Designation: A 950/A 950M – 99 (Reapproved 2007)

# Standard Specification for Fusion-Bonded Epoxy-Coated Structural Steel H-Piles and Sheet Piling[1]

This standard is issued under the fixed designation A 950/A 950M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification covers structural steel H-piles and sheet piling with protective fusion-bonded epoxy coating applied by the electrostatic spray, flocking, or fluidized bed process.

NOTE 1—The coating applicator is identified throughout this specification as the manufacturer.

1.2 Requirements for coatings are contained in Annex A1.

1.3 This specification is applicable for orders in either inch-pound units (as Specification A 950) or SI units (as Specification A 950M). The values stated in either inch-pound or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets.

1.4 *This standard does not purport to address any of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 6/A 6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

A 36/A 36M Specification for Carbon Structural Steel

A 328/A 328M Specification for Steel Sheet Piling

A 572/A 572M Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

A 588/A 588M Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance

A 690/A 690M Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments

A 857/A 857M Specification for Steel Sheet Piling, Cold Formed, Light Gage

B 117 Practice for Operating Salt Spray (Fog) Apparatus

D 2200 Standard Pictorial Surface Preparation Standards for Painting Steel Surfaces

D 3451 Guide for Testing Coating Powders and Powder Coatings

G 8 Test Methods for Cathodic Disbonding of Pipeline Coatings

G 12 Test Method for Nondestructive Measurement of Film Thickness of Pipeline Coatings on Steel

G 14 Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)

G 20 Test Method for Chemical Resistance of Pipeline Coatings

2.2 *American Petroleum Institute Specification:*

API RP 5L7 Recommended Practice for Internal Fusion Bonded Epoxy Coating of Line Pipe[3]

2.3 *National Association of Corrosion Engineers Standard:*

TM0175 Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Shot or Steel Grit (Nace No. 2)[4]

2.4 *Steel Structures Painting Council Standards:*

SSPC VIS 1 Visual Standards[5]

SSPC-SP 1 Surface Preparation Specification No. 1: Solvent Cleaning[5]

SSPC-SP 10 Near-White Blast Cleaning[5]

## 3. Ordering Information

3.1 Information items to be considered, if appropriate, for inclusion in purchase orders are as follows:

3.1.1 Specification designation and year of issue for H-pile or sheet piling,

3.1.2 Section,

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is under the direct responsibility of Subcommittee A01.02 on Structural Steel for Bridges, Buildings, Rolling Stock and Ships.

Current edition approved Sept. 1, 2007. Published September 2007. Originally approved in 1995. Last previous edition approved in 2003 as A 950/A 950M – 99 (2003).

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from the American Petroleum Institute, 1220 L St., Washington, DC 20005.

[4] Available from the National Institute of Corrosion Engineers, 1440 South Creek, Houston, TX 77084.

[5] Available from the Steel Structures Painting Council, 40 24th St., Pittsburgh, PA 15213.

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States.



Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

3.1.3 Quantity,

3.1.4 Length,

3.1.5 Portions to be coated (full length or distance from end to remain bare),

3.1.6 Requirements for certifications (see 13.1),

3.1.7 Requirements for material samples (see 4.3),

3.1.8 Requirements for patching material sample (see 4.5),

3.1.9 Requirements for visual standard of comparison for surface cleaning (see 5.1),

3.1.10 Requirements for number and frequency of tests (see 8.1), and

3.1.11 Requirements for inspection at the manufacturing plant (see 11.1).

NOTE 2—An example of an ordering description is as follows: Structural steel sheet piling, Grade 60, Type 1, to ASTM 572 – ; section PZ35, 20 000 ft, 40 ft, 0 in. long in secured lifts, epoxy-coated to ASTM A 950– , including certification for coated sheet piling, sample of coating material, 2 gal of patching material, and surface cleaning comparison with SSPC-VIS 1.

[Structural steel sheet piling, Grade 400, Type 1, to ASTM 572M – ; section PZ35, 6000 m, 12 m long in secured lifts, epoxy-coated to ASTM A 950M– , including certification for coated sheet piling, sample of coating material, 8 L of patching material, and surface cleaning comparison with SSPC-VIS 1].

