

Guidelines for Inspection and Acceptance of **EPOXY-COATED REINFORCING STEEL** at the Jobsite

Inspection of epoxy-coated reinforcing steel prior to concrete placement is critical to ensure that optimum corrosion protection is provided to the structure. Particularly, repair of coating damage on the reinforcement prior to concrete placement and use of plastic headed vibrators should be addressed. This document contains information on the inspection of epoxy-coated reinforcing steel and should be used to supplement state or other agency requirements for epoxy-coated reinforcement.

INTRODUCTION

Epoxy-coated reinforcing steel is specified almost anywhere corrosion is a concern. While the product is most commonly used on bridges to protect against deicing salts, it can also be used in continuous reinforced concrete pavement, parking garages, piers and docks, water towers, columns and parapets. Inspection of epoxy-coated reinforcement prior to placement plays a critical part in ensuring that long-term durability of the structure is obtained.

This document is provided to guide the inspector as to items that should be considered during an inspection process. It does not eliminate requirements for inspectors to determine compliance with appropriate contract documents.

PRODUCT

Epoxy-coated reinforcing bars are typically specified according to ASTM A775 or ASTM A934 while epoxy-coated welded wire reinforcement is specified according to ASTM A884. These standards are frequently updated and these materials are generally supplied according to the latest ASTM revision. In contract documents, the year of publication should be noted.

Some agencies require all epoxy-coated steel to be provided by plants that are certified by CRSI under their voluntary plant certification program. **Updated information on certified plants may be found at www.crsi.org.**

Epoxy coatings used for ASTM A775 are typically green, while coatings for ASTM A934 are typically purple or grey. Only reinforcing bars made using the green colored coating meeting ASTM A775 should be bent after coating.

Reinforcing steel used for coated bars generally meets either ASTM A615 or ASTM A706. These may be identified using mill marks of "S" or "W," respectively. Bars meeting both specifications are marked with "S" and "W". Manufacturers of bars are identified using mill marks.



Reinforcing bars meeting ASTM A615 may be ordered with the following Grades 40, 60, 75 or 80. Bars meeting ASTM A706 may be ordered as Grade 60 or 80. These numbers also represent the minimum yield strength measured in ksi.

Most commonly, 60 ksi reinforcing bars are used and this is normally identified by either the number 60 or a single longitudinal grade line along the bar. Grade 40 bars do not have any additional grade markings or lines. For Grade 75 and 80 bars, markings include either the number 75 or 80 or two or three lines, respectively.

Bars are often described in contracts, plans and by contractors with a single number for bars that are less than 1 inch in diameter which describes their nominal diameter (i.e. #5 bar for 5/8 inch diameter bar).

Welded wire reinforcement to be epoxy-coated may meet ASTM A1064. Within ASTM A884, Type 1 coatings meet Annex A1 of ASTM A775 while Type 2 coatings meet requirements of ASTM A934.

Documentation should be available that tracks product from mill to delivery on the jobsite.






TRANSPORT AND HANDLING

Just like any material used on a jobsite, appropriate handling of epoxy-coated reinforcing steel is required. These steps are aimed at reducing damage to the coating that would reduce its corrosion protection performance.

Handling and storage requirements for epoxy-coated reinforcing steel may be included in contract documents by reference to many different sources including ASTM A775, A934, A884, D3963, ACI 301 or within individual agency specifications. The following provides a guide to these specifications:

- Bars should be lifted using a spreader bar or strong-back with multiple pick-up points to minimize sag. During sagging, steel may rub on each other, causing coating damage.
 - At no time should coated steel be dragged.
 - Nylon or padded slings should be used and at no time should bare chains or cables be permitted.
 - Steel should be unloaded as close as possible to the point of concrete placement to minimize rehandling.
 - Bundles of steel should be stored on suitable material, such as timber cribbing. At no time should steel be stored directly on the ground.
 - If the steel are to be exposed outdoors for more than 30 days, they should be covered with a suitable opaque material that minimizes condensation.
 - Coated and uncoated steel should be stored separately.
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BAR PLACEMENT INTO FORMS

In order to protect bars from oil contamination, forms should be oiled prior to placement of the reinforcing bars. Bars should not be dragged or placed directly on the forms as this may result in oil contamination of the bar surface.

Bars should be placed on supports coated with non-conductive material, such as epoxy or plastic bar supports, and these should meet Class 1A, as defined in the *CRSI Manual of Standard Practice*.

Bars should be tied using coated tie wire. This wire is typically 16.5 gauge

or heavier and black annealed. When used with epoxy-coated reinforcing bars it is typically coated with PVC.

Coated bars may be cut using power shears or chop saws and cut ends should be repaired using a two-part epoxy. Bars must not be flame cut.

Bars may only be bent at the jobsite with the permission of the engineer responsible for the particular project and this should be documented. If bending is to be conducted it must be conducted at ambient temperatures.



BAR DAMAGE

If the epoxy-coated reinforcing bar has more than 2% of its area damaged in any given 1 ft section it may be rejected. ASTM D3963 further requires that the total bar surface area covered by patching material shall not exceed 5% in any given 0.3 m [1 ft] section of coated reinforcement. This limit on

damaged and repaired area does not include sheared or cut ends.

Prior to repair of all damage, the areas to be repaired should be prepared using a wire brush that removes any rust or other contaminants.



BAR COATING REPAIR

Damage to coatings should be repaired using a two-part epoxy approved by the coating manufacturer. It should be mixed according to the manufacturer's direction and should be used within the specified pot life. While some spray can materials are currently being sold, they are not recommended by the epoxy-coated steel industry.



