



**Summary of Substantive Changes  
between the 2007 and 2015 editions of  
AWWA C213, Fusion-Bonded Epoxy Coatings  
and Linings for Steel Water Pipe  
and Fittings**

**Presented to the IAPMO Standards Review Committee on April 10, 2017**

**General:** The changes to this standard might have an impact on currently listed products. The significant changes are:

- The title of the standard was changed to clarify the products covered by this standard (see Title).
- Updated the referenced standards (see Section 2).
- Added a definition for potable water (see Section 3).
- Added a requirement for compliance with NSF 61 for products in contact with potable water (see Section 4.2).
- Changed the allowable shelf life of epoxy powder from 80°F and 12 months, to a manufacturers specification (see Section 4.3.1.1).
- Removed the specific abrasives to be use in the abrasive blast cleaning process (see Section 4.4.2.2).
- Removed the requirement to hold back a specific length 3 in of epoxy when pipe sections are joined (see Section 4.4.3).
- Added a requirement for an epoxy cured-film thickness of 12 mil and included recommended testing to verify cure when required (see Sections 4.5.3.3 and 4.5.3.4).
- Removed some specifications for construction of the pipeline including handling, bedding and backfill and replaced with a reference to AWWA C604 *Installation of Buried Steel Water Pipe—4 In. (100 mm) and Larger* where the practices are specified (see Section 4.6).
- Added additional testing requirements for verification (see Section 5)
- Removed, revised and added requirements for verification (see Section 5).
- Added specific requirements for packaging and storage of materials and removed requirements for stacking, shipping, loading trench-side placement and outdoor storage (see Section 6).



Title, Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings: Changed the title to more clarify the products covered by this standard as follows:

Fusion-Bonded Epoxy Coatings ~~for the Interior and Exterior of~~ and Linings for Steel Water Pipe ~~lines and Fittings~~

Section 3, Definitions

4. Potable water: Water that is safe and satisfactory for drinking and cooking.

Section 4.2, Materials and Workmanship: Added a requirement for compliance with NSF 61 for products in contact with potable water as follows:

4.2.2 Certification. If the lining system is in contact with potable water, it shall be certified to NSF/ANSI Standard 61.

Section 4.3, Epoxy System: Changed the section title and the allowable shelf life of epoxy powder as follows:

~~4.3 Material Properties and Laboratory Test Methods for Coating Qualification Only~~ Epoxy System

~~4.3.1.1 Shelf life. When stored in the original sealed container at or below 80°F (27 °C), the epoxy powder shall have a minimum shelf life of 12 months from the date of manufacture. Consult the manufacturer if the powder is stored beyond this period or at temperatures above 80°F (27 °C) for determination of continued use.~~ The epoxy powder shall be stored in the original sealed containers at or below the manufacturer's specified temperature and shall be used within the shelf life as specified by the manufacturer.

Sec. 4.4 Epoxy Application

Section 4.4.2, Surface preparation: Removed the specific abrasives to be use in the abrasive blast cleaning process as follows:

4.4.2.2 Abrasive blast cleaning. ~~Pipe-Bare steel~~ surfaces shall be abrasive blast-cleaned ~~with mineral abrasives, slag abrasives, steel shot or steel grit (reference SSPC-AB 1 Mineral and Slag Abrasives and SSPC-AB 3 Ferrous Metal Abrasive)~~ in accordance with SSPC-SP10/NACE No.2 unless otherwise specified by the purchaser. The blast anchor pattern or profile depth shall be 1.5 mil to 4.0 mil (38 µm to 102 µm) measured in accordance with ASTM D4417.

Section 4.4.3, Epoxy application: Changed the section title and the allowance for the length of the epoxy that can be held back when pipe sections are to be joined as follows:.

4.4.3 ~~Coating~~ Epoxy Application

4.4.3.2 Pipe ends. When pipe sections are to be joined by field welding, ~~coatings~~ epoxy shall be held back ~~a minimum of 3 in., or~~ as specified by the purchaser.



Section 4.4.4, Epoxy Repair: Removed the requirements to use specified methods of repair as follows:

~~4.4.4.1.3 Minor defects on the exterior of the pipe shall be repaired in the shop using hot-applied tape, cold-applied tape, liquid epoxy, hot melt patch compound, or heat shrinkable coatings in accordance with the requirements of ANSI/AWWA C203, ANSI/AWWA C209, ANSI/AWWA C210, ANSI/AWWA C214, or ANSI/AWWA C216.~~

4.5 Special Pipe Connections and Appurtenances:

Section 4.5.3, Epoxy application: Added a requirement for an epoxy cured-film thickness of 12 mil as follows:

4.5.3.3 Thickness. The epoxy powder shall be applied to the preheated items at a uniform cured-film thickness of not less than 12 mil (305 µm). However, care shall be taken when this standard is used for coating or lining items other than pipe. The design configuration of these items may include areas with limited access, bolt-holes, irregular shapes, and areas where the faraday cage effect is possible. The epoxy thickness in these areas may vary below the minimum cured-film thickness of 12 mil, but no area should be left uncoated unless specified or agreed on by the purchaser. The maximum thickness shall not exceed the manufacturer's recommendation.