## 4. Materials

4.1 Steel H-piles to be coated shall meet the requirements of Specifications A 36/A 36M, A 572/A 572M, A 588/A 588M, or A 690/A 690M, whichever is specified in the order. Steel sheet piling to be coated shall meet the requirements of Specifications A 328/A 328M, A 572/A 572M, A 690/A 690M, or A 857/A 857M, whichever is specified in the order.

NOTE 3—Surface conditions such as slivers, gouges, laminations, pits, and sharp edges can cause coating application difficulties and effort should be made to hold these conditions to a minimum.

4.2 The coating material shall meet the requirements listed in Annex A1 and shall be approved by the purchaser.

4.2.1 A written certification shall be furnished to the purchaser that properly identifies the batch designation of the powder coating used in the order, material, quantity represented, date of manufacture, name and address of manufacturer, and a statement that the supplied powder coating is the same composition as that prequalifed to Annex A1 of this specification. The powder coating shall be used within the manufacturer's written recommended shelf life.

4.3 If specified in the order, a representative 8-oz. [0.2-kg] sample from each batch of the powder coating shall be supplied to the purchaser. The sample shall be packaged in an airtight container and identified by the batch designation.

4.4 The powder coating shall be maintained in a temperature-controlled environment following the written recommendations of the powder coating manufacturer until ready for use, at which point the powder coating will be given sufficient time to reach approximate plant ambient temperature.

4.5 The patching material shall be as recommended by the powder coating manufacturer and shall be compatible with the coating. If specified in the order, a sample of the patching material shall be supplied to the purchaser.

## 5. Surface Preparation

5.1 Prior to blast cleaning, the surfaces of steel H-piles and sheet piling to be coated shall be precleaned, as required, in accordance with SSPC-SP1. Steel surfaces shall be cleaned by abrasive blast cleaning to near-white metal in accordance with SSPC-SP10. The cleaning media used shall produce an anchor pattern profile of 1.5 mils to 4.0 mils [40 to 100 μm]. The visual standard of comparison used to define the final surface condition shall be SSPC-VIS1 or TM0175. Expended blasting media debris and dust shall be removed from blasted surfaces prior to applying coating.

5.2 Prior to application of the fusion-bonded epoxy coating, raised slivers, scabs, laps, sharp edges, or seams shall be removed using abrasive grinders. No individual area of grinding shall exceed 36 in.$^2$[230 cm$^2$]. Total area of grinding shall not exceed 1 % of total surface area.

5.3 Slivers raised during the cleaning or coating application process shall be treated as permissible coating damage and repaired per Section 10.

5.4 It shall be permissible for a chemical wash and/or conversion of the steel H-piles or sheet piling surface to be used. This pretreatment shall be applied after abrasive blast cleaning and before coating, in accordance with the written application instructions specified by the pretreatment manufacturer.

## 6. Application of Coating

6.1 The powder coating shall be applied to the cleaned and pretreated (if applicable) surface as soon as possible and before visible oxidation of the surface occurs, as discernible to a person with normal or corrected vision. In no case shall application of the coating be delayed more than 3 h after cleaning.

6.2 To achieve the required coating thickness (see 7.1), the steel shall be preheated prior to applying the powder coating in accordance with the manufacturer's written recommendations. The heat source shall not leave a residue or contaminant on the steel surfaces. If oxidation occurs, the steel shall be cooled to ambient temperature and recleaned before applying the powder coating.

6.3 The powder coating shall be applied and cured in accordance with the powder coating manufacturer's written recommendations.

6.4 Areas of steel sections not requiring coating to allow welding or for other purposes shall be specified by the purchaser and shall be blocked-out during the coating application.

