ANSI/AWWA C205-12
(Revision of ANSI/AWWA C205-07)

American Water Works Association

The Authoritative Resource on Safe Water®

AWWA Standard

Cement–Mortar Protective Lining and Coating for Steel Water Pipe—4 In. (100 mm) and Larger—Shop Applied

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA C205.

I. Introduction.

I.A. *Background.* Cement–mortar-lined-and-coated steel pipe was first used in the United States in the late 1800s. Some of the first pipelines were in service for almost a century by the time the first national standard was written. However, it was not until the 1920s that a practical method of plant-applied cement–mortar lining was developed. The first plant-applied linings were installed by standing the pipe on end, placing a tapered plug with a rope attached to the leading end inside the pipe, placing enough cement mortar on top of the plug to coat the pipe, and then pulling the plug up through the pipe. Improvements in the lining process were developed, and the centrifugal process for plant-applied cement–mortar lining emerged.

Cement–mortar-lined and cement–mortar-coated steel pipe combines the physical strength of steel with the protective qualities of cement mortar. The lining, applied centrifugally, creates a smooth, dense finish that protects the pipe from tuberculation and provides a measure of corrosion protection. The smooth interior surface provides a high flow coefficient for the design life of the pipeline under normal operating conditions. In addition, the cement–mortar coating results in a tough, durable, and rugged coating that forms an alkaline environment where oxidation or corrosion of the steel is inhibited.

I.B. *History.* The first edition of this standard, designated 7A.7-41, Standard Specifications for Cement–Mortar Protective Coating for Steel Water Pipe of Sizes 30 Inches and Over, was approved by the AWWA Board of Directors on June 26, 1941. Before that, a tentative draft had been published in the January 1940 *Journal - American Water Works Association* for review and comment.

The first edition provided a section for the field application of cement–mortar lining, which was deleted by action of the Board of Directors effective June 30, 1951. Pending the promulgation of AWWA C602, Cement–Mortar Lining of Water Pipelines—4 In. (100 mm) and Larger—In Place, the ninth, tenth, and eleventh printing of 7A.7 (AWWA C205) continued to carry the withdrawn section.

The next edition, published in 1962, was a major revision and provided for pipe sizes of 4 in. (100 mm) and larger. The standard was subsequently revised in 1971, 1980, 1985, 1989, 1995, 2000, and 2007. This edition was approved on Jan. 22, 2012.

I.C. *Acceptance.* In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a certification program for direct and indirect drinking water additives. Other members of the original consortium included the American Water Works Association Research Foundation (AwwaRF, now the Water Research Foundation) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (AWWA) and the Association of State Drinking Water Administrators (ASDWA) joined later.

In the United States, authority to regulate products for use in or in contact with drinking water rests with individual states.* Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health effects of products and drinking water additives from such products, state and local agencies may use various references, including

1. An advisory program formerly administered by USEPA, Office of Drinking Water, discontinued on April 7, 1990.
2. Specific policies of the state or local agency.
3. Two standards developed under the direction of NSF, NSF†/ANSI‡ 60, Drinking Water Treatment Chemicals—Health Effects, and NSF/ANSI 61, Drinking Water System Components—Health Effects.
4. Other references, including AWWA standards, *Food Chemicals Codex, Water Chemicals Codex*§ and other standards considered appropriate by the state or local agency.

Various certification organizations may be involved in certifying products in accordance with NSF/ANSI 61. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdiction. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Annex A, "Toxicology Review and Evaluation Procedures," to NSF/ANSI 61 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of "unregulated contaminants" are based on toxicity testing guidelines

* Persons outside the United States should contact the appropriate authority having jurisdiction.
† NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48105.
‡ American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
§ Both publications available from National Academy of Sciences, 500 Fifth Street, N.W., Washington, DC 20001.

(noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

ANSI/AWWA C205 does not address additives requirements. Thus, users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements, including applicable standards.
2. Determine the status of certifications by parties offering to certify products for contact with or treatment of drinking water.
3. Determine current information on product certification.

II. Special Issues. The purchaser of cement–mortar linings or coatings is cautioned about the following concerns:

II.A. *Soft, Aggressive Waters.* Soft, aggressive waters, as well as prolonged contact with heavily chlorinated water, may be injurious to cement–mortar linings. When this environment is anticipated, further studies may be necessary to determine the suitability of this type of lining.

II.B. *Intermittent Operations.* Cement–mortar linings are best suited for pipelines that are continuously filled with water. When cement–mortar-lined pipelines are operated under prolonged empty conditions, special precautions may have to be taken to prevent excessive drying out of the cement–mortar lining.

II.C. *Flow Velocity.* Cement–mortar linings perform best when flow velocities are in normal ranges. When the flow velocity exceeds approximately 20 ft/sec (6.1 m/sec), special studies may be required to determine the suitability of this type of lining material.

II.D. *Strain Limitations.* Consideration should be given to limiting the maximum strains (or stresses) developed in the steel cylinder of cement–mortar-lined or -coated steel water pipe from internal pressure to ensure the long-term design life of the system.

II.E. *Weld-After-Backfill.* Weld-after-backfill is the sequence of assembling a lap-welded joint, welding the outside (if required), applying the exterior coating, backfilling the pipe, and then welding the inside joint at a later time (where inside welding is safe and practical). Welding inside field joints after backfill may damage or compromise the performance of shop and field-applied dielectric coatings. Prior to specifying or approving weld-after-backfill, consult with the manufacturers regarding recommended products, installation, and backfill procedures required for the weld-after-backfill sequence. At the request of the purchaser, the manufacturer shall provide testing or historical information to verify that the exterior coating complies with this standard after completion of welding.

II.F. *Cement–Mortar Lining Thickness.* Properly applied cement mortar will inherently have some variations of thickness. The mortar lining thickness may be slightly less than the minimum thickness at localized areas provided the average thickness is not outside of the thickness tolerances given in Table 1 of the standard.

III. Use of This Standard. It is the responsibility of the user of an AWWA standard to determine that the products described in that standard are suitable for use in the particular application being considered.

III.A. *Purchaser Options and Alternatives.* When purchasing protective cement–mortar lining or coating for steel water pipe under the provisions of this standard, the following items (including specific details where applicable) should be specified by the purchaser:

1. Standard used—that is, ANSI/AWWA C205, Cement–Mortar Protective Lining and Coating for Steel Water Pipe—4 In. (100 mm) and Larger—Shop-Applied, of latest revision.
2. Whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required.
3. If interior lining only, exterior coating only, or both lining and coating are required.
4. Footage, inside diameter after lining, lengths of pipe sections, steel-wall thickness, type of joint, and information regarding fittings.
5. Details of other federal, state or provincial, and local requirements (Sec. 4.1.3).
6. Whether reinforcing wire should be galvanized (Sec. 4.2.1.1).
7. Type of wire-fabric reinforcement required, if limited to a single type (Sec. 4.2.1.2).
8. Type of cement required, if other than Type I, Type II, or Type V (Sec. 4.2.2.1).
9. Whether application of a primer at holdbacks is required (Sec 4.2.7).
10. Lining options or restrictions, if any, such as thickness of lining (Sec. 4.4.2), thickness tolerances (Sec. 4.4.2), and length of lining holdback (Sec. 4.4.2).
11. Coating options or restrictions, if any, such as type of undercoat, if any (Sec. 4.5.1); length of coating holdback (Sec. 4.5.3); thickness of mortar coating (Sec. 4.5.3); minimum thickness (Sec. 4.5.3); type of reinforcement (Sec. 4.5.5); and method of curing (Sec. 4.5.9).
12. Whether cement–mortar overcoat is required (Sec. 4.6), and whether cement–mortar overcoat in a single application is allowed (Sec. 4.6.5.1, 4.6.5.2, and 4.6.6.1).

13. If cement–mortar overcoat cracks between 1/16 in. (1.6 mm) and 1/8 in. (3.2 mm) in width require repair (Sec. 4.6.8.2).

14. If additional testing of cement mortar for linings is required (Sec. 5.1.1).

15. The basis of payment for additional testing specified or ordered by the purchaser (Sec. 5.1.1).

16. If an affidavit of compliance is required (Sec. 6.3).

III.B. *Modification to Standard.* Any modification to the provisions, definitions, or terminology in this standard must be provided by the purchaser.

IV. Major Revisions. The major revisions to this edition of the standard are summarized as follows:

1. Added a new section in the foreword under Sec. II, Special Issues, on cement–mortar lining thickness.

2. A definition for moist curing was added in Section 3.

3. Sec. 4.2.1.3, Ribbon mesh, was revised to clarify that wire shall conform to the physical and chemical requirements of ASTM A82.

4. The title of Sec. 4.2.7, Paint was changed to Primer, and the specific properties were changed to more general properties.

5. Sec. 4.4.3, Equipment, was deleted and the information was moved to a new Sec. 4.4.4.1 for better readability.

6. Sec. 4.4.6, Defective lining, was revised to include a new section 4.4.6.2, Lining Shrinkage, that includes information on the drying shrinkage of cement–mortar linings.

7. Sec. 4.5.2, Cement mortar: the second paragraph for the pneumatic process for the mortar was revised to state that the Portland cement can be measured by weight or volume, because many pneumatic systems go by volume. This same change was made to Sec. 4.7.3, Outside field joints (Sec. 4.7.3.1, Material), for the material used in the field joint grouting mortar since it will be difficult to prepare the mix by weight in the field.

8. Sec. 4.5.2, Cement mortar: the third paragraph was revised to clarify that the acid-soluble chloride ion (Cl^-) content needs to be determined in accordance with ASTM C1152 or AASHTO T260.

9. Sec. 4.5.5.5, Special reinforcement: the last two sentences were deleted because they are design related and are covered in Manual M11.

10. Sec. 4.5.8.2 and Sec. 4.6.8.2, Coating cracks: the repair procedure of painting cracks with an epoxy coating was deleted as an option for both the cement–mortar coating and overcoat sections.

11. Sec. 4.5.9.4, Membrane curing, was revised to allow other membrane-forming compounds to be used.

12. Sec. 4.6.5.1, General, and Sec. 4.6.6.1: the approval by the purchaser to allow for a single pass application of the cement–mortar overcoat was deleted because Sec. 4.6.5.1 already includes additional provisions for the use of a single pass application.

13. Sec 5.2, Testing of Cement–Mortar Coating, was revised to clarify that the section is referring to mortar coatings applied in accordance with Sec. 4.5.

14. A new Sec. 5.3 was added for Calibration of the Manufacturer's Equipment.

V. Comments. If you have any comments or questions about this standard, please call AWWA Engineering and Technical Services at 303.794.7711, FAX at 303.795.7603, write to the department at 6666 West Quincy Avenue, Denver, CO 80235-3098, or e-mail at standards@awwa.org.

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AWWA Standard

Cement–Mortar Protective Lining and Coating for Steel Water Pipe—4 In. (100 mm) and Larger—Shop-Applied

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes the material, application, and curing of shop-applied cement–mortar protective linings and coatings for steel water pipe and fittings and field jointing of cement–mortar-lined-and-coated steel water pipe and fittings.

1.1.1 *Pipe-lining application methods.* The inside of pipe shall receive a cement–mortar lining applied by centrifugally spinning or by a method known to provide equivalent results.

1.1.2 *Fitting lining application methods.* The application of cement–mortar linings to miters, angles, bends, reducers, and other special sections, the shape of which precludes application by the spinning process, shall be accomplished by mechanical placement, pneumatic placement, or hand application and finished to produce a smooth, dense surface.

1.1.3 *External coating.* The outside of pipe and specials shall receive a reinforced cement–mortar coating applied by mechanical placement, pneumatic placement, or a method known to provide equivalent results.