

DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
Transportation Laboratory
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**METHOD OF EVALUATING BEND TEST RESULTS OF
FUSION-BONDED EPOXY COATINGS ON
ASTM DESIGNATION: A 934/A 934M STEEL REINFORCEMENT**

A. SCOPE

This test method describes the procedures to visually evaluate the bend test results of ASTM A 934/A 934M fusion-bonded epoxy coated reinforcing bars. The purpose of the bend test for these coatings is to provide a qualitative measure of coating cure and/or failure of coating due to backside contamination through a visual assessment. Other quantitative methods of assessing coating cure and backside contamination are available and required per ASTM Standards; however, successful passing of the bend test is also required.

The intent of this test method is to establish a relatively quick visual test method for assessing the coating cure and integrity of non-bendable fusion-bonded epoxy coatings. The procedure for identifying cracks is intended to be performed by a person with normal or corrected vision. A 10X-magnifying lens should only be used to confirm the presence of visible underlying metal at a crack, and should not be used to search for cracks. Holiday detection devices should not be used to identify or confirm the presence of coating cracks or discontinuities.

Information contained in this test method supersedes information contained in sub-Section 9.3.2 of "Coating Flexibility" in ASTM Designation: A 934/A 934M.

B. REFERENCES

ASTM A 934/934M – Epoxy-Coated Prefabricated Steel Reinforcing Bars
Caltrans Standard Specifications Section 52, "Reinforcement"

C. DEFINITIONS

Fusion-bonded epoxy coating – a product containing pigments, thermosetting epoxy resins, cross-linking agents, and other additives, which is applied in the form of a powder onto a clean, heated metallic substrate that fuses to the metal to form a continuous barrier coating.

Prefabricated bars – steel reinforcing bars that are cut to specified lengths and bent to the required shape prior to coating with fusion-bonded epoxy coatings.

Normal or corrected vision – 20/20 vision or better, as verified by a vision acuity test.

Standard laboratory lighting – Level of lighting considered typical for inspection work; within the range of 750 to 200 Lux (1 Lux = 0.1 Lumen/ft²).

10X Magnifying lens – Lens capable of producing a magnification of 10 times that seen with normal or corrected vision.

Break – a separation in a coating that extends from the exterior surface of the coating to or near the bar surface. Since the break may be extremely narrow, the underlying metal may not always be visible with 20/20 vision or 10X magnification.

Crack – a break in the epoxy coating experienced after bending through which the underlying metal is visible.

Coating discontinuity – a break in the coating experienced after bending through which the underlying metal cannot be seen by the unaided eye or with a 10X-magnification device.

Isolated coating crack or discontinuity – an isolated break in the coating experienced after the bend test attributed to a burr on the surface of the steel reinforcing bar.

Stretching and discoloration – Identifiable changes in color of the fusion-bonded epoxy coating that may occur after bending. Discoloration is an indication of stretching. Note that discoloration of epoxy coating under applied stress does not indicate a separation of the coating.

D. PROCEDURE

1. Figure 1 provides a decision tree for the test procedure.
2. Coated reinforcement test bar samples should be dry and free of contamination prior to testing.
3. Bend coated reinforcement test bar sample in accordance with the requirements of sub-Section 9.3.1 of ASTM A 934/A 934M.
4. Evaluate the bend area under standard laboratory lighting using normal or corrected vision as identified in this test method.
5. Note the presence of cracks and/or coating discontinuities in the coating on the outside radius of the test bar bend area using normal or corrected vision.
6. Cracks and coating discontinuities as described in this test method are to be circled with a permanent marker of a contrasting color to that of the epoxy coating. Care should be taken not to mark over the actual crack or discontinuity.
7. If needed, confirm the presence of exposed underlying metal at cracks using a 10X-magnification device.