## 7. Requirements for Coated H-Piles and Sheet Piling

7.1 *Thickness of Coating*:

7.1.1 The minimum thickness of coating after curing on flat surfaces of H-piles and sheet piling shall be 12 mils [300 μm]. The minimum thickness of coating after curing on edges and corners of sections, as measured on flat surfaces ½ in. [13 mm] from these edges and corners of sections, shall be a minimum of 7 mils [175 μm]. It shall be permissible for the coating thickness to be reduced on the ball and socket of sheet piling.

7.1.2 Measurements shall be made in accordance with Test Method G 12 following the instructions for calibration and use



Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

recommended by the thickness gage manufacturer. Gages shall be of the pull-off or fixed probe type, except that "pencil-type" pull-off gages, which require the operator to observe the readings at the instant the magnet is pulled from the surface, shall not be used.

7.1.3 Thickness measurements on test sheet piling sections shall be taken on flat surfaces and corners of each side and edge at 2 ft [0.6 m] intervals along piling sections. Thickness measurements on test H-piles shall be taken alternately on the edges of flanges, outside and inside of flat surfaces of flanges, intersection of flanges and web, and on each side of the web at 2 ft intervals along H-pile sections.

NOTE 4—Powder coating overspray at interlock segments of sheet piling is inherent to the coating process and should be considered to be acceptable. A heavier coating thickness in these areas may result in the inability to join pieces.

7.2 *Continuity of Coating*:

7.2.1 Damaged or deficiently coated areas, as discernible to a person with normal or corrected vision, shall be patched in accordance with the patching manufacturer's written recommendations.

7.2.2 The applied coating after curing shall not have more than an average of two holidays (pinholes not discernible to a person with normal or corrected vision) per square foot [21 holidays per square metre] of the coated section,as determined by dividing the total number of holidays for the individual section checked by its total outside surface area.

7.2.3 Holiday checks to determine acceptability shall be made only at the manufacturers plant with a 67.5-V direct current, 80 000–Ω wet sponge holiday detector.

7.2.4 Holiday checks on test sheet piling sections shall be made on flat surfaces and corners of each side and edge at 2 ft [0.6 m] intervals along piling sections. Holiday checks on test H-piles shall be taken alternately on the edges of flanges, outside and inside of flat surfaces of flanges, intersection of flanges and web, and on each side of the web at 2 ft intervals along pile sections.

7.3 *Flexibility of the Coating*:

7.3.1 Flexibility of the coating shall be checked by bending coated test panels. Test panels shall be of the same thickness as the respective sheet piling sections or H-pile flange and shall be coated along with these sections using the same application equipment and procedures.

NOTE 5—Bend tests to determine coating flexibility acceptance are intened to be performed at the manufacturer's plant.

7.3.1.1 Test panels shall be bent around a mandrel to a minimum of 1.5° total deflection (after rebound) at ambient temperature in accordance with 5.3.3.1 of API RP 5L7. The radius of the mandrel shall be calculated using the following equation:

$$R = 37.7t$$

where:

$R$ = mandrel radius and

$t$ = panel thickness including coating.

When no mandrel of the calculated size is available, it shall be permissible that a smaller radius mandrel be substituted.

7.3.2 No cracking or disbonding of the coating on the outside radius of the test panels shall be discernible to a person with normal or corrected vision. Except as specified in Section 9, cracking or disbonding of the coating shall be cause for rejection of the coated H-piles or sheet piling represented by the bend test panels.

7.3.3 Fracture or failure of the steel in the bend test shall not be considered a failure of the coating. Another test panel from the same production lot shall be substituted for repeat testing.

7.4 All requirements for coated H-piles and sheet piling shall be met at the manufacturer's plant prior to shipment.

## 8. Number of Tests

8.1 Unless a higher number or higher frequency, or both, is specified in the order, one test for coating thickness, continuity, and flexibility shall be made once every 4 h.

## 9. Retests

9.1 If any test specimen for coating thickness, continuity, or flexibility fails to meet the specified requirements, two further coated specimens from the same lot shall be subjected to the test or tests in which the original sample failed. If both additional coated test specimens pass the retest, the lot from which they were taken shall be deemed to meet the requirements of this specification. If either of them fails, the lot shall be deemed not to comply with this specification.