Repair materials should be provided with sufficient time to cure prior to concrete placement. Some coatings require 8 hours.

All repairs should be strictly conducted according to the written instructions furnished by the patching material manufacturer, and this material should conform to Annex A2 of ASTM A775 or A934.





INSPECTION PRIOR TO CONCRETE PLACEMENT

Inspection prior to concrete placement is critical as this is the final opportunity to document that the coated steel is installed according to the structural design and that the coating will provide optimum durability. Prior to concrete placement, the following should be inspected and appropriately documented.

Bar spacing, size and type: Bars should be placed in accordance with the structural drawings for the particular project and conformance to the required specifications should be documented. Current practice often uses photographic documentation for recording mill and bar strength information which is stamped onto the bar. Information obtained from the mill and fabrication reports may also be obtained.

Bends: The coating at bends should not exhibit any cracking or fractures. Particular care should be taken to inspect the condition of the coating in these regions as damage may occur during fabrication.

Lap lengths: Lap lengths approved by the structural engineer should be measured and documented. Laps are only permitted at locations approved by the structural engineer.

Mechanical splices: Where mechanical splices are used, they should be epoxy-coated. Any damaged coating after connecting the bars should be repaired.

Tolerances and clear cover: Concrete cover should be measured. Additional information on placing tolerances is provided by ACI Committee 117 and CRSI. If concrete cover on the reinforcing steel is inadequate, then force is sometimes used to move the reinforcement. When such methods are employed damage to the coatings must be avoided.

Repair of all damage: Repairs to any visible damage should be made allowing sufficient time for coatings to dry. Such repairs should be conducted using a two-part epoxy. Spray can repair materials are not recommended.

If the bar has more than 2% of its area damaged in any given 1 ft section of coated reinforcement it should be replaced. ASTM D3963 states that if the total bar surface area covered by patching material exceeds 5% in any given 1 ft section of coated reinforcement, the bar may be rejected. This limit does not include sheared or cut ends.

Bar supports: Reinforcement should be placed on supports coated with non-conductive material, such as epoxy or plastic bar supports.

Tie wire: Reinforcement should be tied using a coated tie wire.

Bar samples: Some agencies require inspectors to collect coated steel samples from the jobsite and these should be clearly identified prior to submittal to the appropriate laboratory for testing.

Welding: Welding should only occur with the permission of the engineer. Any welds should be cleaned and patched with repair materials.



CONCRETE OPERATIONS

After placement, minimize traffic over the epoxy-coated steel. Avoid concrete hoses on placed steel as they may damage the coating as they are moved. Care should also be taken to ensure that items such as unprotected couplers for concrete delivery hoses are not dragged across the steel as these may result in coating damage. Consider a runway if necessary. A pre-pour meeting may be beneficial with the concrete contractor. At no time should stands or rails used for concrete placement machines be welded to the epoxy-coated steel.

Care should be used to ensure that activities during the concrete placement do not result in damage to the epoxy-coated steel. Concrete pumps should be fitted with an "S" bend to prevent free fall of concrete directly onto the coating.

Plastic headed vibrators should be used to consolidate concrete. Steel vibrators may cause coating damage.

Bars that are partially cast in concrete, and then exposed for extended periods, should be protected against exposure to UV, salts and condensation. It has been found that wrapping with plastic or individual tubing is suitable for providing long-term protection.

REFERENCES

1. **ASTM A775/A775M** *Standard Specification for Epoxy-Coated Steel Reinforcing Bars*, ASTM International, West Conshohocken, PA.
2. **ASTM A934/A934M** *Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars*, ASTM International, West Conshohocken, PA.
3. **ASTM D3963/D3963** *Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars*, ASTM International, West Conshohocken, PA.
4. **ASTM A884/A884M** *Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement*, ASTM International, West Conshohocken, PA.
5. **ASTM A1064/A1064M** *Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete*, ASTM International, West Conshohocken, PA.
6. **ACI Committee 301** *Specifications for Structural Concrete*, America Concrete Institute, Farmington Hills, MI.
7. **CRSI** *Manual of Standard Practice*, Concrete Reinforcing Steel Institute, Schaumburg, IL.
8. **ACI Committee 117** *Specification for Tolerances for Concrete Construction and Materials*, America Concrete Institute, Farmington Hills, MI.

ABOUT THE EPOXY INTEREST GROUP

The Epoxy Interest Group (EIG) of CRSI (Concrete Reinforcing Steel Institute) is a not-for-profit trade association providing an authoritative resource for information related to the use of epoxy-coated steel (epoxy rebar) in reinforced concrete. Epoxy-coated reinforcing steel is also known as epoxy-coated rebar (ECR), as well as fusion bonded epoxy-coated rebar (FBE CR).

The association serves the needs of specifiers, engineers, architects, fabricators and end-users with the most recent information about how and where epoxy-coated reinforcing steel is used, as well as recent technical changes, educational seminars and promotional activities.

The Epoxy Interest Group serves the construction market in the United States, Canada and Mexico.

Our Mission

To promote the use and advance the quality of Epoxy-Coated Reinforcing Steel. Epoxy-coated steel is used instead of conventional reinforcing bars to strengthen the concrete and protect against corrosion. The epoxy coating is applied to the steel in a factory prior to shipping.

BENEFITS

Epoxy-Coated Reinforcing Steel

- Excellent Corrosion Protection
- Cost Effective
- Lower Maintenance
- Extended Service Life
- Sustainable
- Certified Plants
- Using 40 Years of Improved Manufacturing and Coating Technologies

