Designation: A 884/A 884M – 06

Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement[1]

This standard is issued under the fixed designation A 884/A 884M; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers plain and deformed steel wire and plain and deformed steel welded wire reinforcement with protective epoxy coating. A Class A minimum coating thickness is required for wire and welded wire reinforcement intended for use in concrete and masonry. A Class B minimum coating thickness is required for wire and welded wire reinforcement intended for use in mechanically stabilized earth applications. A Type 1 coating is a fusion-bonded epoxy coating that has been designed to be sufficiently flexible to allow fabrication of the coated wire or welded wire reinforcement. A Type 2 coating is a fusion-bonded epoxy coating that has not been designed to be sufficiently flexible to allow fabrication of the coated wire or welded wire reinforcement.

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

1.2 Other organic coatings may be used provided they meet the requirements of this specification.

1.3 This specification is applicable for orders in either SI units (Specification A 884M) or in inch-pound units [Specification A 884].

1.4 The values stated in either SI or inch-pound units are to be regarded as standard. Within the text, the inch-pound units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other except as specifically noted in Table 1. Combining values from the two systems may result in nonconformance with this specification.

1.5 *This standard does not purport to address all 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 82/A 82M Specification for Steel Wire, Plain, for Concrete Reinforcement

A 185/A 185M Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

A 496/A 496M Specification for Steel Wire, Deformed, for Concrete Reinforcement

A 497/A 497M Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete

A 775/A 775M Specification for Epoxy-Coated Steel Reinforcing Bars

A 934/A 934M Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars

2.2 *NACE International Standard:*

NACE RP-287-87 Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surface Using a Replica Tape[3]

2.3 *Society for Protective Coatings Specifications:*[4]

SSPC-PA2 Measurement of Dry Coating Thickness with Magnetic Gauges

SSPC-SP 10 Near-White Blast Cleaning

SSPC-VIS 1 Pictorial Surface Preparation Standards for Painting Steel Surfaces

2.4 *Unified Facilities Guide Specification:*[5]

NFGS 03200A Concrete Reinforcement

2.5 *American Concrete Institute Specification:*[6]

ACI 301 Specifications for Structural Concrete

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.05 on Steel Reinforcement.

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[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 National Association of Corrosion Engineers (NACE), 1440 South Creek Dr., Houston, TX 77084-4906, http://www.nace.org.

[4] Available from Society for Protective Coatings (SSPC), 40 24th St., 6th Floor, Pittsburgh, PA 15222-4656, http://www.sspc.org.

[5] Available fromthe Naval Facilities Enginnering Service Center (NFESC), 560 Center Drive, Port Hueneme, CA 93043.

[6] Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, http://www.aci-int.org.

***A Summary of Changes section appears at the end of this standard.**

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TABLE 1 Test Requirements

Wire Size No. MW or MD, mm	Wire Size No. W or D, in.	Mandrel Diameter, mm [in.]	Time to Complete, s (maximum)
9 to 39	1.4 to 6	two times the diameter of the wire being tested	15
>39	>6	four times the diameter of the wire being tested	45

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *conversion coating*, *n*—a preparation of the blast-cleaned steel surface prior to coating application that is designed to pretreat the metal to promote coating adhesion, reduce metal/coating reactions, improve corrosion resistance, and increase blister resistance.

3.1.2 *disbonding*, *n*—loss of adhesion between the fusion-bonded epoxy coating and the steel reinforcement.

3.1.3 *fusion-bonded epoxy coating*, *n*—a product containing pigments, thermosetting epoxy resins, crosslinking agents, and other additives. It is applied in the form of a powder on a clean, heated, metallic substrate and fuses to form a continuous barrier coating.

3.1.4 *holiday*, *n*—a discontinuity in a coating that is not discernible to a person with normal or corrected vision.

3.1.5 *patching material*, *n*—a liquid, two-part epoxy coating used to repair damaged or uncoated areas.

3.1.6 *wetting agent*, *n*—a material that lowers the surface tension of water, allowing it to penetrate more effectively into small discontinuities in the coating, giving a more accurate indication of the holiday count.

4. Ordering Information

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for the coated wire and welded wire reinforcement under this specification. Such requirements to be considered include, but are not limited to, the following:

4.1.1 Wire or welded wire reinforcement specification and year of issue,

4.1.2 Wire size,

4.1.3 Wire spacing and sizes, if welded wire reinforcement,

4.1.4 Length and width of sheets or rolls,

4.1.5 Quantity,

4.1.6 Class and type of coating,

4.1.7 Requirements for the epoxy powder coating and provision of test data (5.2 and 5.3),

4.1.8 Requirements for patching material (5.4),

4.1.9 Quantity of patching material,

4.1.10 Specific requirements for test frequency (9.1),

4.1.11 Additional specimens to be provided to the purchaser for testing from the coated wire or welded wire reinforcement being furnished (12.1),

4.1.12 Whether a report on tests performed on the coated wire or welded wire reinforcement being furnished is required (15.2), and

4.1.13 Manufacturer qualification and certification requirements (if any).

NOTE 2—It is recommended that the manufacturing procedures and processes be audited by an independent certification program for epoxy coating applicators plants, such as that provided by the Navy Facility Guide Specification or equivalent.

NOTE 3—A typical ordering description is as follows: 150 sheets 150 × 300 – MD 45 × MD 26 2440 mm (+0, +0) × 6.1 m [6 × 12 – W7.0 × W4.0 96 in. (+0, +0) × 20 ft] epoxy coated to Specification A 884/A 884M_____ Class A Type 2. Include written certifications for powder coating and coated WWR, and one patch kit.

5. Materials

5.1 Plain or deformed steel wire or welded wire reinforcement to be coated shall meet the requirements the applicable Specification, A 82/A 82M, A 185/A 185M, A 496/A 496M, or A 497 as specified by the purchaser and shall be free of surface contaminants such as oil, grease, or paint when received at the manufacturer's plant and prior to cleaning and coating.

5.2 Type 1 coatings shall meet the requirements of and shall be qualified in accordance with Annex A1 of Specification A 775/A 775M. Type 2 coatings shall meet the requirements of and shall be qualified in accordance with Annex A1 of Specification A 934/A 934M. Upon request, the purchaser shall be provided with the test report for review.

5.2.1 A written certification shall be furnished to the purchaser that properly identifies the designation of each lot of powder coating used in the order, material quantity represented, date of manufacture, name and address of the powder coating manufacturer, and a statement that the supplied powder coating is the same composition as that qualified in accordance with 5.2.

5.2.2 The powder coating shall be stored in a temperature-controlled environment following the written recommendations of the powder coating manufacturer until ready for use. At this point, if the storage temperature is below the plant ambient temperature, the powder coating shall be given sufficient time to reach approximate plant ambient temperature. The powder coating shall be used within the powder coating manufacturer's written recommended shelf life.

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

5.4 If specified in the order, patching material, compatible with the coating and inert in concrete, and recommended by the coating manufacturer shall be supplied to the purchaser.

6. Surface Preparation

6.1 The surface of the steel wire or welded wire reinforcement to be coated shall be cleaned by abrasive blast cleaning to near-white metal in accordance with SSPC–SP10. The final surface condition shall be defined according to SSPC-VIS 1. Average blast profile maximum roughness depth readings of 40 to 100 µm [1.5 to 4.0 mils] as determined by replica tape measurements using NACE RP-287-87 shall be considered suitable as an anchor pattern.

NOTE 4—Abrasive blast cleaning of wire and welded wire reinforcement with a high degree (> 90 %) of grit in the cleaning media provides

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the most suitable anchor profile for coating adhesion. After grit has been recycled, a small portion will take on the appearance of shot.

NOTE 5—The use of a profilometer type surface measurement instrument which measures the peak count as well as the maximum profile depth is recommended.

6.2 Multidirectional, high-pressure, dry air knives shall be used after blasting to remove dust, grit, and other foreign matter from the steel surface. The air knives shall not deposit oil on the steel reinforcement.

NOTE 6—It is recommended that incoming wire and welded wire reinforcement and blast media should be checked for salt contamination prior to use. Blast media found to be salt contaminated should be rejected. Wire and welded wire reinforcement found to be salt contaminated from exposure to deicing salts or salt spray should be cleaned by acid washing or other suitable methods to remove salt contaminants from the surface prior to blast cleaning.

