. Use the specimens prepared in Section M.
2. Randomly separate the 7 specimens from each foamed asphalt content into 2 groups of 3 specimens each plus one and condition them as follows:
   A. For the dry test and one remaining specimen: Place specimens in a conditioning chamber or temperature-controlled room at 25° ± 2°C (77° ± 4°F) for 24 hours.
   B. For the wet test: Place specimens on a rack in a water bath with a temperature of 25° ± 2°C (77° ± 4°F) for 24 hours. Remove the specimens from the water and damp dry them according to AASHTO T 166.

   Note: Water level must be a minimum of 100 mm (4 in.) above the top of the specimens and specimens must not be stacked or touching.
3. Determine the indirect tensile strength (ITS) of the 3 dry-test and 3 wet-test specimens according to AASHTO T 283. Record the peak breaking loads. Record the internal temperature of each specimen with an infrared thermometer. Determine the moisture content of one randomly selected dry and wet specimen from each foamed asphalt content according to AASHTO T 265.
4. Calculate the average wet (ITS_{wet}), and dry (ITS_{dry}) of each subset and record the results.
5. Calculate the tensile strength ratio (TSR) of each subset and record the results:

$$TSR = ITS_{wet} / ITS_{dry}$$

6. Select a foamed asphalt content that exceeds the specified minimum ITS_{wet} requirement that also meets the minimum TSR requirement.
7. Determine the bulk specific gravity of the one remaining untested specimen according to ASTM D3203 (specimen dimensions) or AASHTO T 331.
8. Do not adjust the additive content above 1% to achieve the minimum wet strength.

Note 1: If the minimum wet strength cannot be achieved with any of the foamed asphalt contents and 1% additive, the gradation should be checked and adjusted, and the testing repeated.

Note 2: If the ITS_{wet} result meets the specified minimum, but the TSR does not, this may indicate that the additive is dominating the result.

R. DETERMINING THE INDIRECT TENSILE STRENGTH OF EMULSIFIED ASPHALT SPECIMENS FOR "REPORT ONLY" PURPOSES

Determine the indirect tensile break strength and tensile strength ratio of emulsified asphalt specimens for "Report Only" purposes.

1. Use the specimens prepared in Section L.
2. Randomly separate the 7 specimens from each emulsified asphalt residue content into 2 groups of 3 specimens each plus one and condition them as follows:

   A. For the dry test and one remaining specimen: Place specimens in a conditioning chamber or temperature-controlled room at 25° ± 2°C (77° ± 4°F) for 24 hours.

   B. For the wet test: Place specimens on a rack in a water bath with a temperature of 25° ± 2°C (77° ± 4°F) for 24 hours. Remove the specimens from the water and damp dry them according to AASHTO T 166.

   Note: Water level must be a minimum of 100 mm (4.0 in.) above the top of the specimens and specimens must not be stacked or touching.

3. Determine the indirect tensile strength (ITS) of the 3 dry-test and 3 wet-test specimens according to AASHTO T 283. Record the peak breaking loads. Record the internal temperature of each specimen with an infrared thermometer. Determine the moisture content of one randomly selected dry and wet specimen from each emulsified asphalt residue content according to AASHTO T 265.
4. Calculate the average wet (ITS_{wet}), and dry (ITS_{dry}) ITS and record the results.
5. Calculate the tensile strength ratio (TSR) and record the results:

$$TSR = ITS_{wet} / ITS_{dry}$$

6. Determine the bulk specific gravity of the one remaining untested specimen according to AASHTO T 269 (specimen dimensions) or AASHTO T 331.

S. RAVELING AND COATING TESTS FOR EMULSIFIED ASPHALT

At optimum emulsified asphalt content, perform the following additional tests on three replicate specimens prepared using the procedure described in Section K:

1. Raveling test per ASTM D7196
2. Coating Test per AASHTO T 59

If the raveling test fails at the optimum emulsified asphalt content, repeat the test on specimens prepared at the optimum emulsified asphalt content plus 0.25%.

T. OBTAINING PRODUCTION SAMPLES FOR QUALITY TESTS

1. Obtain samples per CT 125
2. Thoroughly mix field samples prior to compacting test specimens.

U. QUALITY TESTING OF PRODUCTION SAMPLES

1. A minimum of 6 samples shall be compacted for each quality test. If multiple quality tests are to be performed, compact as many multiple samples of 6 as required.

2. All production samples shall be compacted within 2 hours of mixing by the recycler.

3. Compact samples as follows:

   A. Gyration (AASHTO T 312; 30 gyrations [600 kPa at 1.16°] in a 100 mm diameter mold).
   B. Marshall (AASHTO T 245; 75 blows per face, in a 4 in. diameter mold).

4. Compacted samples shall be cured a maximum of 30 hours at ambient temperature, prior to the 72-hour oven cure.

5. Cure the compacted specimens and one remaining uncompacted sample in a forced draft oven at 40° ± 1°C (104° ± 2°F) for 72 hours. If after the 72-hour cure, the specimens have not reached constant mass (0.05% change in 2 hours), allow the samples to continue to cure until constant mass is reached checking each additional hour. Record the additional time required for cure.

   Note: During curing, specimens must not be stacked or touching, and allowance must be made for air circulation around each specimen.

6. Remove the specimens from the oven and allow to cool to ambient temperature (25° ± 2°C [77° ± 4°F]). When cooled, record the mass, diameter, and height of each specimen according to AASHTO T 269.

7. Production samples may be handled and transported as follows:

   A. Compacted samples shall be placed in the curing oven within 30 hours of compaction.

   B. Samples shall be protected by wrapping in plastic wrap or placed in a protective container such as a modified plastic concrete cylinder mold immediately after compaction. Within a protective container, samples shall:

      a. Be placed flat on the bottom of the container.
      b. Not stacked.

   C. Each sample shall be separated from each other and the container walls by rags, paper towels or other suitable materials which will not damage the samples. Transport time shall be limited to 4 hours. The transportation time shall not be considered as part of the 72-hour cure period. Place transported samples immediately into oven for 72-hour cure period.

V. REPORTING OF RESULTS

Report results on the Mix Design Forms.

When required, submit test results electronically in accordance with the DIMEXML format and guidance documents found at the following link:

<https://dime.dot.ca.gov/index.php?r=help/submittestresult>

W. HEALTH AND SAFETY

It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Prior to handling, testing, or disposing of any materials, testers must be knowledgeable about safe laboratory practices, hazards and exposure, chemical procurement and storage, and personal protective apparel and equipment.

Refer to the Safety Manual for your Laboratory.

End of Text
(California Test 316 contains 22 pages)

Section 5 – Cold Central Plant Recycling Equipment

1-1 General

All provisions of Section 1 of the MPQP manual shall apply except as noted in this section regarding Cold Central Plant Recycling Equipment.

1-1.1 Equipment

1-1.1.1 Frequency

Cold Central Plant Recycling equipment shall not require re-calibration after relocation. Cold Central Plant Recycling equipment must be calibrated and tested at least once every 6 months.

1-1.2 Measurement of Quantities

1-1.2.1 Scales

1-1.2.1.1 Scale Undersupports

This section shall not apply to CCPR equipment.

1-2 Equipment

1-2.1 General

Except where noted below, CCPR equipment must comply with Section 2 of the MPQP manual.

1-2.1.1 Liquid Measurement

During CCPR Equipment Calibration, 2500-lb total weight calibration test may be used for mass flow meter calibration.

1-2.1.2 Operational Tolerances

No Change

1-2.2 Recycling Agent Storage Equipment (Foamed Asphalt or Emulsions)

1-2.2.1 Ingredient Storage

Recycling Agent must be stored in tanks that maintain material at the manufacturer's recommended temperature. If heating is needed based on manufacturer's recommendations, heating must be effective and controlled. Any flame used to heat the tank must not make contact with the material in the storage tank.

1-2.2.2 Sampling

The Recycling Agent storage or transfer equipment must be equipped with a sampling device or sampling area, where representative samples of the Recycling Agent may be taken.

