

Epoxy Coaters of Reinforcing Steel - 21

SCOPE: This chapter provides procedures for being included on the Qualified Manufacturers List (QML) as a producer of epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars for CDOT projects. CDOT will only accept epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars by a Manufacturer on the QML.

1. REFERENCED DOCUMENTS

Where applicable, the latest edition of the following standards shall be considered a part of these requirements.

1.1 CDOT Standard Specifications for Road and Bridge Construction:

- Section 412.13 – Joints
- Section 602 – Reinforcing Steel
- Section 709.01 – Reinforcing Steel
- Section 709.03 – Dowel Bars and Tie Bars

1.2 AASHTO Standards:

- AASHTO M 31 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- AASHTO M 254 – Standard Specification for Corrosion-Resistant Coated Dowel Bars
- AASHTO M 284 – Discontinued
- AASHTO M 317 – Discontinued
- AASHTO R 38 – Standard Practice for Quality Assurance of Standard Manufactured Materials
- AASHTO T 253 – Standard Method of Test for Coated Dowel Bars

1.3 ASTM Standards:

- ASTM A 615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- ASTM A 775 – Standard Specification for Epoxy-Coated Steel Reinforcing Bars
- ASTM D 3665 – Standard Practice for Random Sampling of Construction Material
- ASTM D 3963 – Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars

1.4 Concrete Reinforcing Steel Institute (CRSI): Epoxy Coating Plant Certification Manual

2. TERMINOLOGY

- 2.1 See ASTM A 775 for terminology related to epoxy-coated steel reinforcing bars.
- 2.2 Coated bar – Steel bar with the protective epoxy coating applied by the electrostatic spray method.
- 2.3 Contractor – The Company under contract with CDOT to produce products using epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars.
- 2.4 Deformed bar – Steel bar with protrusions; a bar that is intended for use as reinforcement in reinforced-concrete construction.
- 2.5 Fabricator – The Company, which cuts and bends steel reinforcing bars either coated or uncoated and/or assembles dowel bar baskets.
- 2.6 Manufacturer – The Company, which produces epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars. Each epoxy-coated applicator plant constitutes a separate company.
- 2.7 Plain bar – Steel bar without protrusions; a bar that is intended for use as a dowel bar in transverse joints of concrete pavement construction.
- 2.8 Supplier – In this chapter, it shall be defined as one who provides materials used in the manufacturing of epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars. Uncoated steel reinforcing bars, uncoated dowel bars, and powder coating are among the materials provided to the Manufacturer.
- 2.9 Uncoated bar – Steel bar without protective epoxy coating.
- 2.10 Quality System Manual (QSM) – A written document that describes the overall internal quality control operating procedures of a Manufacturer. The QSM documents the internal policies for achieving quality and the assignment of responsibility and accountability for quality control within the Manufacturer's organization. It shall describe the minimum quality control requirements expected of material suppliers who are involved with the Manufacturer's product.

3. SIGNIFICANCE AND USE

- 3.1 This Standard specifies requirements that should be followed by the Manufacturer in implementing an effective Quality Control (QC) system. This is accomplished by a certification system that evaluates quality control practices and specification compliance tests performed by the Manufacturer according to their quality control plans.
- 3.2 This Standard specifies requirements and procedures for a certification system that shall apply to all Manufacturers providing epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars. These provisions apply to the plant manufacturing the epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars.

- 3.2.1 This Standard covers the responsibilities of the Manufacturer from point of delivery of uncoated deformed or plain bars at the applicator plant to point of delivery on the construction project site and/or Fabricator plant.
- 3.3 This Standard applies to Fabricators that use epoxy-coated bars. The Fabricator shall conform to the requirements of ASTM D 3963 for the fabrication of bars and dowel bar assemblies after the application of the epoxy coating.
 - 3.3.1 This Standard covers the responsibilities of the Fabricator from point of delivery of epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars at the Fabricator's plant to point of delivery on the construction project site.
 - 3.3.2 This Standard covers the responsibilities of the Fabricator from point of delivery of uncoated bars to point of delivery of the Manufacturers's application site.
 - 3.3.3 This Standard subsequently covers epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars for use on CDOT projects. The Contractor shall conform to the requirements of ASTM D 3963 for job site handling of epoxy-coated bars.

4. SAMPLING

- 4.1 All number and frequency of test samples required by this Standard shall be per ASTM A775 (as a minimum) and the enhanced Manufacturer QC program. It is expected the QC tests are to be tied to critical production processes as well as to the final product.

Note 1: ASTM A 775 specifies the number and frequency of tests for coating thickness, continuity, flexibility, and adhesion. For example, an enhanced Manufacturer QC program that exceeds the minimum outlined in ASTM A 775 would document the method of determination of an additional randomly selected bar to test the bar surface temperature before applying the coating.

- 4.2 In addition, the QC program required by this Standard shall use stratified random sampling techniques. Stratified random sampling should be performed per ASTM D 3665. The use of a stratified random sampling procedure is mandatory to the establishment of a valid QC program. All random QC sample locations shall be properly documented.

Note 2: Determination of random locations (or timing) is universally applied to a construction site or a Manufacturer's production line. ASTM D 3665 covers a flowing stream of material that can be applied to the production line of epoxy-coated bars.

5. TESTING REQUIREMENTS

- 5.1 An internal designated testing location and/or facility of a Manufacturer that performs the required testing under this Standard shall be identified in the submitted Quality System Manual (QSM) (Section 9).
- 5.2 Testing required for this Standard shall be performed by qualified Manufacturers personnel through appropriate QC programs or appropriate training programs.

5.3 As a minimum, the Manufacturers programs used shall include the following;

5.3.1 Training in AASHTO, ASTM, or CRSI test procedures.

5.3.2 Demonstration of proficiency in each Manufactures's QC test.

5.3.3 Demonstration of ability to properly document Manufactures QC test results.

5.3.4 Demonstrate the ability to interpret all the test results.

6. SUPPLIER REQUIREMENTS

6.1 Uncoated bar Suppliers shall be on CDOT's Qualified Manufacturers List (QML) before use by the Manufacturer. The QML can be found at the following web address:

<https://www.codot.gov/business/apl>

6.2 Uncoated bar Suppliers shall follow the procedures described in the CDOT approved quality control plan as required in CP 11-6.

6.3 The uncoated bar Supplier shall provide an annual certification that all steel products delivered to the Manufacturer and permanently incorporated in the work shall have occurred in the United States of America.

6.4 Suppliers of epoxy powder shall be on CDOT's Approved Product List (APL). The APL along with instruction for completing CDOT Form 595, Pre-Approved Product Evaluation Request & Summary, can be found at the web address: <https://www.codot.gov/business/apl>

7. CURRENTLY CERTIFIED MANUFACTURERS

7.1 A Manufacturer, which has been certified for the past three consecutive years under the Concrete Reinforcing Steel Institute (CRSI) certification plant program, will be placed on CDOT's QML after submitting all of the following:

- The certificate from the current year and the preceding three consecutive years of evaluations from CRSI,
- The inspection report from the current year and the preceding three consecutive years of evaluations from CRSI,
- The Quality System Manual as outlined in Section 9 of this Standard.
- 7.2 A Manufacturer, which has been certified for less than three consecutive years under the CRSI certification plant program will be on probation and placed on the QML after submitting all of the following:
 - The certificate from the current year along with any preceding years of evaluations from CRSI,
 - The inspection report from the current year along with any preceding years of evaluations from CRSI,
 - The Quality System Manual as outlined in Section 9 of this Standard.

7.2.1 The probation period will be for three consecutive years after being placed on the QML.

8. DECERTIFICATION

- 8.1 This section applies to Manufacturers that are classified under Subsection 7.1. If the Manufacturer becomes decertified by the CRSI certification plant program after being placed on the QML, the Manufacturer will be removed from the QML until completing and submitting to CDOT the requirements within this Standard. Decertification is the final ruling after the CRSI dispute process has been completed. The Manufacturer may apply for reinstatement on the QML no sooner than six months after removal from the QML. The probationary period will be for one year after being placed back on the QML with Subsections 7.2, 8.2, and 8.3 of this Standard being applied.
- 8.2 This section applies to Manufacturers that are classified under Subsection 7.2. If the Manufacturer becomes decertified by the CRSI certification plant program after being placed on the QML, the Manufacturer will be removed from the QML until completing and submitting to CDOT the requirements within this Standard. The Manufacturer may apply for reinstatement on the QML no sooner than three years after removal from the QML.
- 8.3 CDOT may decertify the Manufacturer when conditions exist as specified in Section 5 - Decertification within the Introduction of the CP 11 Page 2.