6.3 It shall be permissible for the manufacturer to use a chemical wash or conversion of the blast-cleaned steel reinforcement surface, or both, to enhance coating adhesion. This pretreatment shall be applied after abrasive cleaning and before coating, in accordance with the written application instructions specified by the pretreatment manufacturer.

7. Coating Application

7.1 The powder coating shall be applied to the cleaned and pretreated (if used) surface as soon as possible after surface treatments have been completed, and before visible oxidation of the surface occurs 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.

7.2 The fusion-bonded epoxy powder coating shall be applied in accordance with the written recommendations of the manufacturer of the powder coating for initial steel surface temperature range and post-application cure requirements. During continuous operations, the temperature of the surface immediately prior to coating shall be measured using infrared guns or temperature-indicating crayons, or both, at least once every 30 min.

NOTE 7—The use of infrared and temperature-indicating crayon measurement of the reinforcement is recommended.

7.3 The coating shall be applied by electrostatic spray or other suitable method.

8. Requirements for Coated Wire or Welded Wire Reinforcement

8.1 *Coating Thickness*:

8.1.1 *Class A*—The coating thickness measurements after curing shall be ≥ 175 µm [7 mils].

8.1.2 *Class B*—The coating thickness measurements after curing shall be ≥ 450 µm [18 mils], for both plain and deformed welded wire reinforcement for use in mechanically stabilized earth applications.

8.1.3 A single recorded coating thickness measurement is the average of three individual gauge readings obtained approximately evenly spaced along each side of the coated wire or welded wire reinforcement test specimen. A minimum of five recorded measurements shall be taken approximately evenly spaced along each side of the test specimen (A minimum of 10 recorded measurements per test specimen). No individual gauge reading shall be taken closer than 13 mm [0.5 in.] from an intersection.

8.1.4 For acceptance purposes, the average of all coating thickness measurements shall not be less than the specified minimum thickness. No single coating thickness measurement shall be less than 80 % of the specified minimum thickness. Any individual gauge reading may be under-run by a greater amount.

8.1.5 Measurements shall be made in accordance with SSPC-PA2 following the instructions for calibration and use recommended by the thickness gage manufacturer. Pull-off or fixed-probe gages shall be used. Pencil-type pull-off gages that require the operator to observe the reading at the instant the magnet is pulled from the surface shall not be used.

8.2 *Coating Continuity*:

8.2.1 There shall not be more than an average of three holidays per metre [one holiday per foot] on the coated wire (spool and individual lengths).

8.2.2 In welded wire reinforcement, there shall not be more than an average of three holidays per metre [one holiday per foot] in each wire direction. Voids (uncoated areas due to the faraday cage effect and weld spurs) at welded intersections shall not be counted. Damage at cut ends shall not be counted.

8.2.3 Holiday checks to determine acceptability of the wire or welded wire reinforcement shall be made at the manufacturer's plant with a 67½-V, 80 000–Ω, wet-sponge-type dc holiday detector.

NOTE 8—Holiday detection is not intended for use at the job site.

8.3 *Bend Test—Type 1 Coating Requirement Only*:

8.3.1 The flexibility of the coating shall be evaluated by bending production coated steel wire and welded wire reinforcement at a uniform rate 180° (after rebound) around a mandrel of specified size as prescribed in Table 1. The test specimens shall be between 20 and 30°C [68 and 86°F].

8.3.2 Cracking or disbonding of the coating on the outside radius or wrinkling of the coating on the inside radius of the bent wire or welded wire reinforcement visible to a person with normal or corrected vision shall be considered cause for rejection of the coated wire or reinforcement represented by the bend test sample.

8.4 *Place of Testing*—Testing of coated steel wire or welded wire reinforcement shall be done at the manufacturer's plant prior to shipment.

8.5 *Time of Testing*—The requirements for coated wire or welded wire reinforcement shall be met at the manufacturer's plant prior to shipment.

9. Number of Tests

9.1 The purchaser shall have the option to specify the sampling and test schedule for the number and frequency of tests for coating thickness, flexibility, and continuity.