~~4.5.3.3~~4.5.3.4 Cure. If it is necessary to postcure the fusion-bonded coating epoxy, the coated surface shall be heated immediately after application of the coating epoxy according to the coating epoxy manufacturer's recommendations until total cure is achieved. If the purchaser requires testing to verify cure, a method such as differential scanning calorimeter (DSC) or bendability, agreed on by the purchaser, may be performed.

Sec. 4.6 Field Procedures: Removed some specifications for construction of the pipeline including handling, bedding and backfill and replaced with a reference to AWWA C604 *Installation of Buried Steel Water Pipe—4 In. (100 mm) and Larger* where the practices are specified as follows:

4.6.1 General. The methods and practices found in AWWA C604 shall be followed for the handling, shipping, storage, and installation of pipe coated or lined with this material. Special requirements associated with the field procedures of pipe coated or lined with this material can be found in Sec. 4.6.2.

~~4.6.2 Special requirements. During construction of the pipeline the constructor shall use every precaution to prevent damage to the protective coating on the pipe.~~No metal tools or heavy objects shall be permitted to ~~have come into~~ have come into contact with the finished coating or lining. Workers shall ~~not~~ be permitted to walk on the pipe coating ~~except when absolutely or lining only when~~ necessary, in which case ~~they shall wear shoes with rubber or composition soles and heels or other suitable footwear that will not damage the coating.~~only shoes with rubber soles and heels shall be permitted. Damage to the pipe or the protective coating before final acceptance by the purchaser shall be repaired. Coating and lining damaged during installation shall be repaired in accordance with Sec. 4.4.4.

~~4.6.1 Protection during welding. A heat-resistant material with a minimum width of 18 in. (450 mm) shall be draped over the top half of the pipe on each side of the coating holdback during welding to avoid damage to the coating by hot weld spatter. If welding of the interior joint is required by the purchaser, appropriate means of protecting the coating shall be provided by the constructor.~~



*4.6.2.1 Protection during welding. A heat-resistant material of sufficient width to prevent damage to the coating shall be placed on each side of the coating holdback during welding to avoid damage to the coating by hot weld spatter. No welding ground shall be made on the coated part of the article. Any coating or lining damage from welding, including burns from weld spatter, shall be repaired in accordance with Sec. 4.4.4.*

~~*4.6.2 Hoisting. Wide-belt slings shall be used to hoist coated pipes. The use of chains, cables, tongs, or other equipment likely to damage the epoxy coating shall not be permitted, nor shall the pipe be dragged or skidded. The constructor shall allow the coating on the underside of the coated pipes to be inspected while the pipes are suspended. Any coating damage shall be repaired according to Sec. 4.4.4.*~~

~~*4.6.3 Pipe bedding and trench backfill. Pipe bedding and backfill shall be installed so as to avoid abrasion or other damage to the coating. Unless otherwise specified by the purchaser, the following requirements shall be met:*~~

~~*4.6.3.1 Where the trench traverses rocky ground containing hard objects that could penetrate the protective coating, a layer of screened earth, sand, or gravel no less than 6 in. (150 mm) thick with a maximum particle size of 0.75 in. (20 mm) shall be placed in the bottom of the trench prior to the installation of pipe. Other suitable bedding materials may be used in place of earth, sand, or gravel if specified by the purchaser.*~~

~~*4.6.3.2 Placement of backfill around the exterior of the coated pipe shall be performed as specified by the purchaser after final inspection of the exterior coating. Rocks, concrete chunks, or other hard objects shall not be placed within 6 in. (150 mm) of the top of the pipe. If hard objects occur in the backfill along any section of the pipeline, a minimum of 6 in. (150 mm) of screened material shall be placed around and above the coated pipe before backfilling the remainder of the trench.*~~

~~*4.6.3.3 Compaction of bedding and backfill in the trench shall be specified by the purchaser. Compaction with metal rods or other metal tools that could come into contact with the pipe coating shall not be permitted.*~~

Section 5, Verification: Added additional testing requirements for verification as indicated: In addition AWWA calls out specific changes to this section in the front matter of this standard as follows:

- Section 5, Verification, was revised and the heading titles and format were updated to be consistent with the new language and format being used in all AWWA steel pipe coating and lining standards.
- Additional information was added to Sec. 5.2.2.6, Abrasion Resistance, and the ASTM reference was updated to reflect current industry practice.
- New sections on dielectric strength (Sec. 5.2.2.8) and volume resistivity (Sec. 5.2.2.9) were added to be consistent with the requirements included in Table 2.
- A new Sec. 5.2.2.10 on cathodic disbondment testing was added.
- Old Sec. 5.2, Notice of Nonconformance, was renamed to Sec. 5.6, Rejection, and revised to be consistent with other coating and lining standards.
- A new section on Quality Assurance and Records was added (Sec. 5.3).