Note 3: The terms Supplier and Manufacturer are interchangeable when reading Section 5 – Decertification from page 2.

9. MANUFACTURER'S QUALITY SYSTEM MANUAL (MINIMUM REQUIREMENTS)

- 9.1 On an annual basis, at a minimum of two months before producing epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars for a CDOT project, one electronic copy of the Manufacturer's Quality System Manual (QSM) and a copy of the QSM Checklist shall be submitted for review and approval to CDOT's Product Evaluation Coordinator (303) 398-6566 within the Staff Materials & Geotechnical Branch at 4670 North Holly Street, Unit A, Denver, Colorado 80216-6408. In place of a hard copy QSM, a PDF digital format document may be submitted. The PDF manual submittal must be complete and whole. CDOT's approval of the QSM is intended only to indicate that the QSM is in conformance with the minimum QC requirements outlined in this Standard. Once the Manufacturer is approved and on the Qualified Manufacturers List (QML), the QSM provisions will remain in effect for one year, unless revisions are determined to be necessary by the Quality Control Manager or requested by CDOT, or if the Manufacturer is decertified. If any changes are made to the QSM, an updated copy shall be submitted to CDOT for review and approval. In place of a full updated copy, submittals of updates are acceptable. Updates shall be in the same format as the manual and are to be inserted into the manual to replace outdated pages. The updates may be in PDF digital format. The updated pages will have the date of update issuance and are to be recorded in a table of revisions. Guidelines for preparing a QSM may be available from the Concrete Reinforcing Steel Institute (CRSI). Guidelines are also documented in AASHTO R 38.

- 9.2 The Manufacturer's QSM shall include the latest edition of the CRSI Plant Certification Manual.
- 9.3 The Manufacturer's QSM may be maintained in electronic format. However, one or more copies of the QSM shall be maintained by the Manufacturer's QC Manager in a printed and bound format (3-ring or other). The QSM shall be available to all of the Manufacturer's employees. Each document in the QSM shall indicate its preparation date and all pages of the QSM shall be numbered. If a document is revised, the date of revision shall be indicated on the document and recorded in a table of revisions.
- 9.4 The Manufacturer's QSM shall be formatted to provide numbered sections that meet the following order, format, and content:
- 9.4.1 Manufacturer's quality policy or mission Statement endorsed by the company's Chief Executive Officer.
- 9.4.1.1 The quality policy/mission statement shall indicate the support of top management to enforce the QC requirements contained in the QSM.
- 9.4.2 The QSM shall include the address and telephone numbers of applicable personnel at the manufacturing facility. If applicable, the QSM shall include the address and telephone numbers of responsible personnel of the Fabricators.
- 9.4.3 The QSM shall include a brief listing and description of all the epoxy-coated deformed and plain bars being manufactured at the facility.
- 9.4.4 The QSM shall present and define any significant terms used throughout the QSM.
- 9.4.5 For all manufactured items addressed in the QSM, the applicable AASHTO, ASTM, or CDOT specifications shall be identified.
- 9.4.6 The QSM shall present the personnel structure established to implement the Manufacturer's quality system. The specific roles and responsibilities of all QC personnel shall be documented as follows:
- 9.4.6.1 The QSM shall contain an organizational chart. The chart shall indicate a clear separation between the QC personnel and the production personnel. The QC Manager shall be allowed direct access to top management, independent from production. The names of personnel shall be placed on the chart.
- 9.4.6.2 Each facility shall have a Quality Control Manager who has the overall responsibility for implementing the requirements of the QSM. The QC Manager shall review the established QC system annually to satisfy this requirement, or if changes in the manufacturing process(s) occur, or whenever technical or CDOT information indicate a trend in reduced quality.

- 9.4.6.3 Each facility shall have at least one Quality Control Technician to perform QC sampling, testing, and inspection. At least one QC Technician shall be on-site during production. The QC Technicians shall be familiar with the tests they perform and have sufficient authority to assure corrective actions are carried out when necessary. The QSM shall indicate the line of authority of the QC Technicians, which shall demonstrate their authority to require corrective action. The QSM shall designate the QC Technicians at the facility and laboratory involved in the production or testing of the epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars.
- 9.5 The QSM shall contain a description of the qualifications required and attained, and years of experience for each QC Manager and QC Technician. All QC sampling, testing, and inspection personnel shall be trained. Plants certified by CRSI shall have at least one QC Manager and at least one QC Technician who is capable of performing and correctly interpreting all the tests required by the CRSI Plant Certification Manual. The QSM shall also include periodic auditing of each QC Technician's ability to satisfactorily perform the required tests. Retraining shall be provided when the test method is revised.
- 9.6 The QSM shall provide specific training for frontline production personnel in the safe and correct operating procedures implemented to ensure the required quality of all epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars.
- 9.7 The Manufacturer shall maintain its own qualified internal designated testing location and/or facility to perform QC testing. The Manufacturer shall provide backup QC testing personnel and any necessary backup laboratory equipment. The QSM shall include the address and telephone numbers of designated backup personnel. The Manufacturer's internal designated testing location and/or facility shall meet the minimum accreditations or qualifications obtained through one or more of the following programs:
- 9.7.1 The manufacturing industry's Concrete Reinforcing Steel Institute Certification Plant Program.
- 9.7.2 National accreditation programs such as AASHTO Accreditation Program or American Association for Laboratory Accreditation.
- 9.8 The QSM shall contain an inventory of the necessary equipment used for sampling and testing along with associated calibration equipment used for each required test procedure. The QSM shall assign a unique identification number to each piece of testing equipment. The QSM inventory for each necessary piece of equipment shall include the following information:
- 9.8.1 The name of each necessary piece of equipment, date placed in service, Manufacturer, model, and serial number. The QSM shall include the location where the instructions for use and operation of each necessary piece are stored if not included in the QSM.

- 9.8.1.1 For each necessary piece of equipment, the QSM shall include the interval of calibration or verification, a reference to the calibration or verification procedures used, and the location where the current calibration or verification records are stored. The QSM shall describe the methods of calibration and verification procedures that are performed at the specified intervals.
- 9.9 The QSM shall identify all types of Supplier delivered materials used for the production of epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars.
 - 9.9.1 The QSM shall contain a copy of the signed certification from the steel Supplier that all steel products permanently incorporated into the manufactured product shall have occurred in the United States of America.
 - 9.9.2 The QSM shall contain a description of the specification requirements for all Supplier delivered materials.
 - 9.9.3 The QSM shall contain a description of the certification and test reports delivered by the Supplier and a location where these records are stored.
 - 9.9.4 The QSM shall include all QC testing of the supplied materials and shall contain a statement that no raw materials shall be used unless they are on the APL or they have been tested and meet all appropriate CDOT, AASHTO, or ASTM specifications.
 - 9.9.5 All Supplier delivered materials shall be properly stored to prevent damage, contamination, or other alterations before use in production. The QSM shall include procedures for the adequate storage of supplied materials.
- 9.10 The QSM shall describe the procedure and frequency for inspection and selection of material samples during production. Sampling shall be performed on a stratified random procedure per ASTM D 3665. All random QC sample locations shall be properly documented and these procedures shall be included in the QSM.
- 9.11 The QSM shall contain descriptions and examples of the test report forms used by the Manufacturer. The QSM shall identify the individual(s) responsible for maintaining all test records and reports along with the location where the reports are stored.
 - 9.11.1 The test reports shall be maintained and available for inspection for a minimum of three years.
- 9.12 The QSM shall contain a description of the procedures used to identify and document all material or test results that do not conform to specification requirements. The QSM shall contain provisions for resolving non-conforming material or test results.
- 9.13 The QSM shall describe procedures used to properly handle, store, and ship epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars.

10. CDOT EVALUATION PROCEDURE

- 10.1 Manufacturing facilities producing epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars shall meet the minimum industry standards, and be annually inspected and certified by CRSI. A copy of the certification shall be submitted to CDOT as part of the QML process.
- 10.2 Initially the Manufacturer shall submit a representative sample of epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars, test result documentation, and an electronic copy of the QSM to CDOT's Product Evaluation Coordinator (303) 398-6566 within the Staff Materials & Geotechnical Branch at 4670 North Holly Street, Unit A, Denver, Colorado 80216-6408.
 - 10.2.1 A representative sample of epoxy-coated steel reinforcing bar at least 3 feet in length and an epoxy-coated steel dowel bar 18 inches long shall be shipped.
 - 10.2.2 The results of all applicable chemical and/or physical tests required by ASTM A 775 on the most recent 20 samples tested. The results shall be submitted in the format outlined in ASTM A 775 and as documented in the Manufacturer's QSM.
 - 10.2.3 One electronic copy of the Manufacturer's Quality System Manual shall be submitted.
- 10.3 CDOT will verify that the Manufacturer's QSM is adequate.
- 10.4 Within two months after submitting all required information, CDOT will notify the Manufacturer whether or not the manufacturing facility's application for the Qualified Manufacturers List has been granted.
- 10.5 CDOT may perform split sample testing per Section 11.
- 10.6 CDOT may perform quality assurance testing.
- 10.7 CDOT may visit the Manufacturer's site when required. CDOT may inspect the operations of the Manufacturer's facility including those related to shipments if required.
- 10.8 CDOT will post the Manufacturer's name and approved plant on CDOT's Qualified Manufacturers List on the CDOT website: <https://www.codot.gov/business/apl>
- 10.9 Failure in one or more Sections or Sub-sections listed in this Standard may result in an accelerated inspection program. Any additional failures to meet these minimum requirements shall result in the decertification of the plant and the plant will be removed from the QML. The Manufacturer may apply for reinstatement on the QML no sooner than stipulated in Section 8 of this Standard.

11. SPLIT SAMPLE TESTING

- 11.1 CDOT may request split sample testing. A split sample is a sample taken and evenly divided to be tested by two or more individuals or laboratories. The test results will be exchanged as soon as they are available.
- 11.2 If the split sample test data is not within the agreed to precision for that particular test a review of both sampling and testing procedures will be conducted by both the Manufacturer and CDOT.

12. REQUIREMENTS FOR SHIPPING EPOXY-COATED STEEL REINFORCING BARS AND EPOXY-COATED STEEL DOWEL BARS BY AN APPROVED MANUFACTURER

- 12.1 The epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars Manufacturer's QSM as approved by CDOT shall be implemented.
- 12.2 Each shipment shall be accompanied by two copies of the bill of lading, which shall include:
- 12.2.1 The name and location of the epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars Manufacturer and the plant producing the epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars,
- 12.2.2 The size and grade of epoxy-coated steel reinforcing bars and epoxy-coated steel dowel bars conforming to CDOT specification,
- 12.2.3 Certifications for the powder coating,
- 12.2.4 The quantity of material shipped,
- 12.2.5 The date of shipment,
- 12.2.6 A copy of the mill test reports.
- 12.3 If the specification compliance test results do not conform to Subsection 709.01 and 709.03 specifications, the Manufacturer shall remove the non-compliant material from the shipping queue.

13. FABRICATION AND JOBSITE HANDLING

- 13.1 The coated bars to be fabricated by the Fabricator or field fabricated by the Contractor after application of the coating shall meet the following:
 - 13.1.1 Contact points, such as drive rollers, shear contacts, mandrels, and backup barrels on benders shall be protected with a suitable covering to minimize damage during the fabrication process.
 - 13.1.2 The Fabricator shall be responsible for repair to the coating due to damage during shipment, storage, or fabrication at the Fabricator's facility.
 - 13.1.3 The Contractor shall be responsible for repair to the coating due to damage during shipment, storage, fabrication, or placement at the construction Jobsite.
- 13.2 Coating damaged due to fabrication or handling shall be repaired with patching material. The patching or repairing shall be performed following the written recommendations of the patching material Supplier.
- 13.3 Patching or repair material shall be compatible with the coating, inert in concrete, and feasible for repairs. The patching or repair material shall conform to ASTM D 3963.

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