E. EVALUATION CRITERIA

1. Cracks and coating discontinuities in improperly cured fusion-bonded epoxy-coatings will usually appear at multiple locations along the outside bend radius of the test bar.
2. Three or more cracks on the outside bend radius of the test bar constitute nonconforming material. (See Figures 3 & 4)
3. Three or more coating discontinuities on the outside radius of the test bar constitute nonconforming material. (See Figure 2)
4. Breaks, cracks or coating discontinuities within the coating at contact points of mandrel devices used to produce the bend in a bar for the bend test should be disregarded.
5. Stretching and/or discoloration of the epoxy coating within the outside radius of the test bar after bending does not constitute nonconforming material. (See Figure 5)

6. Figures 2 through 5 may be used to assist in identifying and classifying coating breaks.

F. REPORTING OF RESULTS

On an appropriate form (Figure 6 is an example) record the number of coating breaks and identify them as either cracks or coating discontinuities on the appropriate test form. Also note whether or not stretching or discoloration was seen on the bar sample after testing.

On an appropriate form (Figure 7 is an example) report results for the test bar as complying or not complying with specifications on the test report form. Results for the test bar sample should be documented with the coating company's name, material lot number, appropriate ASTM coating specification, inspector's name, date sampled and date tested.

G. 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.

Caltrans Laboratory Safety Manual is available at:

http://www.dot.ca.gov/hq/esc/ctms/pdf/lab_safety_manual.pdf

End of Text
(California Test 686 contains 10 pages)

