Application Guide for Fusion Bonded Epoxy reinforcing bar coatings

Introduction

This document provides guidelines for the factory application of fusion-bonded epoxy (FBE) coatings used to protect the external surface of steel reinforcement bars.

General overview

FBE coatings provide high quality corrosion and mechanical protection of steel reinforcing bars for concrete used in the construction industry.

The critical steps that must be controlled are:

1) Selection of suitable bar
2) Blast cleaning
3) Final cleaning and inspection
4) Preheating
5) FBE coating application
6) Post treatment
7) Final inspection and quality control
8) Repair procedures
9) Rebar handling

A review of each step follows.

1. Selection of suitable bar

The quality of the steel rebar must be such that it meets the requirements of ASTM A 615, 616, 617 or 706. It should be free of contaminants such as oil, grease or paint. Bars showing imperfections (sharp edges and deformations) should not be coated.

2. Surface Preparation

Proper attention to the cleaning and preparation of the steel bar surface prior to abrasive cleaning has a considerable effect on the eventual quality of finished coating.

Steel reinforcing bar may be contaminated by salts, soil, grease, oil, organic coating residues and mill treatments. It is important that all of these contaminants are removed prior to the first abrasive cleaning step. Failure to remove contaminants may lead to contamination of the abrasive media which will cause poor performance of the subsequently applied coating. Deeply embedded salts and certain organic contaminants will, if not completely removed, cause adhesion failures and film formation problems and lead to corrosion.
3. **Blast Cleaning**

The purpose of abrasive cleaning is to achieve a ‘clean’ surface, having an angular anchor pattern with an average profile depth between 50 and 100 microns. The surface cleanliness should meet a minimum of “Near White Blast” quality as described under any of the following specifications:

SSPC – SP10, NACE No. 2, SA 2½

This can be achieved most effectively with centrifugal type blasting equipment using steel grit as the abrasive media.

The most effective blast media is G-25 or G-40 (or as required by the coating specification) steel grit, having a hardness of 50–60 Rockwell C.

It is important that the centrifugal wheels should have adequate horsepower and be positioned correctly to achieve high quality and efficient cleaning.

4. **Final cleaning and inspection**

All abrasive dust needs to be removed, usually by vacuum or air knife and the level of cleanliness checked periodically by pressing a clear adhesive tape onto the steel surface and examining the underside for dirt particles.

It is more difficult to check for oil or organic matter contamination. The use of surface tension measurements, using wetting tension solutions of known values and characteristics, provide the best information. However, for practical purposes observing how well a drop of clean water will wet the surface is a useful indicator.

All reinforcing bar coating operations require a “near white metal” blast quality. In most cases, a skilled operator can visually recognize the required standard using visual standards (NACE or Swedish pictorial standards).

It is very important that the required anchor profile is achieved. The profile should be angular but should not have “undercuts” that can result from “over blasting”, wrong abrasive or improper positioning of the centrifugal wheels. The profile can be measured by instruments such as an Elcometer Surface Profile Gauge or Testex Press-O-Film.

5. **Pre-Heating**

Correct heating of the steel is one of the most important steps in the successful application of fusion-bonded epoxy (FBE) coatings. The steel must reach the appropriate application temperature recommended by the FBE manufacturer to achieve optimum performance of the coating. The pre-heating temperature can vary according to the grade of material but typically will be in the range of 230°C to 250°C. Refer to the TDS for Jotaguard RB.

At no time should the metal temperature exceed 275°C (527°F) as this may cause metallurgical or surface defects. A strong “blueing” or darkening of the rebar surface is one indication of excessive heating.

Electromagnetic induction heating is the most common method used.
With induction heating it is important that the appropriate frequency is used to ensure “deep” heating. Intense skin heating must be avoided. Multiple induction coils are recommended for stable heating, especially in the case of large diameter bars.