~~*5.1 Inspection by the Purchaser*~~

~~*5.1 Epoxy Materials Prequalification*~~

~~*5.2 Notice of Nonconformance*~~

~~*5.3 Laboratory Tests*~~ *5.2 Requirements of Epoxy System*



~~5.3.2 Powder and coating systems~~ 5.2.1 Properties of epoxy powder materials. Before acceptance and application of the epoxy materials, samples of materials requested by the purchaser and submitted by the constructor may be tested by the purchaser in the purchaser's laboratory or in an independent commercial laboratory designated by the purchaser. If the values or conditions of the powder and coating systems determined from testing do not meet the values in Sec. 4.3.2 for the following items, they shall be subject to rejection.

~~5.3.2.9~~ 5.2.2.6 Abrasion resistance. Abrasion resistance shall be conducted in accordance with ~~ASTM D1044~~ ASTM D4060 with a ~~Taber~~ CS 17 abrasive wheel, or equivalent, and 1,000-g loading.

5.2.2.8 Dielectric strength. The epoxy shall be tested for dielectric breakdown according to ASTM D149 using a 1-in. (25-mm) diameter electrode and 500-V/s voltage rise. A value below the limit in Table 2 shall constitute a failure of the coating to meet the requirement

5.2.2.9 Volume resistivity. The epoxy shall be tested for volume resistivity according to ASTM D257. A value below the limit in Table 2 shall constitute failure of the coating to meet the requirement.

5.2.2.10 Cathodic disbondment. The cathodic disbondment of the coating system shall be determined in accordance with ASTM G8. The test shall run for 30 days. Each specimen shall be a laboratory-coated steel panel with minimum dimensions of 4 in. × 6 in. × 0.25 in. (100 mm × 150 mm × 6 mm) prepared per Sec. 4.4. A single intentional holiday 0.25 in. (6.35 mm) in diameter shall be made in each specimen. The disbondment shall be measured from the edge of the initial holiday along each radial cut. The average of these measurements shall be the result for each specimen. Three specimens shall be tested and the results averaged.

### 5.3 Quality Assurance and Records

### 5.4 Inspection and Testing by the Purchaser

### 5.5 Quality Control Requirements of Applied Epoxy System

### 5.6 Rejection



Section 6, Delivery: Added specific requirements for packaging and storage of materials and removed requirements for stacking, shipping, loading trench-side placement and outdoor storage as follows:

### 6.1 Marking

6.1 ~~Packaging and~~ Marking

### 6.2 ~~Handling, Storage, and Shipping~~ Packaging and Shipping

6.2.1 Packaging. Epoxy materials shall be supplied to the jobsite in the manufacturer's original unopened containers.

6.2.2 Storage of materials. Materials shall be stored and protected from the elements as required by current applicable federal, state or provincial, and local regulations.

Temperature ranges in the storage area shall be maintained within the limits recommended by the manufacturer.

~~Pipe shall be handled and stored so as to minimize damage to pipe, appurtenances, and the coating system. Damaged pipe, appurtenances, and coatings shall be repaired. Damaged coating shall be repaired in accordance with Sec. 4.4.4.~~

~~6.2.1 Stacking. Stacking shall be in accordance with appropriate safety practices and purchaser's instructions. Spacers or padding shall be used to prevent damage to the pipe and coating.~~

~~6.2.2 Shipping. Pipe shall be transported from the coating yard to the jobsite as recommended by the manufacturer and agreed to by the purchaser. Pipe shall be shipped using shoring or dunnage, padding, and banding to protect the pipe and its coating.~~

~~6.2.3 Loading. Pipe shall be loaded for shipping in compliance with existing shipping standards.~~

~~6.2.4 Trench-side placement. Pipe placed alongside the trench shall be supported off the ground to avoid damage to the coating.~~

~~6.2.5 Outdoor storage. The purchaser should consult with the manufacturer and the constructor regarding the specific weather conditions (e.g., temperature, humidity, ultraviolet exposure) to which coated steel articles, especially pipes coated on the exterior, will be subjected during storage prior to installation. From this consultation, any decisions concerning any protective measures shall be made.~~

The former Table 2 was divided into two (Table 2 and Table 3) to clarify the prequalification versus quality control requirements of epoxy systems as follows:

Table 1 Physical properties of epoxy powder materials

Table 2 Physical properties of laboratory applied materials Prequalification requirements of epoxy system

Table 3 Quality control requirements of applied epoxy system

Table 4 Adhesion rating criteria for epoxy system tests