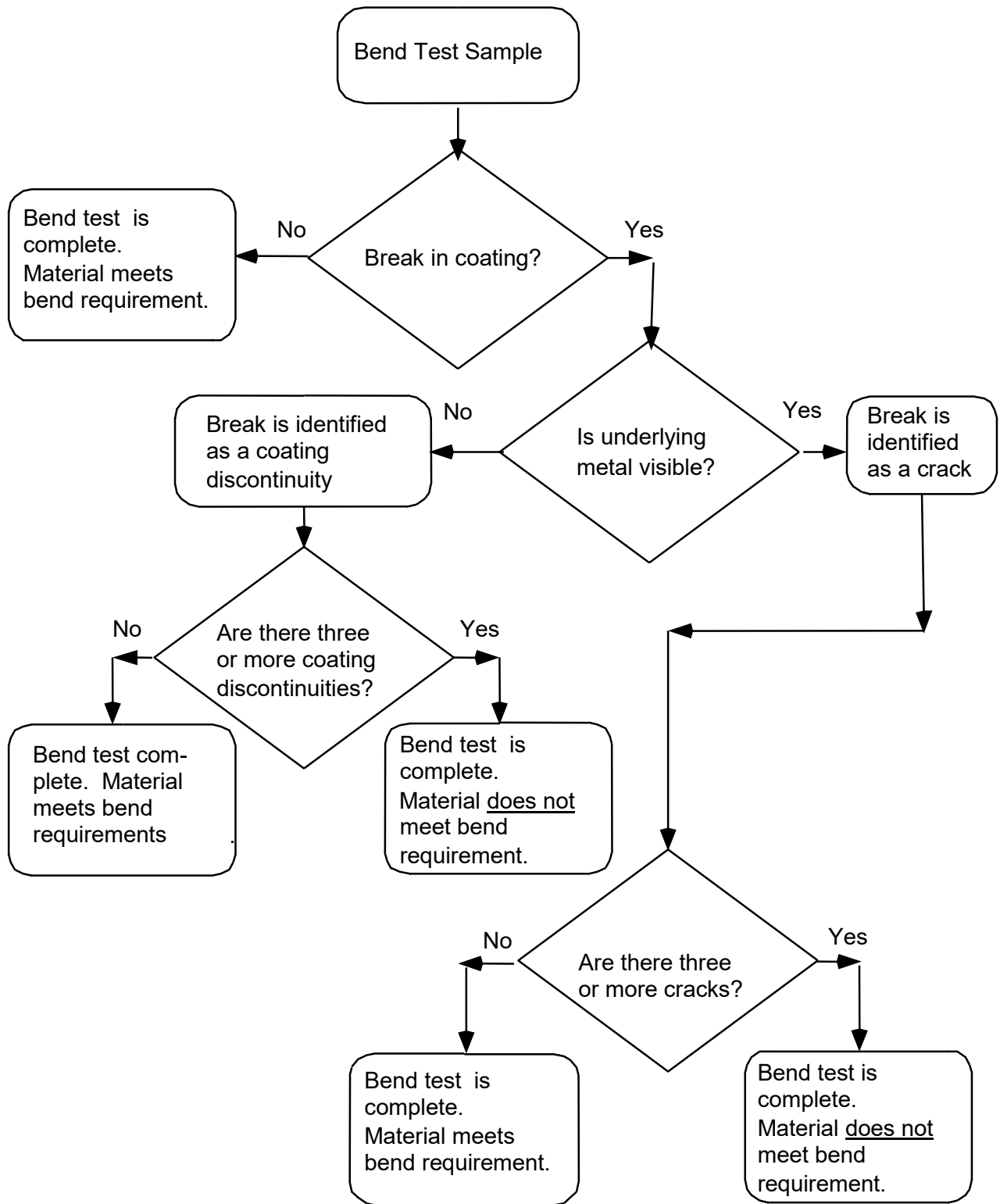


Figure 1. Decision tree for evaluating bend test results.