Uniform metal temperature at the specified levels must be maintained for the best results. The temperature must be controlled at the entrance to the coating chamber. Tempilsticks are most commonly used and can be very effective when used by experienced operators. Infrared Pyrometers are satisfactory control tools, but must be calibrated regularly to ensure their accuracy.

6. **FBE Application**

Powder application is best accomplished by electrostatic spraying. It is important that a fluidizing powder feed is used and the following points are observed:

a) The bar must be well grounded during its entire travel through the coating chamber.
b) The proper charge on the sprayed powder must be maintained (normally 50-100 kV).
c) The guns should be positioned appropriately in the coating chamber to give a uniform powder deposition.

Powder delivery tubing should be of the appropriate diameter and material (usually 12 mm or greater) and the length be as short as practical with minimum restrictions between the guns and fluidized bed. Avoid gravity effects on powder flow through the tubing by careful routeing of the supply pipe.

Improper adjustments can also result in the more serious problem of gun clogging. This can also be caused by either the guns being too near the hot surface, or partially cured overspray entering the diffusers. Proper design and selection of diffusers will minimize problems. The deposition rate should be adjusted to give a steady build-up of the required film and not flood the bar.

A test should be made to measure the necessary powder delivery for a given bar diameter and speed. This information can be used to determine deposition efficiency and effectiveness of equipment settings.

It is important that all air used in the coating chamber and supporting systems is clean and dry. Moisture can cause both deposition problems and coating deficiencies such as porosity and pinholes. Worse problems will result from air contaminated with oil. In addition to causing coating defects oil contamination is a major cause of impact fusion, which can cause system clogging and erratic spray patterns. Excess porosity can also be caused by a high powder deposition rate.

Excessive electrostatic charge must also be avoided since this may cause back ionisation and possible film defects and “cobwebbing” in the powder booth.

7. **Post Treatment**

To achieve optimum mechanical and protective properties, quenching should occur after the coating is fully cured. The minimum time requirement will depend on the preheat temperature, the bar diameter and wall thickness. Wetting of the conveying wheels to minimise “tracking” should be done.
8. **Final inspection and quality control**

Thorough inspection and coordination with the other application steps are essential for a quality coating. If each processing step is done correctly, a high quality coating is assured. Regular quality control tests to be carried out during application include film thickness, holiday detection and cure. ASTM A775 details the recommended testing methods and acceptance criteria. These may vary according to the project requirements.

9. **Repair procedures**

Most likely, the bar ends will require patching and there may be other small areas needing repair from time to time. A two-component 100% epoxy such as Polyguard 85 or Jotamastic 90 are recommended to be used for repairs.

10. **Handling coated bars**

**Epoxy-Coated Steel Reinforcing Bar** should be handled to ensure that it is not damaged prior to or during concrete placement. The following information provides guidance:

**Storage**
Store rebar bundles on suitable material, such as timber supports. Space the timber supports to minimize sagging.

**Strapping**
Strapping should be padded or protected with other non-abrasive material.

**Outdoor Storage**
If the bars are to be exposed outdoors for more than 30 days, they should be covered with a suitable opaque material that minimizes condensation and protects from UV radiation.

**Shearing**
Contact points on shearing equipment should be a suitable material.

**Bending**
Contact points on bending equipment should be a suitable material.

**Inspection/Patching**
Inspect bars after bending and repair any cracks with patching material.

**Patching Material**
Use a two-component epoxy repair material, approved by the coating manufacturer. Follow manufacturer’s directions.

**Loading**
Bars should be lifted using a spreader bar or strongback with multiple pick-up points to minimize sagging. Nylon or padded slings should also be used.
For shipping, secure the load with nylon or padded strapping.

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Note: The information on this Application Guide is given to the best of the manufacturer's knowledge, based on laboratory testing and practical experience. Jotun Powder Coatings reserves the right, without notice, to alter or change the content of this Application Guide. This Application Guide supersedes all previously issued versions.

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