1-2.3 Cold Central Plant Recycling Additives

1-2.3.1 General

1-2.3.2 Dry Cement

1-2.3.2.1 Storage

Cement shall be stored in silos or other containers in which cement is protected from moisture. Cement shall not be stored for more than 7 days prior to use.

1-2.3.2.2 Proportioning

Cement shall be proportioned by weight. Cement dispensing mechanism shall be interlocked to the belt scale of recycling unit to ensure that amount of cement is automatically adjusted based on weight of RAP processed.

1-2.4 Cold Central Plant Recycling Equipment

1-2.4.1 Weight-based Proportioning Systems

The plant shall be a standalone cold central plant recycling machine. Recycler shall be capable of incorporating the recycling agent, water and additive, and mix the materials to

produce a homogeneous material. The machine shall be capable of crushing and screening RAP and shall be equipped with a closed-loop system to guarantee a maximum nominal aggregate size prior to material entering the pugmill. Alternatively, a crushing and screening system and operation may be used prior to Cold Central Plant Recycling to size RAP and RAP/Base materials in accordance with project specifications. The machine shall be equipped with a belt scale which feeds RAP into the pugmill. The pugmill shall have separate systems for adding recycling agent and water with each system having a spray bar interlocked to the belt scale to insure that the amount of recycling agent and water being added is automatically adjusted based on weight of RAP processed.

Each liquid additive system shall have its own spray bar equipped with 2 nozzles per ft of spray bar and be capable of incorporating up to 75 gal/min of recycling agent.

If equipment is to be used for foamed asphalt, the recycling agent delivery system must meet the following requirements:

1. The recycling agent shall be introduced at the spray bar in individual injection chambers into which both the hot asphalt binder and water, are injected under controlled pressure through individual and separate orifices that promote atomization. The rate of addition of water into the hot asphalt binder shall be kept at a constant rate (percentage by mass of asphalt binder) by a computerized system.
2. An inspection (or test) nozzle shall exist that produces a representative sample of foamed asphalt.

A heating system capable of maintaining the temperature of all recycling agent flow components at the necessary temperatures.

1-3 Calibration and Dynamic Testing

1-3.1 Scope

This section consists of procedures to test, calibrate, and approve proportioning devices including Cold Central Plant Recycling equipment scales and meters.

1-3.2 Testing and Approved Weighing and Measuring Devices

1-3.2.1 Dynamic Testing of Weight-based Proportioning Systems

Dynamic Testing of weight-based CCPR proportioning systems includes:

1. RAP belt scale
2. Recycling agent mass flow meter
3. Cement proportioning system

1-3.3 Proportioning System Calibration and Approval

Perform a pre-test inspection of weighing and measuring system and controls as follows:

1. Note and record model number, serial number, and manufacturer's name
2. Ascertain whether the indicating and recording elements are compatible with their intended use and are located appropriately.
3. Make a visual inspection of the devices to be calibrated. Any faulty condition affecting the plant functionality that can be detected visually must be corrected before continuing with the MPQP inspection.

1-3.4 Procedures for Liquid Metering

1-3.4.1 Inspection

Meter installations must be inspected visually for proper connections and conditions before tests for accuracy are performed. The meter installation must comply with the meter manufacturer's instructions, a copy of which must be furnished to the WMC.

1-3.4.2 Testing Equipment and Provisions

1-3.4.2.1 General

Test the liquid meter at the material-production site under normal operating and environmental conditions. Reschedule the testing when weather conditions cause the witness scale indicator to fluctuate more than three graduations.

The metering systems of the CCPR equipment must be operated in the circulate mode for at least 15 minutes just before testing and calibration to prime the system.

Test drafts must be weighed on a witness scale at the proportioning plant. Witness scale error testing must be performed with test weights complying with "General Device Testing" in Chapter 3, II-D of the MPQP Manual and must produce a witness scale within two graduations of the test weight load.

For the calibration procedure, the producer must provide a suitable container capable of receiving the full flow of material delivered from the meter for the size of the required test draft. Meter installation must be plumbed to facilitate the diversion of the test draft to the container. The meter system must not leak calibration liquid or air. If testing material is lost during the calibration run between the liquid storage and test weight determination on the witness scale, cancel the testing until it is corrected. Any physical change of the meter system requires a restart of the calibration procedures.

Product flow rates used during device testing must be commensurate with anticipated production flow rates. Specifications for minimum test draft size, witness scale capacity, and witness scale graduations must comply with Appendix A, "Meter Testing Extremes," in the Appendix of the MPQP Manual, except that the medium draft size of 2,500 lbs. may be used in the dynamic testing of all liquid meters in use with CIR equipment regardless of meter size.

The device plumbing must allow the resident engineer to clearly ascertain that none of the liquid passing through the meter during calibration is diverted before entering the test draft container.

1-3.4.3 Device Testing and Calibration

1-3.4.3.1 General

A rate meter is a digital display of the speed of the operation in units such as tons-per-hour or gallons-per-minute. A totalizer is a digital display of the amount in units such as tons or gallons delivered at any time. Check the rate indicator against the totalizer's indicator for an interval of at least one minute. Time the interval with a stopwatch. The indicated rate must track the rate determined from the totalizer.

Before starting the meter calibration, send calibration liquid through the system to bring the calibration path to an as-used condition. Leave the system at the same degree of "empty" for all test runs. This exercise will ensure the meter system is in the same condition for all test runs, including the first one. Reset the totalizer to zero and re-tare the calibration container before the start of each calibration test run.
Hoses, ropes, and other paraphernalia on or hanging from the calibration container may affect the weighing accuracy of the test draft. If fill hoses are left attached to the calibration container during the weighing process, the witness scale may require error testing again after the hoses have been softened by the hot asphalt.
Record the meter's span number (calibration constant) for each test in the series. Each series of tests consists of at least three runs. Each calibration run size must comply with Table A, "Meter Testing Extremes," in the Appendix for the medium or large draft option. Calibration flow rates must be commensurate with flow rates anticipated during production.

Read the meter totalizer with the indicator at rest. Totalizer readings must not be made on the fly. The meter totalizer indicator must start from zero, return to zero, or both and must not advance its indications before material delivery.
At the end of each individual test run, as indicated by the process controller, log the amount measured by the meter, the value from the meter totalizer, or the weight delivered. Compare the meter indication for the measured liquid for any individual test run with the weight determined by weighing the measured liquid on the witness scale. Make determinations of accuracy by comparing metered results with actual results from the witness scale.

Calculate error with the formula $E = A - M$, where *E = error for the run*, *A = the actual weight of the liquid as determined on the witness scale*, and *M = the weight of the liquid as determined by the meter.*
Determine the percentage error with the formula $\%E = (E/A) \times 100$
Average error for the device is the combined percent error for three sequential runs divided by three. If the metering device is adjusted before completion of the three calibration runs, the test is aborted, and a new series must be initiated. Error limits must comply with Table A in the Appendix.

1-3.4.4 Test Method Summarized

Large-scale Calibration Procedure

Test consists of three different pump speeds (low, medium, high) using Emulsified Recycling Agent (ERA) or asphalt, or another fluid of similar viscosity and unit weight to ERA or asphalt.

Scales to be used to measure truck weight must measure in 20-pound increments.

1. Pump a total of 8500 lbs. (+/- 500 lbs.) of ERA/asphalt from one tanker through the mass flow meter into a tared tanker.

2. Record the flow rate, elapsed time, and total weight discharged according to mass flow meter.

3. Weigh tanker and calculate weight of ERA/asphalt discharged. Variance from flow meter may not be more than 1% for any individual test, or 0.5% for average of 3 tests.

4. Perform 3 tests, one at each of the following speeds:
   minimum speed anticipated during construction
   maximum speed anticipated during construction
   average speed between minimum and maximum anticipated construction speed

Medium Scale Calibration Procedure

Test consists of three different pump speeds (low, medium, high) for Emulsified Recycling Agent (ERA) or asphalt.

