EPOXY-COATED STEEL REINFORCEMENT

GENERAL

Acceptance of epoxy-coated steel reinforcement (Article 4151.03B) will be on the basis of certification from an approved manufacturer of steel reinforcement, an approved coater, and an approved distributor or supplier of steel reinforced products subject to the testing of the acceptance and verification samples secured at destination as outlined herein. Approval to furnish epoxy-coated steel on a certification basis may be withdrawn for deficient test results on verification samples or inadequate documentation or identification of materials. Approved coaters are listed in Appendix A of this IM and approved suppliers are listed in Appendix B of IM 451. Approved manufacturers of reinforcing steel are listed in Appendix D of IM 451. Approved epoxy powders are listed in Appendix B of this IM.

All reinforcement (deformed and plain) required to be epoxy-coated shall have a protective coating of epoxy applied by the electrostatic spray method in accordance with the requirements of ASTM A775/A775M, except as outlined in this IM. Fabrication, acceptance, and job site handling of epoxy-coated reinforcing steel bars shall be in accordance with the requirements of ASTM D3963/D3963M and IM 451.03B.

All steel reinforcement shall be melted and manufactured in the USA. Epoxy Coating Plants shall be certified by the Concrete Reinforcing Steel Institute (CRSI) for Fusion-Bonded Epoxy Coating Application. Approved coaters shall submit a complete copy of the annual CRSI inspection report to the Materials Office of the Iowa Department of Transportation for continual approval.

ACCEPTANCE REQUIREMENTS

A. QUALITY CONTROL

The coating plant shall maintain an updated Quality Control Manual. The coating plant shall also have a trained designated Quality Control Inspector, as well as trained personnel to serve as back-up inspectors for every production shift. Inspection and testing shall be performed in a timely manner during each production shift.

The Plant is responsible to maintain a record of Quality Control monitoring and testing, and document Quality Control meetings and training with personnel.

B. SURFACE PREPARATION

Reinforcing steel surfaces to be coated shall receive a thorough blast cleaning to near-white metal in accordance with SSPC SP10. Mill scale, rust and foreign matter shall be completely removed. The blasting media shall produce a suitable anchor pattern profile. A minimum profile depth of 2.0 mils to a maximum depth of 4.0 mils (50 µm to 100 µm) shall be considered suitable as an anchor pattern. Coating shall be applied to a cleaned surface soon thereafter. In no case shall the coating be delayed more than 0.5 hr. after cleaning.

The abrasive blasting media shall be inspected for contamination every production shift and a sieve analysis shall be performed at a minimum of twice per week.

Additional blast media containing sufficient grit shall be required if a suitable anchor pattern and/or profile depth has not been achieved. A maximum of 10% steel shot may be added to the blast media.

C. COATING THICKNESS

- The coating thickness measurements after curing shall be 7 to 12 mils (175 to 300µm) for bar sizes No. 3 to 5 (10 to 16).
- The coating thickness measurements after curing shall be 7 to 16 mils (175 to 400µm) for bar sizes No. 6 to 18 (19 to 57).
- Coating thickness measurements shall not be less than the specified minimum thickness or more than the specified maximum thickness.
- A single recorded epoxy coating thickness measurement shall be the average of three individual gage readings obtained between four consecutive deformations. A minimum of five recorded measurements shall be taken approximately evenly spaced along each side of the test bar (a minimum of 10 measurements per bar).
- Note: All individual gage readings shall be reported along with the averages.
- Note: The upper thickness limit shall not apply to repaired areas of damaged coating.
- Test for coating thickness shall be made on a minimum of two bars every two production hours, or whenever bar size changes.

D. COATING CONTINUITY (HOLIDAYS)

Coating continuity shall be monitored by:

- An In-Line Holiday detector
- A Hand-held Holiday detector (wet sponge type)

Hand-held Holiday detection checks shall be performed at a minimum rate of once per shift. The accuracy of the In-Line System shall be compared to the accuracy of the Hand-held detector at all times. There should be fairly close correlation between the Hand-held and In-Line Holiday counts. Only 1 Holiday per 1.0 linear foot (3 Holidays per meter) shall be allowed over the length of the coated bar.