9.2 If the number and frequency of tests are not specified by the purchaser:

9.2.1 Tests for coating thickness and continuity shall be made on a minimum of 0.3 m [1 ft] of each size of wire or style of welded wire reinforcement coated during each production hour.

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9.2.2 Bend tests for Type 1 coating flexibility shall be conducted on at least one wire of each size or style of welded wire reinforcement from each 2 h of production.

10. Retests

10.1 If the specimen for coating thickness, continuity, or bend test (if applicable) fails to meet the specified requirements, two retests on random specimens shall be conducted for each failed test. If the results of both retests meet the specified requirements, the coated material represented by the specimens shall be accepted.

11. Handling and Identification

11.1 All systems for handling coated reinforcement shall have padded contact areas. Bundling bands shall be padded, or suitable banding shall be used to prevent damage to the coating. Bundles of coated reinforcement shall be lifted with a strong back, spreader bar, multiple supports, or a platform bridge. The bundled reinforcement shall be transported with care and stored off the ground on protective cribbing. The coated reinforcement shall not be dropped or dragged.

11.2 If circumstances require storing coated wire or welded wire reinforcement outdoors for more than two months, protective storage measures shall be implemented to protect the coated reinforcement from sunlight, salt spray, and weather exposure. If the manufacturer stores coated wire or welded wire reinforcement outdoors without protective covering, the date on which the coated reinforcement is placed outdoors shall be recorded on its identification tag. Coated wire or welded wire reinforcement, whether individual pieces or bundles of pieces, or both, shall be covered with opaque polyethylene sheeting or other suitable opaque protective material. For stacked bundles, the protective covering shall be draped around the perimeter of the stack. The covering shall be secured adequately, and allow for air circulation around the coated reinforcement to minimize condensation under the covering.

12. Inspection

12.1 The inspector representing the purchaser shall have free entry, at all times, to the parts of the manufacturer's coating line that concern the manufacture of the coated wire or welded wire reinforcement ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy the inspector that the coated wire or welded wire reinforcement is being furnished in accordance with this specification. All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the coating line. At a mutually agreed upon frequency, the purchaser or the purchaser's representative shall be permitted to take coated specimens from the production run for testing.

13. Permissible Amount of Damaged Coating Due to Handling and Processing

13.1 Prior to shipment, all visible damaged coating on each wire and welded wire reinforcement shall be repaired with patching material.

13.2 All uncoated areas that result from hanging or supporting coated wire or welded wire reinforcement shall be patched.

13.3 The maximum amount of repaired damaged coating shall not exceed 1 % of the total surface area in each 0.3 m [1 ft] of the wire. This limit shall not include sheared or cut ends that are coated with patching material (see 13.4).

13.4 When coated wire or welded wire reinforcement is sheared, saw-cut, or cut by other means, the cut ends shall be coated with patching material. Coated wire or welded wire reinforcement shall not be flame cut.

13.5 Patching shall be done in accordance with the patching material manufacturer's written recommendations.

NOTE 9—All visible damage incurred to the coating during shipping, handling and installation of the wire and welded wire reinforcement should be repaired with patching material.

13.6 Repaired areas shall have a minimum coating thickness of 175 μm [7 mils].

NOTE 10—This patching material coating thickness applies to both Classes A and B coatings. The desired chemical resistance of the cured patching material can be obtained at this thickness, and recoating the repaired area is avoided.

14. Rejection

14.1 Coated steel reinforcement represented by test specimens that do not meet the requirements of this specification shall be rejected and marked with a contrasting color paint or other suitable identification. At the manufacturer's option, the affected lot shall be replaced or, alternately, stripped of coating, recleaned, recoated, and resubmitted for acceptance testing in accordance with the requirements of this specification.

15. Certification

15.1 At the time of shipment the purchaser shall be furnished written certification that samples representing each lot of coated steel reinforcement have been either tested or inspected as required by this specification and the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

15.2 A material test report, certificate of inspection, or similar document printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the certifier's facility. The content of the EDI transmitted document must meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the supplier. Notwithstanding the absence of a signature, the organization submitting the EDI transmission is responsible for the content of the report.

NOTE 11—The industry definition as invoked here is: EDI is the computer-to-computer exchange of business information in a standard format such as ANSI ASC X12.