Scales (5,000 lb.) to be used to measure tote weight must measure in 1-pound increments.

1. Pump a total of 2500 lbs. (+/- 100 lbs.) of liquid from one tote through the mass flow meter into a tared tote.

2. Record the flow rate, elapsed time, and total weight discharged according to mass flow meter.

3. Weigh tote and calculate weight of liquid discharged. Variance from flow meter may not be more than 1% for any individual test, or 0.5% for average of 3 tests.

4. Perform 3 tests, one at each of the following speeds:
   minimum speed anticipated during construction
   maximum speed anticipated during construction
   average speed between minimum and maximum anticipated construction speed

1-3.5 Procedure for Conveyor Scales

1-3.5.1 Inspection

Undersupports for conveyor scale-bearing points are not required to comply with section 1-2.02.02 of the MPQP manual for Cold Central Plant Recycling equipment.

1-3.5.2 Test Equipment and Provisions

Calibration procedures are not restarted for any physical change of conveyor scale due to mobile nature of CCPR equipment.

1-3.5.3 Device Testing and Calibration

General

If multiple sources of RAP or RAP/Aggregate Base blend are to be used, CCPR plant must include system to ensure accuracy of aggregate blend proportioning. Each component of aggregate blending system must comply with testing requirements as outlined in this section and must be calibrated separately. I.E.

if a multi-bin feeder is used, each individual bin feeder must be calibrated in accordance with these MPQP testing requirements.

1-3.5.3.1 Test Method Summarized

Test consists of three different weigh belt speeds (low, medium, high) using crushed RAP or crushed aggregate.

Scales to be used to measure truck weight must measure in 20-pound increments.

1. Process aggregate through mixing unit for 3 minutes (+/- 1 minute) into a tared dump truck so that aggregate weight is measured by mixing unit weigh belt.

2. Record the speed, time elapsed, and total weight per the mixing unit weigh belt.

3. Weigh truck and calculate tonnage of aggregate processed. Variance from weigh belt may not be more than 2% for any individual test, or 1% for average of 3 tests.

4. Perform tests at the following 3 speeds:
   minimum anticipated production rate
   maximum anticipated production rate
   average rate between minimum and maximum

1-3.6 Procedure for Cement Proportioning System

1-3.6.1 Device Testing and Calibration

Test consists of verifying the quantity of cement placed per ton of CCPR Material is accurate and controllable.

Suspend or fix tared collection pan (6 ft^3) beneath discharge chute of cement proportioning unit such that all cement discharged will be collected by pan.

1. Process cement through proportioning system for a total of approximately 400 lbs. cement. Record cement discharge rate as denoted by the proportioning system.

2. Weigh pan and determine total amount of cement discharged. Amount discharged must be within +/- 2% of target amount based on tons processed.

3. Perform test at the minimum and maximum proportioning rates and the median proportioning rate between minimum and maximum, anticipated during production, +/- 0.25%.

4. Variance between actual weight of cement dispensed and theoretical cement weight may not be more than 2% for any individual test, or 1% for average of 3 tests.

Replace section 30-7 with:

30-7 COLD CENTRAL PLANT RECYCLING

30-7.01 GENERAL

30-7.01A Summary

Section 30-7 includes specifications for constructing pavement using the cold central plant recycling (CCPR) process.
CCPR consists of:

1. Cold planing the existing asphalt concrete pavement to the depth shown
2. Stockpiling RAP along with any imported or local material
3. Screening and crushing; reconstitute as needed
4. Mixing the RAP material with recycling agent, cement, and water
5. Stockpiling the material at the project site
6. Transporting material from plant to project site
7. Spreading and compacting the mixture
8. Applying asphaltic emulsion and sand cover

30-7.01B Definitions

action limit: Test results at which corrective actions must be made while production continues.

break-over point: Maximum density of the CCPR section achieved when nuclear density tests do not show an increase in density after additional compaction passes.

CCPR: Cold central plant recycling is a type of recycling where RAP or RAP and aggregate base is used

CCPR-EA: Cold central plant recycling using emulsified asphalt.

CCPR-FA: Cold central plant recycling using foamed asphalt.

Recycling Agent: Cationic emulsified asphalt or foamed asphalt used in the recycling process.

lot: 400 CY or fraction thereof of CCPR pavement constructed in the same day.

sub-lot: 80 CY or fraction thereof of CCPR pavement constructed in the same day.

suspension limit: Test results at which production must be suspended while corrections are made.

Local CCPR material: Materials incorporated into CCPR recycled from the project.

Imported CCPR material: Materials incorporated into CCPR not generated from project.

30-7.01C Submittals

30-7.01C(1) General

Submit all test results, including where the requirement shown is "Report only," to the Engineer and e-mail to: PDR@dot.ca.gov.
At least 20 days before starting CCPR work, submit the following:

1. Quality Control (QC) Plan
2. Mix Design
3. Contingency Plan
4. Plant layout and location

30-7.01C(2) Quality Control Plan

Allow the Engineer 5 business days to review the QC plan. Do not start CCPR production until the Engineer authorizes the QC plan.
If QC procedures, personnel, tester qualifications, or lab accreditation status change, submit a QC plan supplement at least 3 business days before implementing proposed changes.
If a change is needed in your QC plan, do not implement the change without authorization.

30-7.01C(3) Mix Design

Submit separate mix designs based on recycled pavement material qualities for each location shown on the following table:

Mix Design

Location No.	Post mile to post mile
1	
2	
3	
4	
5	

If additional RAP or aggregate materials are to be imported, these materials must be incorporated into the mix design testing in the same proportions as they will be incorporated in the field.

For each CCPR mix design, submit:

1. Mix Design form per California Test 316, including all raw test data and calculations. The mix design submittal must be signed and sealed by an engineer who is registered as a civil engineer in the State of California.
2. SDS for:
2.1. Recycling Agent
2.2. Cement
2.3. Other additives
3. Manufacture's Certificate of Compliance for:
3.1. Recycling agent
3.2. Cement
3.3. Other additives

30-7.01C(4) Contingency Plan

Contingency plan must include actions you will take to ensure the roadway will be open to traffic at the specified time. The contingency plan must include provisions for constructing a temporary structural section and reopening the roadway to traffic.

30-7.01C(5) Quality Control Reporting

Submit a daily report that includes the following items for each lot:

1. General Information:
    1.1. Lot number
    1.2. Location description
    1.3. Beginning and ending station
    1.4. Lane number and offset from centerline
    1.5. Temperature:
        1.5.1. Ambient air temperature before beginning daily CCPR activities including time of temperature reading
2. For emulsified asphalt or foamed asphalt recycling agent:
    2.1. Weight in tons
    2.2. Percentage by weight of dry recycled pavement material
3. For cement:
    3.1. Total weight in tons
    3.2. Percentage by weight of dry recycled pavement material
4. Water application rate:
    4.1. Used for foaming asphalt by weight of asphalt for CCPR-FA
    4.2. Added during mixing for compaction by theoretical percent dry weight of CCPR
5. For CCPR processing:
    5.1. Calculated weight in tons of material processed
    5.2. Break-over point used for relative compaction calculation
6. Straightedge measurement locations and the following:
    6.1. Variance measured from the lower edge of a 12-foot straightedge placed parallel with the centerline
    6.2. Variance measured from the lower edge of a 12-foot straightedge placed transverse
7. CCPR quality control test results for:

7.1. Wet field gradation for material passing the 1-inch, 3/4-inch, and No. 4 sieves under AASHTO T 27
7.2. Relative compaction under California Test 231 for lifts greater than 4-inches and relative compaction under California Test 375 for lifts less than or equal to 4-inches
7.3. For CCPR-EA test for Marshall stability under California Test 316 and for CCPR-FA test for ITS under California Test 316
7.4. Air voids under AASHTO T 269
7.5 Maximum theoretical specific gravity under AASHTO T 209

8. For asphaltic emulsion used on finished CCPR surface:
   8.1. Emulsion type
   8.2. Emulsion application rate in gal/sqyd
   8.3. Emulsion dilution as the weight ratio of added water to asphaltic emulsion
9. Rate of sand cover application
10. Note on the daily report postmile or station limits of any:
    10.1. Changes to recycling agent application rate, including application rate change and reasons for change
    10.2. Changes to water application rate, including application rate change and reasons for change for:
        10.2.1. Water for foaming (only for CCPR-FA)
        10.2.2. Water added for compaction
    10.3. Unsuitable materials locations and when the Engineer was notified

Update each day's submitted report within 24 hours of obtaining test results. Consolidate all the lots completed in a day into one report with each lot reported separately.
During CCPR activities, submit the following items daily:

1. The total square yards, cubic yards, and tons of CCPR: processed, recycled, and placed.
2. The tons of recycling agent delivered, utilized, and the tons not used and carried over to next production day.
3. The tons of cement utilized and to be carried over to next production day.