E. COATING FLEXIBILITY

A bend test shall be performed to evaluate the flexibility of the coating. Coated bars shall be

tested at a uniform rate, a minimum of one bar of each size every four production hours around a mandrel of a specified size within a maximum specified time period. (See Table 1, ASTM A775/AA775M.) No cracking or disbonding of the coating shall be visible on the outside radius of the bent bar. Evidence of cracking or disbonding of the coating shall be considered a cause for rejection. The test bars shall be between 68˚F and 86˚F (20˚C and 30˚C) when tested.

F. POWDER STORAGE

Epoxy Powder shall be stored in a suitable temperature and humidity controlled environment within the epoxy powder manufacturer's specified limit. The powder storage area shall be equipped with a recording gauge and an alarm system.

The powder shall be kept dry at all time. The Epoxy powder shall be used within the manufacturer's recommended shelf life. Epoxy powder that has exceeded the manufacturer's "Use-By" date shall not be used.

G. STORAGE AND HANDLING OF COATED BARS

All systems for handling epoxy coated steel bars shall be padded. All bundling bands shall be suitable banding to prevent damage to coating. All bundles of epoxy coated steel bars shall be carefully lifted to prevent bar-to-bar abrasion, sagging of bars, and/or damage to coating.

Long-term storage (greater than two months) of bars shall be minimized at the fabricator and at the job site. Coated steel reinforcing bars shall be stored off the ground on protective cribbing, and/or on padded support with padded timbers placed between bundles when stacking is necessary. Sufficient supports shall be spaced evenly to prevent sags in the bundles during storage.

Epoxy coated steel reinforcing bars stored outdoors longer than two months either at the fabricator or at the project site shall be protected from sunlight, salt spray and weather exposure. The coated bars shall be covered with a non-transparent material, or other suitable opaque protective material. Provisions shall be made for adequate ventilation to minimize condensation. The date on which the coated bars are placed outdoors shall be recorded on the identification tag of the bundled steel. Weathered (discolored) bars shall be rejected.

If coated bars have been stored outside at the coater for a period of six months or longer from the date of coating, the coater shall inspect, sample, and retest the bars prior to shipment to a warehouse or project site. If coated bars have been stored indoors at the coater for a period of one year or longer from the date of coating, the coater shall inspect, sample and retest the bars prior to shipment to a warehouse or project site. Bars shall be retested for coating thickness and flexibility (bend test). A copy of the test results shall be attached to original coating report.

Epoxy coated bars that have been stored at the project site for a period of six months or longer from the date of coating may be inspected, sampled, and retested prior to use at the discretion of the District Materials Engineer.

NOTE: Coated and uncoated steel reinforcing bars shall be stored separately.

Epoxy coated tie wires and bar supports shall be used with epoxy coated reinforcentment to prevent damage to the coating.

H. COATING REPAIR MATERIAL

- The patching or repair materials shall be compatible with the coating as required per ASTM D3963/D3963M and Appendix B of this IM.
- Sheared ends and / or saw cut ends of coated reinforcing bars shall have adequate coating, have no signs of surface rust or damage, and shall be coated and / or repaired with approved patch / repair material listed in Appendix B.
- Repaired / Patched areas shall be allowed to cure (dry to touch) before concrete placement over the coated bars.
- Surface preparation, repair, and patching application procedures shall be in accordance with the powder manufacturer's recommendations.

REJECTION

Coated bars that do not meet the requirements of this IM, ASTM A775/A775M, ASTM D3963/D3963M, and the requirements of IM 451.03B and Specification 4151.03 shall be rejected. Rejected bars shall be marked with contrasting color paint or other suitable identification and stored separately.

COATER APPROVAL

Each coater shall be approved prior to bidding on projects. The coater shall provide the Central Materials Office a written application to become an approved coater of reinforcing steel. This application shall include the following:

1. Sources of steel that would be handled by the company and supplied to Iowa DOT projects.
2. Quality control procedures that the company has established to ensure material identity (as to heat numbers and inventory control) from the time the material arrives from a mill or a source, through the coating and fabricating process, and shipment.
3. Coating quality procedures to ensure the coated steel complies with Iowa DOT Specifications. This shall include the following:

    a. Names of quality control personnel.

b. Quality control testing conducted during the bar cleaning operation.
c. Quality control testing conducted on the epoxy coating after coating.

4. Sample three epoxy-coated bars of every size that the coater plans to coat. These samples will be called Process Approval Samples. The bars shall be approximately 6 ft. (2 m) in length. Samples are to be secured by the District Materials Engineer for the source approval.

5. An example of certification documents that the company will furnish for Iowa DOT projects.

6. Plant must be CRSI certified. Copies of the last three CRSI inspection reports must be submitted for review and evaluation.