9.2 If the lot does not comply with this specification, the lot immediately preceding and immediately following the non-compliant lot shall have two test pilings selected from them which shall be subjected to the test or tests in which the original pilings failed. If all test pilings pass the retests, the lots shall be deemed in compliance with this specification.

9.3 In the case of a second non-compliant lot, the untested lot immediately next to it, which may be preceding or following, shall be subjected to a retest. This procedure shall be repeated until a compliant lot is tested.

NOTE 6—In the use of the retest provision of this specification, a lot is defined as the H-piles or sheet piling that are not represented by the sample that has been tested. A certain number of H-piles or sheet piling have been coated since the last acceptance test was performed and accepted. The H-piles or sheet piling that have been coated since that last test should be divided into four equal time period groups according to when they were produced. Each lot should then be further defined as those coated H-piles or sheet piling that have been produced in a given time period since the last acceptance test.

## 10. Permissible Coating Damage and Repair of Damaged Coating

10.1 Coating damage to H-pile or sheet piling sections due to handling or other causes shall be repaired in the manufacturer's plant with patching material prior to shipment.

10.2 The areas of coating damage shall be prepared for the application of patching material by cleaning the damaged area, removing the damaged coating using grinders or other suitable means, feathering the adjacent coating, and removing all remaining residue or dust.

10.3 The application of the patching material to the damaged areas shall be in accordance with the patching material manufacturer's written recommendations.



Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

## 11. Inspection

11.1 The purchaser's inspection representative (inspector) shall be allowed entry to the area of the manufacturer's plant where work on the purchaser's order is being performed during times of operation. The manufacturer shall afford the inspector all reasonable facilities to satisfy that the material is being furnished in accordance with this specification.

11.2 The inspector shall be allowed to select completed sections randomly for inspection and testing in the manufacturer's plant. Such inspections and tests conducted by the inspector shall not interfere unnecessarily with the manufacturer's operation.

## 12. Rejection

12.1 Coated H-piles or sheet piling represented by test specimens that do not meet the requirements of this specification shall be rejected. At the manufacturer's option, rejected sections shall be replaced or, alternatively, stripped of coating, cleaned, recoated, and resubmitted for acceptance testing in accordance with the requirements of this specification.

## 13. Certification

13.1 If specified in the order, the manufacturer shall furnish, at the time of shipment, written certification that the coated H-piles or sheet piling meet the requirements of this specification.

## 14. Handling, Packaging, and Shipping

14.1 Coated H-pile or sheet piling shall not be dropped, dragged, or handled in a manner resulting in damage to the coating. Equipment for handling coated sections shall have padded contact areas.

14.2 Coated H-piles or sheet piling shall be stored off of the ground on supports that prevent excessive deflection. Stacked sections shall be separated with wood dunnage to prevent damage to the coating.

14.3 Bundling bands for packaging and tie-down bands for shipping shall be padded or made of material that will not damage the coating. Sections shall be supported during shipping in a manner that prevents impact damage to the coating and excessive deflection.

## 15. Identification

15.1 In addition to the requirements in Specification A 6/A 6M, the identification of sections shall be maintained throughout the coating process to the point of shipment.

## 16. Keywords

16.1 corrosion resistance; fusion-bonded epoxy coating; H-piles; sheet piling; structural steel

# ANNEX

**(Mandatory Information)**

## A1. QUALIFICATION OF FUSION-BONDED EPOXY COATINGS FOR STEEL PILING

### A1.1 Scope

A1.1.1 This annex covers qualification requirements for fusion-bonded epoxy coatings for protecting structural steel H-piles and sheet piling from corrosion.

A1.1.2 At the request of the purchaser, the manufacturer of the fusion bonded epoxy coating shall be required to certify that products used to coat piling meet the requirements of this specification.

### A1.2 Coating Material

A1.2.1 The coating material shall be a 100 % solids, heat curable, thermosetting, dry powdered epoxy coating.