16. Keywords

16.1 coating requirements; concrete reinforcement; corrosion resistance; epoxy coating; steel wire; welded wire reinforcement

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APPENDIX

(Nonmandatory Information)

X1. GUIDELINES FOR JOB-SITE PRACTICES

X1.1 This specification is a product standard. Requirements for fusion-bonded epoxy-coated steel reinforcement from the point of shipment to the job-site and subsequent practices at the job-site are not delineated in this product standard.

X1.2 The American Concrete Institute promulgates "Specifications for Structural Concrete" (ACI 301). Standard Specifications ACI 301 is intended to be used in its entirety in the project specifications. An architect-engineer may cite Standard Specifications ACI 301 in the project specifications for any cast-in-place concrete construction project. Standard Specifications ACI 301 include provisions for epoxy-coated steel reinforcement.

X1.3 The project specifications should prescribe requirements for the coated steel reinforcement from the point of shipment to the job-site and subsequent practices at the jobsite. In the absence of these requirements in the project specifications, the following guidelines for job-site practices are recommended:

X1.3.1 When handling coated steel reinforcement, care should be exercised to avoid bundle-to-bundle or wire-to-wire abrasion.

X1.3.2 Equipment for handling coated steel reinforcement should have protected contact areas.

X1.3.3 Coated steel reinforcement should be off-loaded as close as possible to their points of placement or under the crane so that the material can be hoisted to the area of placement to minimize rehandling.

X1.3.4 Coated steel reinforcement should be stored off the ground on protective cribbing, and timbers placed between bundles when stacking is necessary. Space the supports sufficiently close to prevent sags in the bundles.

X1.3.5 Coated and uncoated steel reinforcement should be stored separately.

X1.3.6 Long-term storage should be minimized and work stoppages phased to suit construction progress.

X1.3.7 If circumstances require storing coated steel reinforcement outdoors for more than two months, protective storage measures should be implemented to protect the material from sunlight, salt spray and weather exposure. If the coated steel reinforcement are stored outdoors without protective covering, it is recommended that the date on which the coated reinforcement are placed outdoors be recorded on the identification tag on the bundled steel. Coated steel reinforcement stored in corrosive environments may require protection sooner. Coated steel reinforcement should be covered with opaque polyethylene sheeting or other suitable opaque protective material. For stacked material, the protective covering should be draped around the perimeter of the stack. The covering should be secured adequately, and allow for air circulation around the coated reinforcement to minimize condensation under the covering.

X1.3.8 When the extent of damaged coating exceeds 2 % of the surface area of the coated steel reinforcement in any 0.3–m [1–ft] length, the coated wire or welded wire reinforcement should be rejected.

X1.3.9 When the extent of the damaged coating does not exceed 2 % of the surface area in any 0.3–m [1–ft] length, all damaged coating discernible to a person with normal or corrected vision should be repaired with patching material.

X1.3.10 Coated wire and welded wire reinforcement should not be flame cut.

X1.3.11 Placed coated steel reinforcement should be inspected for damaged coating prior to placing concrete. Where damage exists, it should be repaired with patching material complying with this specification.

X1.3.12 Patching material should be applied in strict accordance with the written instructions furnished by the patching material manufacturer. Prior to application of the patching material, rust should be removed from the damaged areas by suitable means. The patching material should be allowed to cure before placing concrete over the coated steel reinforcement.

X1.3.13 When placing coated steel reinforcement, all wire bar supports, spacers, and tie wire should be coated with dielectric material, that is, an epoxy-coated or plastic-coated material compatible with concrete.

X1.3.14 After placing, walking on coated steel reinforcement should be minimized. The placement of mobile equipment should be planned to avoid damage to the coated material.

X1.3.15 When immersion-type vibrators are used to consolidate concrete around epoxy-coated steel reinforcement, the vibrators should be equipped with nonmetallic vibrator heads.

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SUMMARY OF CHANGES

Committee A01 has identified the location of the following changes to this standard since A 884/A 884M-04 that may impact the use of this standard. (Approved December 1, 2006)

(1) Revised Sections 2.1, 2.3, 8.1.1, 8.1.2, 8.1.3, 8.1.5, and 8.2.2

(2) Added 8.1.4

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