ANSI/AWWA C105/A21.5-10
(Revision of ANSI/AWWA C105/A21.5-05)

American Water Works Association

The Authoritative Resource on Safe Water®

AWWA Standard

Polyethylene Encasement for Ductile-Iron Pipe Systems

Effective date: Oct. 1, 2010.
First edition approved by AWWA Board of Directors in 1972.
This edition approved June 20, 2010.
Approved by American National Standards Institute July 15, 2010.

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AWWA Standard

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA C105/A21.5.*

I. Introduction

I.A. *Background.* In 1926, the American Standards Association (ASA) (now American National Standards Institute [ANSI]) Committee A21, Cast-Iron Pipe and Fittings, was organized under the sponsorship of the American Gas Association (AGA), the American Society for Testing and Materials (ASTM), American Water Works Association (AWWA), and the New England Water Works Association (NEWWA). The current sponsor is AWWA, and the present scope of Committee A21 is to develop standards and manuals for ductile-iron pressure pipe for water, wastewater, and reclaimed water service and ductile-iron and gray-iron fittings for use with this pipe. These standards and manuals include design, dimensions, materials, coatings, linings, joints, accessories, and methods of inspection and testing.

In 1958, Committee A21 was reorganized. Standards were divided into groups focusing on the topics listed above, and subcommittees were established to study each group in accordance with the review and revision policy of ASA. In 1984, the committee became AWWA Standards Committee A21 on Ductile-Iron Pipe and Fittings.

The present scope of A21 Subcommittee 4, Coatings and Linings, is to review interior and exterior corrosion of ductile-iron pipe and fittings and to draft standards for the interior and exterior protection of ductile-iron pipe and fittings. Accordingly, Subcommittee 4 is responsible for the development of

1. Standards on polyethylene encasement materials and their installation to provide corrosion protection, when required, for ductile-iron pipe and fittings.
2. Procedures for the investigation of soil to determine when polyethylene protection is indicated.

I.A.1 History of polyethylene encasement. Loose polyethylene encasement was first used experimentally in the United States in 1951 for protection of gray-iron pipe in corrosive environments. The first field installation of polyethylene wrap on gray-iron pipe in an operating water system was in 1958. The installation consisted of approximately 600 ft (180 m) of 12-in. (305-mm) pipe installed in a waste-dump fill area. Since 1958, polyethylene encasement has been used extensively in installations in severely corrosive soils throughout the United States on pipe ranging in size from 3 in.

* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

to 64 in. (76 mm to 1,600 mm) in diameter. Polyethylene encasement has been used as a soil-corrosion preventive in a number of other countries as well. An International Standard for Polyethylene Sleeving (ISO-8180)* has been adopted since the procedure was developed in the United States.

I.B. *Research.* The Cast Iron Pipe Research Association (CIPRA)† (now known as the Ductile Iron Pipe Research Association [DIPRA]) has researched several severely corrosive test sites. The tests indicate that polyethylene encasement provides a high degree of protection resulting in minimal and generally insignificant exterior surface corrosion of ductile-iron and gray-iron pipe protected in this manner.

Investigations of many field installations in which loose polyethylene encasement has been used as protection for ductile-iron and gray-iron pipe against soil corrosion confirm DIPRA's findings. These field installations also indicate that the dielectric capability of polyethylene provides shielding for ductile-iron and gray-iron pipe from stray direct current at most levels encountered in the field.

I.C. *History.* The first edition of this standard was published in 1972 as American National Standard for Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids.

In 1976, Subcommittee 4 reviewed the 1972 edition and submitted a recommendation to Committee A21 that the standard be reaffirmed without change, except for updating the foreword.

In the 1982 revision, ANSI/AWWA C105/A21.5-82, references to gray cast-iron pipe were deleted from the title and throughout the standard because gray cast-iron pipe was no longer produced in the United States. Also, metric conversions of all dimensions were added to the standard.

The 1986 edition of the standard defined the thickness requirement for polyethylene film; provided new figures showing installation methods; and extended the length of connecting piping to be wrapped from 2 ft (0.6 m) to 3 ft (0.9 m). Additionally, a requirement for wrapping service lines of dissimilar metals for a distance of 3 ft (0.9 m) from the ductile-iron pipe was also incorporated.

In the 1993 revision of the standard, Sec. 4.1, Materials, was expanded to include 4-mil high-density cross-laminated (HDCL) polyethylene, and Class B (colors) material was added to allow the purchase of colored polyethylene. Additionally, Table 1 was modified to reflect reduced tube widths comparable with push-on joint pipe and fittings,

* International Organization for Standardization (ISO), ISO Central Secretariat, 1 ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland.

† CIPRA became the Ductile Iron Pipe Research Association (DIPRA) in 1979.

and the size range was expanded to include 60- and 64-in. (1,500- and 1,600-mm) pipe. A recommendation that circumferential wraps of tape be placed at 2-ft (0.6-m) intervals along the barrel of the pipe for installation below the water table or in areas subject to tidal actions was added to Sec. 4.3.1, and Sec. 4.3.6 was revised to indicate the preferred method of making direct service taps on polyethylene-encased pipe. An illustration of this procedure was added.

In 1999, the format was changed to AWWA standard style; Sec. II.D, Copper Service Connections, was added to the foreword of the standard; and, definitions of parties and types of polyethylene film were added to Section 3, Definitions, of the standard. Additionally, changes to Sec. 4.1, Materials, included: (1) deletion of low-density polyethylene film; (2) the addition of linear low-density polyethylene film and appropriate material requirements and physical properties; (3) increasing the tensile strength requirements for the high-density cross-laminated polyethylene film; (4) the addition of impact- and tear-resistance requirements for both polyethylene materials; (5) deletion of the minus tolerance on film thickness for both materials; and, (6) the addition of an ultraviolet inhibitor to any natural or colored film except black film containing 2 percent or more of carbon black. Other changes to the standard included the addition of Sec. 4.3, Marking, to facilitate traceability and to help ensure compliance with the standard; the addition of an alternate method of using a 3-ft (0.9-m) sheet of polyethylene rather than a 3-ft (0.9-m) length of polyethylene tube for joint makeup to Sec. 4.4.2.2, Method; and, the addition of Sec. 5.1, Inspection and Certification by Manufacturer, to help ensure compliance with the standard. Also, in appendix A, a new paragraph on stray current corrosion and a new section on uniquely severe environments were added. Additionally, the resistivity ranges in Table A.1, Soil-Test Evaluation, were increased to make the procedure more conservative.

The next edition of ANSI/AWWA C105/A21.5 was approved by the AWWA Board of Directors on June 12, 2005. This edition of ANSI/AWWA C105/A21.5 was approved on June 20, 2010.

II. Special Issues.

II.A. *Useful Life of Polyethylene.* Tests of polyethylene used to protect ductile-iron and gray-iron pipe have shown that after 40 years of exposure to severely corrosive soils, strength loss and elongation reduction are insignificant. US Bureau of Reclamation (BUREC) studies* of polyethylene film used underground illustrate

* Laboratory and Field Investigations of Plastic Films. US Department of the Interior, Bureau of Reclamation, Rept. No. ChE-82 (September 1968).

that tensile strength was nearly constant and that elongation was only slightly affected during a seven-year test period. BUREC's accelerated soil-burial testing (acceleration estimated to be 5 to 10 times that of field conditions) shows polyethylene to be highly resistant to bacteriological deterioration.

II.B. *Type of Material.* The materials described in this standard are a linear low-density polyethylene film and a high-density cross-laminated film. A low-density film was used in the initial research and testing of polyethylene encasement to protect ductile-iron and gray-iron pipe from corrosion. The current materials provide the same degree of protection as the low-density film and are stronger and more damage resistant. Other types of polymeric material are also available that may provide equally suitable protection.

II.C. *Exposure to Sunlight.* Prolonged exposure to sunlight will eventually deteriorate polyethylene film. Although the film is required to contain not less than 2 percent carbon black or 2 percent of a hindered-amine ultraviolet inhibitor, exposure of wrapped pipe should be kept to a minimum.

II.D. *Copper Service Connections.* The direct connection of copper services to ductile- and gray-iron pipelines has historically been a common practice in the waterworks industry. To minimize the possibility of bimetallic corrosion, service lines of dissimilar metals and the attendant corporation stop should be wrapped with polyethylene or a suitable dielectric tape for a minimum clear distance of 3 ft (0.9 m) from the main (Sec. 4.4.7).

In addition, the grounding of household electrical services to the copper water service line may also result in stray current corrosion of the copper service or the ductile-iron or gray-iron main. AWWA policy opposes the grounding of electrical systems to pipe systems conveying drinking water to a customer's premises. AWWA further states that interior piping systems may be connected to an electrical service neutral and to a separate grounding electrode, provided these systems are electrically insulated from the water utility's pipe system. To minimize the possibility of stray-current corrosion on the ductile-iron or gray-iron main, electrical insulating couplings should be installed at the water main.

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.* The following items should be provided by the purchaser:

1. Standard used, that is, ANSI/AWWA C105/A21.5, Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems, of latest revision.

2. Type of polyethylene material (Sec. 4.1.2 and Sec. 4.1.3).
3. Color of polyethylene material (Sec. 4.1.4).
4. Installation method—A, B, or C (Sec. 4.4)—if there is a preference.
5. Requirement for delivery of an Affidavit of Compliance (Sec. 5.1.2).

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. Major revisions made to the standard in this edition include the following:

1. The definition of high-density cross-laminated polyethylene film was revised to more clearly define the lamination process (Section 3).
2. New Sec. 4.1.1 was added to emphasize the use and requirements of virgin polyethylene for film.
3. A minimum thickness requirement for the required tensile strength and a minimum tensile strength per width of film was added for linear low-density polyethylene film and high-density cross-laminated polyethylene film (Sec. 4.1.2.2 and Sec. 4.1.3.2).
4. The minimum elongation was reduced from 800 percent to 700 percent for linear low-density polyethylene film (Sec. 4.1.2.2).
5. The section on color of polyethylene film was reworded for clarification and the maximum particle diameter for carbon black was increased based on the industry standard (Sec. 4.1.4).
6. The section on marking requirements was revised (Sec. 4.3.1).
7. A new section on requirements for polyethylene installers was added (Sec. 4.4.2).
8. Sec. 5.1, Inspection and Affidavit of Compliance, was revised to provide firmer requirements to achieve verification.
9. The first sentence of appendix Sec. A.1.4, Sulfides, was no longer accurate and was deleted.
10. The phrase "salt/brackish water tidal area" was added under Sec. A.3, Uniquely Severe Environments, to help better define this environment (appendix A.3).

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

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American Water Works Association

AWWA Standard

Polyethylene Encasement for Ductile-Iron Pipe Systems

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes materials and installation procedures for polyethylene encasement to be applied to underground installations of ductile-iron pipe. This standard also may be used for polyethylene encasement of fittings, valves, and other appurtenances to ductile-iron pipe systems.

Sec. 1.2 Purpose

The purpose of this standard is to provide the minimum requirements for polyethylene sheet and tubes to be used for external corrosion protection of buried ductile-iron pipe, fittings, and appurtenances.

Sec. 1.3 Application

This standard or sections of this standard can be referenced in documents for the purchasing and installation of polyethylene sheet or tubes for corrosion protection of buried ductile-iron pipe, fittings, and appurtenances.