30-7.01C(6) Certificates

Submit certificates of compliance for the cement, recycling agent and asphaltic emulsion with each delivery. Include the manufacturer's test results for recycling agent and asphaltic emulsion with your certificate of compliance. The test results must be from material tested within 30 days prior to delivery.

Submit a certified copy of each delivery's weight for recycling agent, cement, asphaltic emulsion, and sand.

30-7.01C(7) Recycling Agent

Submit samples of asphalt recycling agent in 1-quart cans to the Engineer.
Within 10 days after taking asphalt recycling agent quality control samples, submit the test results for asphalt quality characteristics.

30-7.01C(8) Asphaltic Emulsion

Submit two samples of asphaltic emulsion in 1-quart plastic containers to the Engineer.
Within 10 days after taking asphaltic emulsion quality control samples, submit the test results for asphaltic emulsion.
Each time you dilute the asphaltic emulsion, submit data under section 30-1.01C(2).

30-7.01C(9) Cold Central Plant Recycling

Submit quality control test results for the quality characteristics within the reporting times allowance after sampling shown in the following tables:

CCPR Quality Control Test Result Reporting

Quality characteristic	Test method	Maximum reporting time allowance
Water sulfates (max, ppm)	California Test 417	Before work starts

Water chlorides (max, ppm)	California Test 422	
Asphalt expansion (for CCPR-FA) (min, volume)	Visual Inspection	24 hours
Asphalt half-life (for CCPR-FA) (min, seconds)	Visual Inspection	
Maximum wet gradation (% passing) Sieve Size: 1-inch	AASHTO T 27	24 hours
Wet field gradation (% passing) Sieve size: 1-inch 3/4-inch No. 4	AASHTO T 27	24 hours
Dry gradation (% passing) Sieve size: 1-inch 3/4-inch No. 4 No. 30 No. 200	AASHTO T 27	10 business days
Bulk specific gravity of compacted samples	AASHTO T 269	10 business days
Maximum theoretical specific gravity	AASHTO T 209	10 business days
Air voids (%)	AASHTO T 269	10 business days
Relative compaction (min, %)	California Test 231	24 hours
In-place wet density (g/cc)	California Test 375, Part 4, or California Test 231	24 hours
Relative compaction (%)	California Test 375, or California Test 231	24 hours
Thickness (inch) Each Core Average thickness of cores	Core measurements	24 hours
Marshall stability (min, lbs)	AASHTO T 245	10 business days
Marshall retained stability (min, %)	AASHTO T 245	10 business days
Indirect dry tensile strength (psi)	AASHTO T 283	10 business days
Indirect wet tensile strength (min, psi)	AASHTO T 283	10 business days
Tensile strength ratio (%)	AASHTO T 283	10 business days

30-7.01C(10) Cold Central Plant Recycling Surface Smoothness

Submit the PPF files for the initial CCPR surface and the corrected CCPR surface under section 36-3.01C. Use the required naming convention, except that:

X = *CCPRPAVE* for the initial CCPR surface, and *CCPRCORR* for the corrected CCPR surface.

Include both CCPR profiles in the ProVAL project PVP file and payment adjustment spreadsheet required for the smoothness payment adjustment request for the hot mix asphalt pavement placed over the CCPR surface.

30-7.01D Quality Assurance

30-7.01D(1) General

Not used

30-7.01D(2) Quality Control

30-7.01D(2)(a) General

The laboratory used for preparing the mix design must be qualified under AASHTO re:source program and the Department's Independent Assurance Program.

Quality control laboratories and personnel performing sampling and testing must be in compliance with the Department Independent Assurance Program. For asphalt binder, cationic emulsified recycling agent and asphaltic emulsion, the quality control laboratory must be accredited under AASHTO re:source program.

If you adjust the application rate of CCPR components, record the adjustments and document the reasons for the adjustments in your daily report submittal to the Engineer.

30-7.01D(2)(b) Quality Control Plan

The QC plan must describe the organization, responsible parties, and procedures you will use to perform the following:

1. Control the production process
2. Determine whether a change to the production process is needed
3. Obtain samples, including determining sampling locations
4. Control quality, including sampling, testing, and reporting
5. Determine action limits when corrective actions are needed
6. Implement corrective actions
7. Ensure coordination of the following CCPR activities
    - 7.1 CCPR plant activities including crushing, stock piling, reconstituting, mixing, temporary stock piling of produced mix
    - 7.2 Transporting, paving, compacting, and finishing activities

The QC plan must include action and suspension limits and the details of the corrective action to be taken if any process is outside of those limits. The suspension limits must not exceed the specified acceptance criteria.

The QC plan must address the elements affecting CCPR quality including:

1. RAP and supplemental materials and stock piling
2. Recycling Agent
3. Cement
4. Production
5. Stockpiling
6. Transport
7. Paving
8. Compaction and curing
9. Fog seal and sanding
10. Smoothness

The QC plan must contain copies of the forms that will be used to provide the required inspection records and sampling and testing results.

The QC plan must include the name of your authorized laboratory.

30-7.01D(2)(c) CCPR Preconstruction Meeting

At least 10 days before starting CCPR activities, meet with the Engineer for a CCPR preconstruction meeting at a mutually agreed time and place. Discuss the QC plan and the methods of performing CCPR production and placement. This meeting will also include just in time training provided by the contractor to Caltrans personnel working on the project.

The following personnel must attend the preconstruction meeting:

1. Project manager
2. Project superintendent
3. QC manager
4. Workers and your subcontractor's workers, including:
    - 4.1. Foremen
    - 4.2. Ground supervisors
    - 4.3. Representative from quality control testing lab
    - 4.4. CCPR plant operator

30-7.01D(2)(d) Test Strip

On the 1st day of CCPR activities and within the pavement area to receive CCPR, construct a test strip. The test strip must be a single lane width and at least 1,000 feet in length. The test strip must show:

1. How the equipment, materials, and processes proposed can produce and place the CCPR mixture
2. CCPR plant application rates for recycling agent, cement, and water are appropriate
3. Rolling pattern needed to reach break-over point

4. Application rates of asphaltic emulsion and sand cover

Document the established rolling pattern and submit to the Engineer
The Engineer evaluates the test strip for authorization based on:

1. Visual inspection for the following:
   1.1 Segregation, raveling, rutting, humps, depressions, roller marks, and loose material.
   1.2 Uniform surface texture throughout the work limits.
2. Wet gradation
3. Smoothness
4. Relative compaction

For smoothness, only the straightedge requirements apply for test strip authorization.
Retest the test strip smoothness under section 30-7.01D(2)(d)(i)(F). Rework and recompact or remove and replace test strip if it does not comply with the specifications. Do not proceed with CCPR activities until the Engineer notifies you that the test strip is authorized.

30-7.01D(2)(d)(i) Quality Control Testing

30-7.01D(2)(d)(i)(A) General

Take samples under California Test 125.
For any lot including the test strip, stop CCPR activities and immediately notify the Engineer whenever any test result does not comply with the quality characteristic requirements or your quality control plan suspension limits. If CCPR activities are stopped for noncompliance, before resuming activities:

1. Notify the Engineer of the adjustments you will make
2. Reprocess, remedy, or replace the noncompliant lot

30-7.01D(2)(d)(i)(B) Recycling Agent

During CCPR activities, take four 1-quart samples of recycling agent from each load delivered to the plant in the presence of the Engineer. Use 2 samples for QC testing and submit 2 samples to the Engineer.
Perform sampling and testing of asphalt binder for compliance with the quality characteristics requirements shown in the table titled "PG Asphalt Binders" for the performance grade of asphalt used.
Test the first three asphalt samples and then every third sample taken.
Store recycling agent samples in clean, dry, and sealed 1-quart plastic containers at a temperature between 40 to 100 degrees F.
For emulsified asphalt, the authorized laboratory must perform sampling and testing every second tanker load according to section 94-1.02E.

30-7.01D(2)(d)(i)(C) Asphaltic Emulsion

Circulate asphaltic emulsion in the distributor truck before sampling. Take samples from the distributor truck at mid-load or from a sampling tap or thief. Before taking samples, draw and dispose of 1 gal. In the presence of the Engineer take four 1-quart samples of asphalt emulsion in plastic containers with lined sealed lid for testing. Use 2-quart samples for QC testing and submit 2-quart samples to the Engineer for acceptance testing. Sample must be submitted in insulated shipping container.
For asphaltic emulsion, the Authorized Laboratory must perform quality control sampling and testing at each tanker load .

30-7.01D(2)(d)(i)(D) Cold Central Plant Recycling

Perform sampling and testing at the specified frequency and location for the following quality characteristics:

CCPR Quality Testing Frequencies

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Water sulfates (max, ppm)[a]	California Test 417	1 per source	Source
Water chlorides (max, ppm)	California Test 422	1 per source	Source
Asphalt expansion and half-life (for CCPR-FA)	Visual Inspection	Each Tanker Truck	CCPR plant

Maximum wet gradation (% passing) Sieve size: 1-inch	AASHTO T 27	Test strip and 2 per lot	CCPR plant
Wet gradation (% passing) Sieve size: 1-inch 3/4-inch No. 4	AASHTO T 27	Test strip and every 3rd lot	
Dry gradation (% passing)[b] Sieve size: 1-inch 3/4-inch No. 4 No. 30 No. 200	AASHTO T 27	1 per day and prior to the introduction of recycling agent	
Marshall stability (min, lbs)	California Test 316	Every other lot	
Marshall retained stability (min, %)[c]	California Test 316	Every other lot	
Indirect dry tensile strength (psi)	California Test 316	Every other lot	
Indirect wet tensile strength (min, psi)[c]	California Test 316	Every other lot	
Tensile strength ratio (%)	California Test 316	Every other lot	

[a]Only required for non-potable water sources.
[b]Sampling must be conducted prior to mixing the RAP with recycling agent and cement to obtain accurate gradations on dry gradations.
[c]Contractor shall fabricate companion samples for department testing.

30-7.01D(2)(d)(i)(E) Density

Take and split a sample of the loose CCPR mixture daily at a randomly determined time. Split the CCPR samples into 2 parts and label the containers with location and station. Submit 1 split part and use 1 part for your testing. For density, perform sampling and testing at the specified frequency and location for the following quality characteristics:

Density Quality Testing Frequencies

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Maximum theoretical specific gravity[a, b, c]	AASHTO T 209	Test strip and 2 per day	CCPR plant
Air voids of compacted and cured specimens (%)[a, b, c]	AASHTO T 269	Test strip and 2 per day	CCPR plant
In-place wet density (g/cc)[d]	California Test 375 Part 4, or California Test 231	Test strip and 1 per day	Compacted mix
Relative compaction (min, %)[d, e]	California Test 375, or California Test 231	Test strip and 2 test sites per sublot	Compacted mix

[a]Take and split a sample of the loose CCPR mixture daily at a location determined by the Engineer. Split the CCPR samples into 2 parts and label the containers with location and station. Submit 1 split part and use 1 part for your testing. Determine maximum theoretical gravity of the CCPR sample under AASHTO 209. Use the maximum theoretical gravity and calculate air voids under AASHTO T 269 for each compaction test site and the average of the lot. Report air voids ratio at end of project. The Department does not use your maximum theoretical specific gravity test results and air voids to determine specification compliance.

[b]Fabricate 3 4-inch diameter specimens compacted under AASHTO T 245 at 75 blows per side or under AASHTO T312 at 30 gyrations. Fabrication of specimens must be completed within 2 hours after materials have been mixed. Compact lab specimens during production under the same procedures that was used for the mix design.

[c]Test specimens after 104 degrees F curing to constant weight for 72 hours and allow the specimens to cool to room temperature.

[d]Use California Test 375 for 4 inches or less and California Test 231 for greater than 4 inches. The relative compaction is based on the break-over point. Verify break-over point once per day of production and when significant changes in material are observed.

[e]Testing frequency two test sites per sub-lot and no lot shall be represented by fewer than five test sites.

30-7.01D(2)(d)(i)(F) Smoothness

Straightedge and record surface smoothness at least once every 1,000 feet along the cut length. Stop CCPR paving activities and immediately inform the Engineer whenever:

1. Variance of more than 0.02 foot measured from the lower edge of a 12-foot straightedge placed parallel with the centerline
2. Transverse slope variance of more than 0.03 foot measured from the lower edge of a 12-foot straightedge
3. Visual inspection shows evidence of
   3.1. Raveling
   3.2. Loose material
   3.3. Non-uniform surface texture

After completing CCPR activities, prior to HMA overlay, determine CCPR surface smoothness under section 36-3. Smoothness is measured after supplemental compaction for CCPR -EA. Smoothness is measured after final compaction for CCPR -FA.

Correct CCPR surface with MRI greater than 90 in/mi for each 0.1-mile section and areas of localized roughness greater than 240 in/mi. Measure smoothness after corrections have been made under section 30-5.01C(10). For areas corrected by grinding or micro milling reapply asphaltic emulsion and sand. Smoothness corrections must leave at least 90 percent of the specified CCPR thickness. If ordered, core the pavement at the locations selected by the Engineer. Coring, including traffic control, is change order work. Remove and replace deficient pavement areas where the overlay thickness is less than 75 percent of the thickness specified.

30-7.01D(3) Department Acceptance

30-7.01D(3)(a) General

The Engineer samples materials for testing under California Test 125.

CCPR acceptance is based on:

1. Visual inspection for the following:
   1.1. Segregation, raveling, rutting, humps, depressions, roller marks, and loose material.
   1.2. Uniform surface texture throughout the work limits.
2. Compliance with smoothness requirements on the CCPR surface of:
   2.1 MRI of 90 in/mi or less for each 0.1-mile section
   2.2 No areas of localized roughness greater than 240 in/mi.
   2.3 For areas that require CCPR surface smoothness determined using a 12-foot straightedge, the CCPR surface must not vary from the lower edge of the straightedge by more than:
      2.3.1 0.02 foot when the straightedge is laid parallel with the centerline
      2.3.2 0.03 foot when the straight edge is laid perpendicular to the centerline and extends from edge to edge of a traffic lane
3. Asphalt acceptance is based on the Department's sampling and testing for compliance with the requirements for the quality characteristic requirements in Section 92 table "PG Asphalt Binder" for the performance grade of asphalt used.
4. Emulsified Recycling Agent is based on the Department's sampling and testing for compliance with the requirements for the quality characteristic requirements in Section 94-1.02E.
5. Asphaltic emulsion acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

Asphaltic Emulsion Requirements

Quality characteristic	Test method	Requirements	
		Minimum	Maximum
Test on emulsion:			
Sieve test (max, %)	AASHTO T 59	--	0.1
Residue by evaporation (min, %)	AASHTO T 59	28.5[a]	--
Test on residue by evaporation:			
Penetration, @ 25 °C (mm)	AASHTO T 49	40	90

[a]Residue requirement is based on 1:1 dilution ratio of asphaltic emulsion and water.

Compliance with quality characteristic requirements in the following table:

CCPR Quality

Quality characteristic	Test method	Requirement
Maximum wet gradation (% passing) Sieve Size 1-inch	AASHTO T 27	100
Wet gradation (% passing) Sieve size: 1-inch 3/4-inch No. 4	AASHTO T 27	100 Report only Report only
Dry gradation (% passing) Sieve size: 1-inch 3/4-inch No. 4 No. 30 No. 200	AASHTO T 27	Report only
Indirect wet tensile strength (min, psi)[a,b]	AASHTO T 283	Report only
Relative compaction (min, %)[c]	California Test 231 or California Test 375	98–102
Maximum density	California Test 216	Report only
Thickness (inch)[d] Each core Average thickness of cores	Core measurements	±0.75 inch of the thickness shown ≥ thickness shown

[a]Fabricate 3 indirect tensile strength specimens under AASHTO T 245 or AASHTO T 312. Fabrication of indirect tensile strength specimens must be completed within 2 hours after materials have been mixed. Indirect tensile strength testing is only required for acceptance of CCPR -FA. No indirect tensile strength testing is required for CCPR -EA. Compact lab specimens during production under the same procedures that was used for the mix design.
[b]Cure the specimens at 100 degrees F for 72 hours and allow the specimens to cool to room temperature. Test 3 specimens for wet tensile strength under AASHTO T 283 after moisture conditioning.
[c]Average of lot test locations 98 to 102 percent with no individual test less than 95 to 105 percent. Use California Test 375 for 4 inches or less and California Test 231 for greater than 4 inches. Relative compaction is based on CT 231 or CT 375 divided by breakover density.
[d]Take 4 or 6-inch cores from two random locations per lot as determined by the Engineer. Coring at more than 2 locations per lot is change order work. Perform coring and measure core depth in the presence of the Engineer or submit depth measurements, taken in the presence of the engineer, if core retrieval is not achieved. This process will be done after supplemental compaction for CCPR -EA. Coring must be done after any milling.

If the Engineer orders you to stop CCPR activities for noncompliance, before resuming activities:

1. Notify the Engineer of the adjustments you will make
2. Reprocess, remedy, or replace the noncompliant lot
3. Obtain the Engineer's authorization

30-7.01D(4) Dispute Resolution

30-7.01D(4)(a) General

You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result discrepancies. You and the Engineer may only dispute each other's test results if one party's test results pass and the other party's test results fail.
If there is a dispute, submit your test results and copies of paperwork including worksheets used to determine the disputed test results within 3 business days of receiving the Engineer's test results. An independent third party performs referee testing. Before the third party participates in a dispute resolution, it must be qualified under AASHTO re:source program and the Department's Independent Assurance Program. The independent third party must have no prior direct involvement with this Contract. By mutual agreement, the independent third party is chosen from:

1. Department laboratory in a district or region not in the district or region the project is located
2. Transportation Laboratory
3. Laboratory not currently employed by you or your CCPR producer

If the Department's portion of the split acceptance samples are not available, the independent third party uses any available material agreed by you and the Engineer as representing the disputed CCPR for evaluation.

If you or the Engineer dispute each other's visual inspection findings, submit copies of your visual inspection findings. An independent third party (ITP) consisting of a Department expert and a CCPR industry or Academia expert will perform a joint visual inspection. The ITP must be independent of the project. The ITP is chosen by mutual agreement.

30-7.02 MATERIALS

30-7.02A General

A summary of existing material investigations is available in the *Information Handout* as supplemental project information.

30-7.02B Material Quality Characteristics During Production

CCPR Quality Characteristic Requirements

Quality characteristic	Test method	Requirement
Asphalt expansion and half-life (for CCPR-FA)	Visual Inspection	Foaming
Maximum wet gradation (% passing) Sieve size 1-inch	AASHTO T 27	 100
Wet gradation (% passing) Sieve size 1-inch 3/4-inch No. 4	AASHTO T 27	 100 Report only Report only
Dry gradation (% passing) Sieve size 1-inch 3/4-inch No. 4 No. 30 No. 200	AASHTO T 27	 Report only
Bulk specific gravity of compacted samples	AASHTO T 269	Report only
Maximum theoretical specific gravity	AASHTO T 209	Report only
Air voids (%)	AASHTO T 269	Report only
Relative compaction (min, %)[a]	California Test 231 or California Test 375	98–102
In-place wet density (g/cc)	California Test 375, Part 4	Report only
Thickness (inch)[b] Each Core Average thickness of cores	Core measurements	 ±0.75 inch of the thickness shown ≥ thickness shown
Marshall stability (min, lbs)[c]	AASHTO T 245	Report only
Marshall retained stability (min, %)[c]	AASHTO T 245	Report only
Indirect dry tensile strength (psi)[c]	AASHTO T 283	Report only
Indirect wet tensile strength (min, psi)[c]	AASHTO T 283	Report only
Tensile strength ratio (%)[c]	AASHTO T 283	Report only

[a]Average of lot test locations 98 to 102 percent with no individual test less than 95 to 105 percent. Use California Test 375 for 4 inches or less and California Test 231 for greater than 4 inches.

[b]Take 4 or 6-inch cores from two random locations per lot as determined by the Engineer. Coring at more than 2 locations per lot is change order work. Perform coring and measure core depth in the presence of the Engineer or submit depth measurements, taken in the presence of the engineer, if core retrieval is not achieved. This process will be done after supplemental compaction for CCPR-EA.

[c]Testing is report only during production, alternating between ITS and Marshall stability per lot.

30-7.02C Water

If a water source other than potable water is used, test water for sulfates and chlorides.

Water Requirements

Quality characteristic	Test method	Requirement
Water sulfates (max, ppm)	California Test 417	1,300
Water chlorides (max, ppm)	California Test 422	650

30-7.02D Cement

Cement must comply with section 90-1.02B(2).

30-7.02E Recycling Agent

Use PG 64-10 unmodified binder for CCPR -FA or as approved by the Engineer.
Use PG 64-22 as the asphalt binder for CCPR -EA.
Cationic emulsified recycling agent must comply with the requirements in Section 94-1.02E.

30-7.02F CCPR Mix Design

The mix design must include RAP which will be used in the CCPR mix, asphalt, cement, and water.
The mix design must comply with California Test 316 and the requirements shown in the following table:

Mix Design Requirements

Quality Characteristic	Test Method	Requirement
RAP asphalt content (%)	ASTM D 2172, Method B	Report only
Bulk specific gravity of compacted samples[a, b]	AASHTO T 269	Report only
Maximum theoretical specific gravity[b]	AASHTO T 209	Report only
Air voids of compacted and cured specimens (%)[b]	AASHTO T 269	Report only
Marshall Stability, cured specimen[b, e] at 104 °F with cement (min, lbs)	AASHTO T 245	1,500
Marshall retained stability[b, c, d, e] based on moisture conditioning on cured specimen at 104 °F with cement (min, %)	AASHTO T 245	70
Indirect dry tensile strength (psi)[f]	AASHTO T 283	Report only
Indirect wet tensile strength (min, psi)[f]	AASHTO T 283	35
Tensile strength ratio (min, %)[f]	AASHTO T 283	70
Maximum density (lb/cu ft)	California Test 216	Report only
Ratio of asphalt binder to cement (min, %)	--	2.5:1
Raveling test at 50 °F (max, %)[e]	ASTM D7196	7
RAP coating Test for CCPR EA (%)	AASHTO T 59	95

[a]4-inch diameter mold compaction based on gyratory compactor at 30 gyrations or marshall compactor with 75 blows per side.
[b]Test specimens after 104 degrees F curing to constant weight between 16 hours and 48 hours.
[c]Vacuum saturation from 55 percent to 75 percent. Water bath at 77 degrees F for 23 hours, with the last 30 minutes to 40 minutes in 104 degrees F water bath.
[d]If the saturated Marshall Stability is at least 1500 lbs, the Marshall Retained Stability ratio may be reduced to 60 percent
[e]Requirements are only applicable to CCPR -EA and for CCPR -FA will be report only.
[f]Requirements are only applicable to CCPR-FA and for CCPR-EA will be report only.