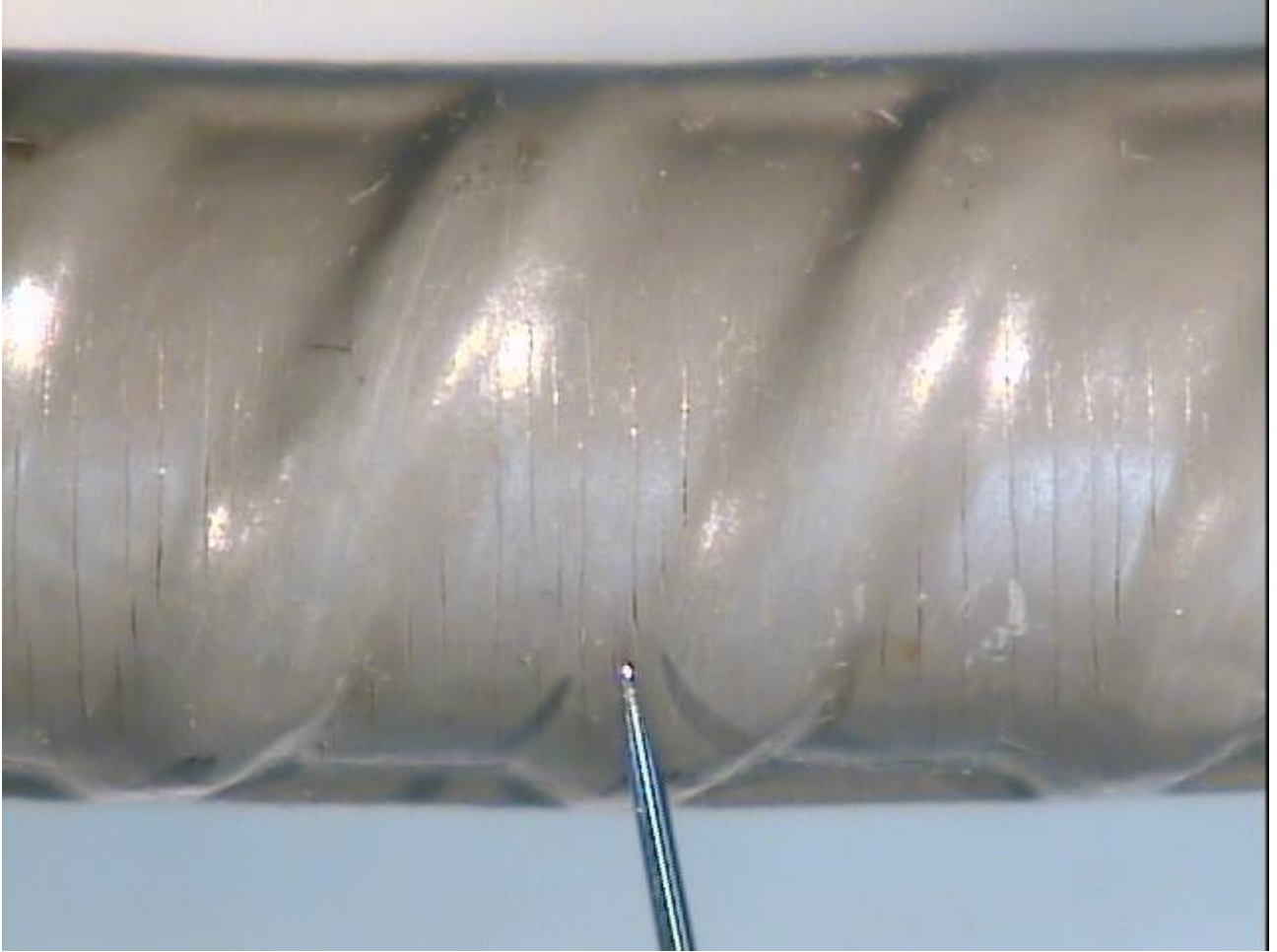


Figure 2. Breaks in the coating after bending that have been identified as coating discontinuities. The discontinuities have a repeated pattern that extends over the entire bend radius. The test bar has failed the bend requirements of this test method.



Figure 3. Test bar showing two of three breaks in the epoxy coating at the outer bend radius of a test bar. The breaks appear to be cracks that expose the underlying metal. Exposed underlying metal can be confirmed, if needed, by viewing with a 10X-magnification device.