Upon satisfactory review of this application, satisfactory test results and satisfactory inspection of the facilities for compliance with quality control procedures, the company may be placed on the approved list, Appendix A.

POWDER APPROVAL

Prior to furnishing epoxy powder to coaters for Iowa DOT projects, the powder manufacturer shall submit the following:

1. A written application by the company to become an approved powder manufacturer shall be submitted to the Central Materials Office in Ames, Iowa.

2. Product information, specifications, and recommended application procedures, including minimum gel and cure time

3. A fingerprint sample of the powder, product name and number, and manufacturer name.

4. Prequalification shall be in accordance with ASTM D3963/D3963M and ASTM A775/A775M.

5. A 100 gm (3.5 oz.) sample shall accompany the application.

Upon satisfactory review of this application and a satisfactory trial run in an approved coating plant, the company will be placed on the approved list in Appendix B. Continued approval will be based on satisfactory test results of monitor samples secured at the coating plant.

ACCEPTANCE PROCEDURES

Epoxy-coated steel will be accepted on a certification basis. The coating plant shall furnish an identification list, invoice, or bill of materials for each shipment to a project. It shall show the project and design number, the size, length, grade, heat number and number and weight of pieces in the shipment, a copy of Mill certificates from the black steel manufacturer, a copy of epoxy powder certificates, and epoxy coating test certificates. It shall also contain a certification

stating that the attached Mill Certifications and epoxy-coating certifications are applicable to the material.

The Mill Certifications for black steel, which are to be attached as directed above, shall state the chemical, physical, and mechanical tests reported and the ASTM designation, type, grade, heat number, and source for all heats represented in the shipment.

The epoxy-coating certifications, which are to be attached as directed above, shall provide the powder certifications, lot numbers and the quality control test results for coating thickness, coating continuity, and coating flexibility for all coating lots represented in the shipment.

Coating plants that have been approved on a project-by-project basis shall supply all necessary documentation for each shipment as described above. A random acceptance sample, 6 ft. (2m) of any size bar in the shipment, shall be secured and tested for coating thickness and flexibility (bend test) prior to incorporation into the project. **NOTE:** The location of the sample within a bar shall be at least 3 ft. (1m) from the ends of the bar.

One copy of the documents prescribed above shall accompany each shipment and be retained in the Project Engineer file. Two copies shall be forwarded, at the time of shipment, one to the Central Materials Office in Ames, Iowa, and one to the District Materials Office responsible for project administration.

VERIFICATION SAMPLING & TESTING

Personnel from the District Materials Office shall secure a random field verification sample 6 ft. (2 m) of any size bar in the project. The location of the sample within a bar shall be at least 3 ft. (1 m) from the ends of the bar.

NOTE: Coated bars that have been stored at the project site that have shown any amount of rust (trace, moderate or heavy) shall not be sampled and shall not be accepted; and shall be considered grounds for rejection.

Two additional samples of the same size shall be secured if the first sample indicates non-compliance. Non-compliance may be considered a cause for rejection. If a bar size in a shipment is rejected, a similar sampling procedure shall be applied to the remaining bar sizes in the shipment.

Bridge Decks

The verification sample and acceptance sample will be the same sample. The District Materials Office will randomly sample any bar size of the epoxy coated steel for the deck. If the sample fails, two additional random samples of the same size shall be secured. Noncompliance on any one of the additional samples shall be cause for rejection of that particular size in the shipment.

If a bar size in a shipment is rejected, a similar sampling procedure shall be applied to the remaining bar sizes in the shipment.

The contractor shall not place concrete on the deck until there are passing test results of the epoxy-coated steel.

Samples of epoxy-coated steel reinforcement for all other applications (other than bridge decks) shall be limited to a project quantity of 5 tons (5 Mg) or over.

Pavement Tie Bars

Epoxy-coated pavement tie bars shall be accepted on the same basis as dowel bars in accordance with Appendix C of this IM.

STEEL FROM WAREHOUSE SUPPLY

The District Materials Engineer shall sample epoxy-coated reinforcing steel, which is shipped to a fabricator or contractor for use on several projects, at the above-indicated rates.

Certification

Each coating plant shall furnish at the time of shipment, written certification that samples representing each lot of coated steel reinforcing bars have been either tested or inspected as specified and that the coating requirements have been met. A report of the test results shall be furnished on a regular basis.