Cement must be at least 0.50 but not more than 1.0 percent of the dry weight of recycled pavement material.
If additional mix designs are required, this work is change order work.

30-7.02G Temporary Structural Section

Use minor HMA or commercial quality bituminous material to construct a temporary structural section.
The minor HMA for the temporary structural section must comply with Section 39-2.07.

30-7.02H Asphaltic Emulsion

Asphaltic emulsion must be Grade SS1h or Grade CSS1h or cationic emulsified recycling agent complying with section 94-1.02.
Notify the Engineer if you dilute the asphaltic emulsion with water. The ratio by weight of added water to asphaltic emulsion must not exceed 1 to 1.
Measure added water weight.

30-7.02I Sand Cover

Sand used for sand cover must be fine aggregate and not contain more than 2 percent moisture by dry weight of sand.

30-7.03 CONSTRUCTION

30-7.03A General

Do not disturb or damage the underlying materials during pavement cold planing activities. Do not use a heating device to soften the pavement.
CCPR material shall be placed and compacted within 2 hours after mixing.
Use the same equipment, materials, rolling pattern and construction methods that were used for the authorized test strip for the remainder of the CCPR work. Any adjustments must be authorized.
If the equipment or process fail to meet the specifications, stop CCPR activities and notify the Engineer.

30-7.03B Surface Preparation

Before starting CCPR activities, prepare the existing roadway by:

1. If milling pavement, remove loose material from the roadway width including:
   1.1. Dirt
   1.2. Vegetation
   1.3. Standing water
   1.4. Combustible materials
   1.5. Oils
   1.6. Pavement markers and underlying adhesive
2. Accurately referencing the existing pavement's profile and cross slope.
3. Accurately marking the proposed longitudinal cut lines on the existing roadway surface.
4. If milling is not performed, sweep the entire roadway using a mechanical broom.
5. Prior to placement of CCPR, a tack coat diluted at a ratio of 50:50 emulsion to water of CSS-1h, emulsified recycling agent or equivalent to 0.10 gallons per square yard minimum asphaltic emulsion shall be applied to existing surfaces receiving the CCPR. If CCPR is to be paved directly on aggregate bases, cement stabilized subgrades or bases, a prime coat shall be applied to the layer surface just prior to paving the CCPR asphalt. Prime coat should be diluted at a ratio of 50:50 emulsion to water and applied at a rate between 0.14 to 0.20 gallons per square yard and allowed to break.

30-7.03C Cold Central Plant Recycling Equipment

30-7.03C(1) General

The equipment for CCPR must consist of:

1. Cold planing (if part of the project)
2. Crushing, or sizing of recycled pavement material
3. Recycling agent storage, supply and foaming for CCPR -FA.
4. Loading, Mixing, and proportioning
5. Water storage and supply
6. Cement storage and supply
7. Transporting CCPR material
8. CCPR mixture spreading
9. Compacting
10. Applying asphaltic emulsion to the surface
11. Spreading sand cover

Use equipment that:

1. Cold planes the existing asphalt pavement (if part of the project)
2. Crushes and sizes the RAP or RAP and underlying layer material

3. Mixes the recycled pavement material with the recycling agent and cement into a homogeneous mixture
4. Loads and transports the CCPR mixture without loss or segregation
5. Places the CCPR mixture to the lines, grades, and specifications

Crushing, or sizing equipment must produce uniform material to the specified size before mixing the recycling pavement material with recycling agent.

30-7.03C(2) Crushing and Sizing Equipment

The recycled material shall be processed through a material crushing and sizing unit having screening and crushing capabilities to fractionate and reduce the RAP to the gradations as required in section 30-5.02. Crushing and sizing equipment must be of the impact crusher or jaw crusher type and must include a screening system to ensure that 100 percent of RAP passes the maximum allowable gradation of 1-inch prior to incorporation into the CCPR mixture.

Crushing and screening equipment must be equipped with dust control systems such as a misting system to minimize fugitive dust during the crushing operation.

When paving fabric is encountered, no fabric piece incorporated into the recycled section shall have any dimension exceeding a length of 2-inches. The Contractor shall be required to remove and properly dispose of oversized pieces of paving fabric as directed by the Engineer during the crushing and sizing operation. Similarly, loop wires, pavement markers, rubberized crack fill materials, thermoplastic marking materials, milled concrete, and other materials that are present within RAP stockpile shall be removed from the recycled material unless the Contractor can demonstrate that minor amounts of residual materials that remain will not compromise the integrity of the recycled asphalt.

30-7.03C(3) Mixing Chamber or Pugmill

CCPR plant shall provide a continuous mixing chamber or pugmill mixing machine with a belt scale to control:

1. Recycled pavement material delivered to the mixing chamber or pugmill
2. Amount of recycling agent being delivered

The mixing chamber or pugmill must be arranged to mix the recycled pavement material, recycling agent, and cement to produce the specified CCPR mixture. The mixing chamber may be equipped with paddles or other suitable mixing devices. If paddles or other suitable mixing devices are used, the recycled pavement material must be fed from a hopper or from the, crushing or sizing equipment to the mixer at a uniform and controlled rate.
The recycling plant must load directly into the transport trucks or onto the stockpile.

If stockpiling CCPR material, the contractor shall ensure that only CCPR material is picked up when loading into transport trucks.

30-7.03C(4) Mixing and Proportioning Equipment

30-7.03C(4)(a) General

Use a mass flow, Coriolis Effect type meter with a visible readout display and printing capabilities.
The weighing and measuring devices for the recycling agent and cement must comply with the requirements of the MPQP. You may use equipment that has successfully passed the calibration requirements of MPQP within the past 6 months.

30-7.03C(5) Water Storage and Supply Equipment

As part of the recycling plant, provide an independent supplemental water source. Interlock the supplemental water with the recycled pavement material weighing device or microprocessor to properly disperse the recycling agent.

30-7.03C(6) Cement Storage and Supply Equipment

Keep cement in dry cement, pneumatic trailers, or silos.

30-7.03C(7) Spreading Equipment

Spreading equipment for CCPR operations must be:

1. Self-propelled
2. Mechanical
3. Equipped with a screed or strike-off assembly that can distribute CCPR 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. Do not heat the screed during spreading operations.

Material transport vehicles shall not be used.

Install and maintain grade and slope references.

The screed must produce a uniform CCPR 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.

In areas inaccessible to spreading and compacting equipment:

1. Spread the CCPR 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

Transport trucks may load directly into hopper or deposit into a windrow ahead of spreading operations. The paver's loading equipment must pick up the CCPR mixture and deposit it in the paving machine without waste. If the paving screed is directly attached to the CCPR equipment, feed the CCPR mixture directly to the paving screed.

Spreading equipment must be equipped with ski devices for longitudinal profile. The ski devices maybe a conventional contact ski or noncontact laser or sonar device.

30-7.03C(8) Compacting Equipment

Compacting equipment must comply with sections 39-2.01C(2). Provide a minimum of 1 pneumatic-tired roller weighing at least 25 tons and 1 double drum vibratory steel-wheeled roller weighing at least 10 tons. Rollers must be at least 5.5 foot wide. Each roller must have a working water spray system.

Rollers must be equipped with a system that prevents CCPR from sticking to the wheels. You may use a parting agent that does not damage the CCPR or impede the bonding of layers.

30-7.03D Cold Central Plant Recycling

30-7.03D(1) General

Do not perform CCPR activities under the following conditions:

1. Pavement surface is wet due to rain.
2. Rain is forecasted within 24 hours of the scheduled work.
3. Pavement temperature is less than 60 degrees F.
4. Ambient temperature is less than 50 degrees F.
5. Between 30 minutes before sunset and 30 minutes after sunrise for CCPR-EA.
6. Temperatures less than 32 degrees F forecast in the next 48 hours.

Use the existing pavement profile and cross slope to establish the CCPR finished profile and cross slope. You may adjust the recycling depth by ± 0.75 inch from the depth shown to achieve uniform pavement profile, cross slope, and surface smoothness. The average recycled depth determined by cores must be equal to or greater than the depth shown.

Construct the CCPR finished profile and cross slope based on the project's planned grades.

30-7.03D(2) Cold Planing

Do not leave gaps of unrecycled material between successive cuts along the same longitudinal cut line. Do not leave untreated wedges created by the entry of the milling drum into the existing pavement.

During cold planing of existing pavement use automatic controls for profile and cross slope.

30-7.03D(3) Unsuitable Conditions

If you encounter unsuitable subgrade material:

1. Notify and meet with the Engineer immediately.
2. Clearly define the unsuitable material areas and depth.
3. Excavate and dispose of any unsuitable subgrade material encountered.
4. Unless otherwise ordered, backfill the excavated area with CCPR material.

5. Submit within 24 hours of defining unsuitable material the following:
    5.1. Unsuitable areas including station or postmile, length, width, depth, and centerline offset.
    5.2. Remediation taken, including quantities of materials used.

Excavating and disposing of unsuitable material and replacing with AB and surfacing material is change order work.

30-7.03D(4) Recycling Agent for CCPR-FA

Inspect recycling agent foaming half-life and expansion ratio for each tanker load of asphalt. Verify the half-life and expansion ratio by visual inspection and confirm that the foaming action of the recycling agent is taking place through the test port.

30-7.03D(5) Cement

Add cement directly into the pugmill during the recycling process

30-7.03D(6) Water

Determine percentage of water for foaming based on expansion and half-life testing for each truck load of asphalt for CCPR-FA.

For additional water added for compaction, water should be added within the CCPR plant so that material being placed is consistent with the established break-over point.

30-7.03D(7) Proportioning

The amount of recycling agent must match the amount reported in the JMF or the amount as adjusted and authorized.

30-7.03D(8) Spreading and Compacting

Remove any visible oversized crack treatment material or paving fabric larger than 2 inch measured at any dimension in the in-place recycled pavement material or in the CCPR mixture before placement and compaction.

Paving equipment for spreading must be:

1. Self-propelled
2. Mechanical
3. Equipped with a screed or strike-off assembly that can distribute CCPR 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

Place CCPR material to the lines and grades established in accordance with contract documents.

Install and maintain grade and slope references, matching existing elevations and cross slopes.

The screed must produce a uniform CCPR 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.
Do not allow segregation of CCPR mixture, or tearing, or scarring of the compacted surface.
For CCPR -EA, determine the time interval between spreading and start of compacting CCPR mixture. Establish the time interval based on ambient temperatures, weather, and type of emulsified asphalt. Record the time intervals in the daily quality control records. Avoid starting or stopping rolling on uncompacted material.
Compact the CCPR mixture by implementing the same compaction rolling pattern established in the authorized test strip.
On the 1st day of supplemental compaction activities construct a test strip. The test strip must be a single lane width and at least 528-feet in length. The test strip must demonstrate the rolling pattern needed to reach break-over point. The Contractor shall provide a sequence and manner of rolling which will define maximum compaction by establishing a rolling versus density chart that shows the progress of densification from initial material density through maximum obtainable density at the "break over point."

Perform supplemental compaction of the CCPR material by implementing the same compaction rolling pattern established in the authorized supplemental compaction test strip.

Compact the CCPR to the required density. Establish a new rolling pattern and maximum break over point as specified under Test Strip 30-7.01D(2)(d) if any of the following criteria occurs:

1. Relative compaction of any of the 10 sublots is less than 95 percent or greater than 105 percent of the break-over point
2. Average relative compaction of the lot is less than 98 percent or greater than 102 percent of the break-over point
3. Changes in the in-place recycled pavement material or proportions
4. Changes in equipment or procedures
5. Change in temperature or weather conditions affecting compaction temperatures of the mixture
6. Visible displacement or cracking occurs

Perform final rolling with a double-drum vibratory steel-wheel roller operating in static or vibratory mode. The compacted CCPR surface must be free from raveling, segregation, rutting, humps, depressions, roller marks, or irregularities. Rework, recompact, or remove and replace CCPR that shows raveling, segregation, rutting, humps, depressions, roller marks, or irregularities.
For CCPR smoothness, the completed CCPR surface must have an MRI of 90 in/mi or less for a 0.1-mile section and no areas of localized roughness greater than 240 in/mi.
For areas that require CCPR surface smoothness determined using a 12-foot straightedge, the CCPR surface must not vary from the lower edge of the straightedge by more than:

1. 0.02 foot when the straightedge is laid parallel with the centerline
2. 0.03 foot when the straightedge is laid perpendicular to the centerline and extends from edge to edge of a traffic lane

30-7.03E Asphaltic Emulsion and Sand Cover

After final compaction and before opening the PDR surface to traffic, apply a coat of asphaltic emulsion followed by sand cover to the CCPR surface and place temporary painted traffic stripes and painted pavement markings used for temporary delineation under section 12-6. Apply asphaltic emulsion and sand cover under section 37-4.03.
Remove excess sand from the pavement surface by sweeping before opening to traffic.

30-7.03F Temporary Structural Section

Place a temporary structural section to the level of the CCPR surface if either occurs:

1. You are unable to complete the CCPR before opening to roadway to traffic
2. CCPR fails during the maintaining period by raveling or rutting

For minor HMA or commercial quality bituminous material, place in layers and compact until the level of the CCPR surface is reached. Compact the minor HMA or commercial quality bituminous material using method compaction process as specified in section 39-2.01C(15)(b).
If commercial quality bituminous material or minor HMA is used, remove and replace it with HMA Type A under an authorized JMF meeting the requirements for HMA Type A before placing overlay.

30-7.03G Maintain, Cure and Protect Surface

Do not recompact the CCPR for CCPR-FA.
Do not place HMA or CCPR layer over CCPR surface until one of the following conditions is met:

1. 3 days and moisture measured at mid-depth of the CCPR pavement is 2.0 percent or less
2. 10 days without rainfall
3. 4 days without rainfall and no change in measured moisture content of the CCPR pavement within a 24-hour period

HMA layer must be placed within 15 days of completion of the final CCPR layer.
Immediately repair any damage or defects by:

1. Reworking and recompacting the CCPR surface
2. Replacing any damaged area with the same depth of cold bituminous surfacing material or HMA

30-7.03H Supplemental Compaction for CCPR-EA

Recompact the CCPR surface:

1. After curing is completed per section 30-5.03G
2. When surface temperature is at least 80°F
3. Before smoothness testing
4. Before placing the HMA surfacing

Use the same equipment to establish the rolling pattern and break over curve for recompacting the CCPR surface. Adjustments must be authorized.

30-7.04 PAYMENT

Test strips are paid for as CCPR.

The Department does not adjust the unit price for an increase or decrease in the quantity for:

1. Cement (Cold Central Plant recycling)
2. Recycling agent (Cold Central Plant recycling)
3. Asphaltic emulsion (Cold Central Plant recycling)
4. Sand cover (Cold Central Plant recycling)

PMPC Final Report Signature Page for Develop CCPR Specifications

Many efforts within the Pavement and Materials Partnering Committee (PMPC) require signature approval from the Executive Committee and Task Group members. This document provides final approval and close out by the Task Group and Executive Committee members for **Develop CCPR Specifications** work product and that the working group (WG) has met their commitments for the final report with documentation of decisions/implementation recommendation made. A signature here indicates that each Task group member and Executive Committee has reviewed the final report and agrees the WG has met final report criteria set out in the scoping document and SOP. Furthermore, it is everyone's responsibility to ensure that the final effort/improvement is:

1) Street Ready
2) Monitored and recorded for performance
3) Successfully implemented statewide as appropriate.

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