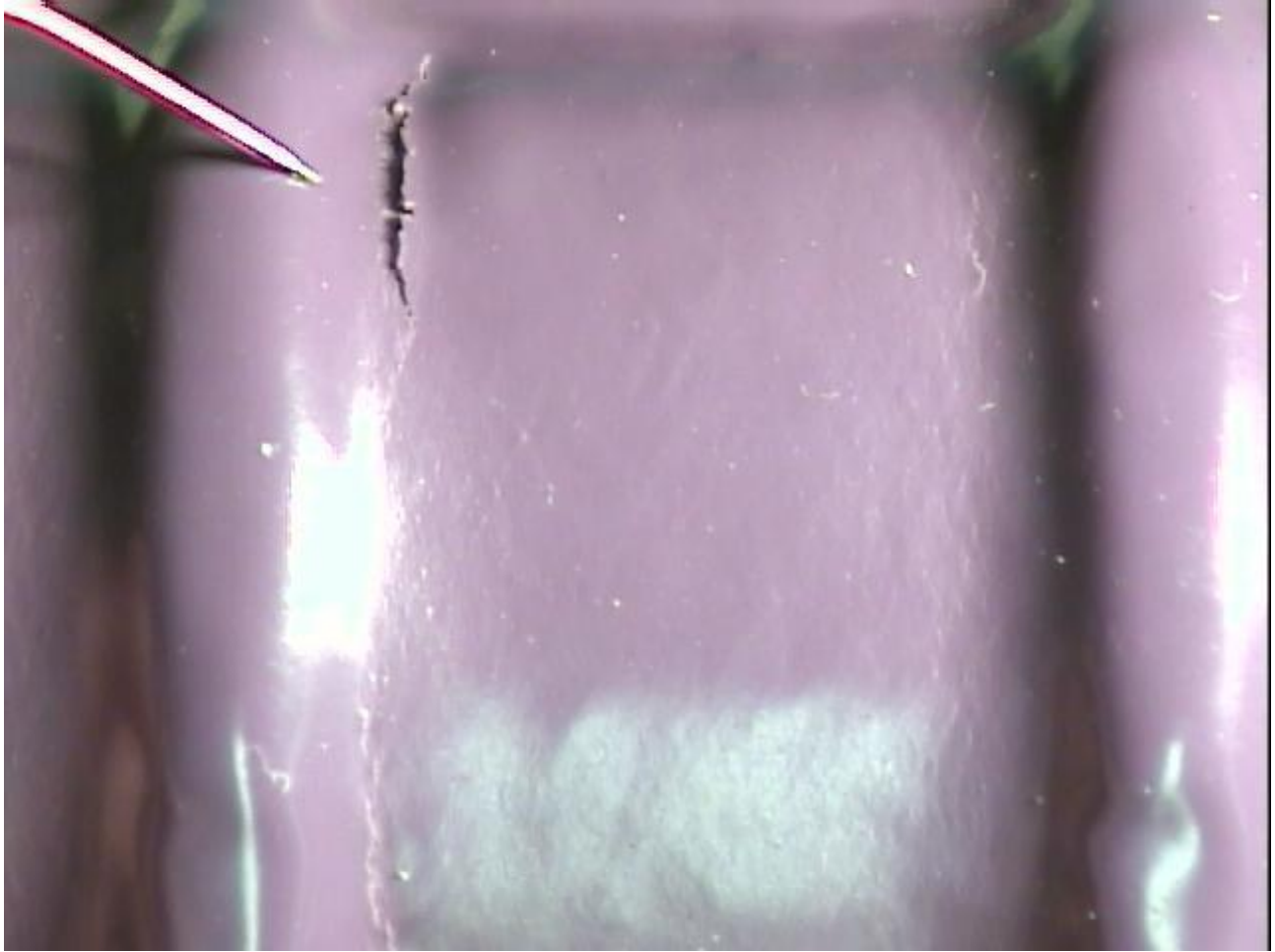


Figure 4. 10X magnification of the test sample from the photograph shown in Figure 3. The magnified view shows that the coating is separated from the bar surface and the underlying metal is exposed. The two other breaks on the test bar sample were also identified as cracks. Since the test bar incurred three cracks after bending, it has failed the bend requirements of this test method.



Figure 5. Test sample showing discoloration in coating after the bend test. This type of discoloration is due to stretching of the coating during bending and is typical. Discoloration of the coating after bending does not constitute a failure of the bend test.

Figure 6. Test Form for Recording Bend Test Results

California Test 686 – Bend Test Results	
	SM No.: <u>04-1601</u>
	TL 101 No.: <u>C6301M2</u>
	Date Received: <u>9/18/04</u>
Standard Specs: 52-1.06	Date Tested: <u>9/21/04</u>
ASTM: A934/A934M	Operator: <u>JASON WU</u>
Bend Test:	Lot No.: <u>B6011</u>
Criterion for passing = less than 3 cracks or 3 coating discontinuities.	Contract No.: <u>14-1321M1</u>
	Epoxy Color: <input checked="" type="checkbox"/> Purple <input type="checkbox"/> Gray
	No. of Bars: <u>4</u>
	Bar ID: <u>57</u>
	Length: <u>4'</u>
	Lot/Load/Release No.: <u>H6236</u>
	No. of Coating Breaks: <u>1</u>
	No. of Coating Breaks that are Cracks: <u>0</u>
	No. of Coating Breaks that are Coating Discontinuities: <u>1</u>
	Is any Stretching Observed? <input type="checkbox"/> Yes (evidenced by discoloration) <input checked="" type="checkbox"/> No
	Results: <input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail

Figure 7. Sample Test Report

State of California
Department of Transportation

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TEST REPORT



Remarks

ref. Standard Specifications (52-1.02B); ASTM A934; TM 07. Heat #SE13101901, SE13101318. Load 99.

Sample No: SM-13-0701

Date Sampled: 06/05/13

Date Rec'd: 06/10/13

Date Reported: 06/13/13

Lot No: B3136513

TL-101 / SIC No: C646189

Contract/Permit No: 02-3E7604

Material: A934 #6/19mm Purple Epoxy Coated Rebar.

Manufacturer: Farwest Steel Reinforcing

Sampler: Dennis Combs

Results: SAMPLE(S) SUBMITTED COMPLY WITH SPECIFICATIONS

Note: Results relate only to the items tested