### A1.3 Coating Requirements

A1.3.1 *Chemical Resistance*

The chemical resistance of the coating shall be evaluated in accordance with Test Method G 20 by immersing three 3 by 6 by ⅛ in.[75 by 150 by 3 mm] steel plates, coated to a thickness of 12–14 mils [300–350 μm] in each of the following: distilled water, a 3-*M* aqueous solution of calcium chloride, a 3-*M* aqueous solution of sodium hydroxide, and a solution saturated with calcium hydroxide. Specimens without holidays and specimens with an intentional ¼-in. [6-mm] diameter hole drilled through the coating shall be tested. The temperature of the test solutions shall be 75 ± 4°F [24 ± 2° C]. The immersion shall last 45 days. The coating shall not blister, soften, lose bond, or develop holidays during this period. The coating surrounding the intentionally made hole shall exhibit no undercutting during the 45-d period.

A1.3.2 *Impact Resistance*

The impact resistance of the coating shall be tested in accordance with Test Method G 14 using a ⅝-in. [16-mm] diameter tup. Three 3 by 6 by ⅛ in [75 by 150 by 3 mm] steel plates, coated to a thickness of 12–14 mils [300–350 μm], at 75 ± 4°F [24 ± 2°C], shall be tested. One test shall be performed for each plage. The minimum acceptable value shall be 40 in·lbf [4.5 J] of impact with no visible breaks in the coating, as discernible to a person with normal or corrected vision.

A1.3.3 *Coating Flexibility*

The flexibility of the coating shall be evaluated by bending three ⅝-in. [16-mm] thick panels coated to a thickness of 12 mils [300 μm] of fusion-bonded epoxy over a mandrel at 32°F [0°C]. Tests shall be performed in accordance with 5.3.3.1 of API RP 5L7 with an acceptance criterion of a minimum of 1.5° total deflection (after rebound) at 32°F [0°C]. Bends shall be visually inspected; any visible tears or cracks in the coating at bends, as discernible to a person with normal or corrected vision, is cause for rejection, unless located within 0.1 in. [2.5



Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

mm] of the edge of the strap. Unopened stretch marks on the coating surface do not constitute coating failure.

A1.3.4 *Abrasion Resistance*

The abrasion resistance of the coating shall be tested by a Tabor Abraser, using standard panels for this apparatus coated to a thickness of 12–14 mils [300–350 μm] and CS-10 wheels with a 2.2-lb [1-kg] load per wheel. The maximum allowable mass loss shall not exceed 0.0035 oz [100 mg] after 1000 cycles.

A1.3.5 *Salt Fog*

The resistance of the coating to a hot, wet corrosive environment shall be evaluated in accordance with Test Method B 117 by exposing for 1000 h three 3 by 6 by ⅛-in [75 by 150 by 3-mm] steel plates, coated to a thickness of 12–14 mils [300–350 μm], containing intentional coating imperfections, to 95 ± 4°F [35 ± 2°C] salt spray comprised of 5 % sodium chloride by mass dissolved in distilled water. Three intentional 0.12-in [3-mm] diameter imperfections shall be drilled through the coating approximately evenly spaced along one side of each test specimen along the center vertical line of the face. The average coating disbondment radius of nine test sites on the three coated specimens shall not exceed 0.12 in [3 mm] when measured from the edge of the intentional imperfection made in the coating. In addition, the coating shall not blister from the exposure.

A1.3.6 *Cathodic Disbondment*

The effects of electrical and electrochemical stresses on the adhesion of the coating to steel and on the film integrity shall be assessed in an elevated cathodic disbondment test. Test Method G 8 shall be followed, except that flat plates coated with the proposed material shall be used. The drilled coating imperfection shall be 0.12 in. [3 mm] in diameter, the electrolyte solution shall be 3 % sodium chloride by mass dissolved in distilled water, the electrolyte solution temperature shall be 150 ± 4°F [65 ± 2°C]. The test duration shall be 24 h. The average coating disbondment radius of the three test panels shall not exceed 0.24 in [6.0 mm] as measured from the edge of the intentional coating imperfection.

*ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.*

*This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.*

*This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).*



Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale