HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

American Water Works Association
ANSI/AWWA C205-00
(Revision of ANSI/AWWA C205-95)

AWWA STANDARD FOR

CEMENT–MORTAR PROTECTIVE LINING AND COATING FOR STEEL WATER PIPE—4 IN. (100 mm) AND LARGER—SHOP APPLIED

ANSI American National Standards Institute

Effective date: May 1, 2001.
First edition approved by AWWA Board of Directors June 26, 1941.
This edition approved June 11, 2000.
Approved by American National Standards Institute March 14, 2001.

AMERICAN WATER WORKS ASSOCIATION

6666 West Quincy Avenue, Denver, Colorado 80235

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

AWWA Standard

This document is an American Water Works Association (AWWA) standard. It is not a specification. AWWA standards describe minimum requirements and do not contain all of the engineering and administrative information normally contained in specifications. The AWWA standards usually contain options that must be evaluated by the user of the standard. Until each optional feature is specified by the user, the product or service is not fully defined. AWWA publication of a standard does not constitute endorsement of any product or product type, nor does AWWA test, certify, or approve any product. The use of AWWA standards is entirely voluntary. AWWA standards are intended to represent a consensus of the water supply industry that the product described will provide satisfactory service. When AWWA revises or withdraws this standard, an official notice of action will be placed on the first page of the classified advertising section of *Journal AWWA*. The action becomes effective on the first day of the month following the month of *Journal AWWA* publication of the official notice.

American National Standard

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether that person has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review, and users are cautioned to obtain the latest editions. Producers of goods made in conformity with an American National Standard are encouraged to state on their own responsibility in advertising and promotional materials or on tags or labels that the goods are produced in conformity with particular American National Standards.

CAUTION NOTICE: The American National Standards Institute (ANSI) approval date on the front cover of this standard indicates completion of the ANSI approval process. This American National Standard may be revised or withdrawn at any time. ANSI procedures require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute, 11 W. 42nd St., New York, NY 10036; (212) 642-4900.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information or retrieval system, except in the form of brief excerpts or quotations for review purposes, without the written permission of the publisher.

Copyright © 2001 by American Water Works Association
Printed in USA

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

Committee Personnel

The Steel Water Pipe-Manufacturer's Technical Advisory Committee (SWPMTAC) Task Group on updating AWWA C205, which developed this standard, had the following personnel at the time:

Henry H. Bardakjian, *Chair*

H.H. Bardakjian, Ameron Concrete & Steel Pipe, Rancho Cucamonga, Calif. (AWWA)
B.J. Britton, W. Walsh Company, Attleboro, Md. (AWWA)
R.J. Card, Brico Industries Inc., Atlanta, Ga. (AWWA)
Jim Davenport, Northwest Pipe Company, Riverside, Calif. (AWWA)
B.H. Ebner, Heitkamp Inc. Watertown, Conn. (AWWA)
Bruce Vanderploeg, Northwest Pipe Company, Portland, Ore. (AWWA)

The AWWA Standards Committee on Steel Pipe, which reviewed and approved this standard, had the following personnel at the time of approval:

George J. Tupac, *Chair*

John H. Bambei Jr., *Vice-Chair*

Dennis A. Dechant, *Secretary*

Consumer Members

G.A. Andersen, New York City Bureau of Water Supply, Corona, N.Y. (AWWA)
J.H. Bambei Jr., Denver Water, Denver, Colo. (AWWA)
B.R. Bullert,* Council Liaison, St. Paul Board of Water Commissioners, St. Paul, Minn. (AWWA)
R.V. Frisz, US Bureau of Reclamation, Denver, Colo. (USBR)
T.J. Jordan, Metropolitan Water District of Southern California, La Verne, Calif. (AWWA)
W.M. Kremkau, Washington Suburban Sanitary Commission, Laurel, Md. (AWWA)
T.A. Larson, Tacoma Water Division, Tacoma, Wash. (AWWA)
A.L. Linard, Los Angeles Department of Water and Power, Los Angeles, Calif. (AWWA)

*Liaison, nonvoting

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

G.M. Snyder,* Metropolitan Water District of Southern California, Los Angeles, Calif. (AWWA)

G.P. Stine, San Diego County Water Authority, Escondido, Calif. (AWWA)

J.V. Young, EPCOR Water Services Inc., Richmond, B.C. (AWWA)

General Interest Members

Ergun Bakall, AKM Consulting Engineers, Irvine, Calif. (AWWA)

W.R. Brunzell, Brunzell & Associates Ltd., Skokie, Ill. (AWWA)

R.L. Coffey, Kirkham Michael Consulting Engineers, Omaha, Neb. (AWWA)

H.E. Dunham,* Montgomery Watson, Bellevue, Wash. (AWWA)

L.J. Farr, CH2M Hill Inc., Redding, Calif. (AWWA)

K.G. Ferguson, Montgomery Watson, Las Vegas, Nev. (AWWA)

S.N. Foellmi, Black & Veatch LLP, Irvine, Calif. (AWWA)

J.W. Green, Alvord Burdick & Howson, Lisle, Ill. (AWWA)

K.D. Henrichsen, HDR Engineering Inc., Denver, Colo. (AWWA)

M.B. Horsley,* Black & Veatch LLP, Overland Park, Kan. (AWWA)

J.K. Jeyapalan, Engineering Consultant, New Milford, Conn. (AWWA)

R.Y. Konyalian, Engineering Consultant, Huntington Beach, Calif. (AWWA)

Rafael Ortega, Lockwood Andrews & Newnam Inc., Houston, Texas (AWWA)

A.E. Romer, Boyle Engineering Corporation, Newport Beach, Calif. (AWWA)

H.R. Stoner, Consultant, North Plainfield, N.J. (AWWA)

C.C. Sundberg,* CH2M Hill Inc., Bellevue, Wash. (AWWA)

G.J. Tupac, G.J. Tupac & Associates, Pittsburgh, Pa. (AWWA)

J.S. Wailes,† Standards Engineer Liaison, AWWA, Denver, Colo. (AWWA)

L.W. Warren, Tetra Tech Inc., Seattle, Wash. (AWWA)

W.R. Whidden, Post Buckley Schuh & Jernigan, Winter Park, Fla. (AWWA)

Producer Members

H.H. Bardakjian, Ameron Concrete & Steel Pipe, Rancho Cucamonga, Calif. (AWWA)

T.R. Brown, Sensus Technologies Inc., Uniontown, Pa. (AWWA)

R.J. Card, Brico Industries Inc., Atlanta, Ga. (AWWA)

Dennis Dechant, Northwest Pipe Company, Denver, Colo. (AWWA)

---

*Alternate
†Liaison, nonvoting

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756
仿

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

F.C. Pausic, American Steel Pipe Company, Birmingham, Ala. (MSS)

J.C. Taylor, North American Pipe Inc., Saginaw, Tex. (SPFA)

Bruce Vanderploeg,* Northwest Pipe Company, Portland, Ore. (AWWA)

J.A. Wise, Canus Industries Inc., Port Coquitlam, B.C. (AWWA)

*Alternate

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

SEC.		PAGE
Foreword		
I	Introduction	ix
I.A	Background	ix
I.B	History	ix
I.C	Acceptance	x
II	Special Issues	xi
II.A	Soft, Aggressive Waters	xi
II.B	Intermittent Operations	xi
II.C	Flow Velocity	xi
II.D	Strain Limitations	xi
III	Use of This Standard	xi
III.A	Purchaser Options and Alternatives	xii
III.B	Modification to Standard	xii
IV	Major Revision	xii
V	Comments	xii
Standard		
1	**General**	
1.1	Scope	1
1.2	Purpose	2
1.3	Application	2
2	**References**	2
3	**Definitions**	4
4	**Requirements**	
4.1	General	4
4.2	Material	5
4.3	Surface Preparation	6
4.4	Cement–Mortar Lining	7
4.5	Cement–Mortar Coating	10
4.6	Cement–Mortar Overcoat	14
4.7	Field Joints	17
5	**Verification**	
5.1	Sampling and Testing Cement Mortar for Linings	18
5.2	Testing Cement Mortar for Coatings	19
5.3	Inspection and Testing by Purchaser	20
6	**Delivery**	
6.1	General	21
6.2	Plastic End Caps	21
6.3	Affidavit of Compliance	21
Tables		
1	Cement–Mortar-Lining Thickness	7

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

Foreword

This foreword is for information only and is not a part of 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 will provide 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 AWWA* for review and comment.

The first edition provided 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, and 1995. This edition was approved on June 11, 2000.

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

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 all direct and indirect drinking water additives. Other members of the original consortium included the American Water Works Association Research Foundation (AWWARF) 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 Apr. 7, 1990.

2. Specific policies of the state or local agency.

3. Two standards developed under the direction of NSF, ANSI†/NSF‡ 60, Drinking Water Treatment Chemicals—Health Effects, and ANSI/NSF 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 ANSI/NSF 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 ANSI/NSF 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

*Persons in Canada, Mexico, and non-North American countries should contact the appropriate authority having jurisdiction.

†American National Standards Institute, 11 W. 42nd St., New York, NY 10036.

‡NSF International, 789 N. Dixboro Rd., Ann Arbor, MI 48105.

§Both publications available from National Academy of Sciences, 2102 Constitution Ave. N.W., Washington, DC 20418.

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756
仿

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

unspecified list of "unregulated contaminants" are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

AWWA C205-00 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 all 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 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/s (6.1 m/s), 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 and/or coated steel water pipe from internal pressure to ensure the long-term design life of the system.

III. Use of This Standard. AWWA has no responsibility for the suitability or compatibility of the provisions of this standard to any intended application by any user. Accordingly, each user of this standard is responsible for determining that the standard's provisions are suitable for and compatible with that user's intended application.

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

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 covered in the purchaser's specifications:

1. Standard used—that is, AWWA C205, Standard for Cement–Mortar Protective Lining and Coating for Steel Water Pipe—4 In. (100 mm) and Larger—Shop Applied, of latest edition.

2. If interior lining only, exterior coating only, or both lining and coating are required.

3. Footage, inside diameter after lining, lengths of pipe sections, steel-wall thickness, type of joint, and information regarding fittings.

4. Whether reinforcing should be galvanized (Sec. 4.2.1.1).

5. Type of wire-fabric reinforcement required, if limited to a single type (Sec. 4.2.1.2).

6. Type of cement required, if other than Type I, Type II, or Type V (Sec. 4.2.2.1).

7. 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).

8. 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).

9. If cement–mortar overcoat is required (Sec. 4.6).

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

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

12 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 in the purchaser's specifications.

IV. Major Revision. The major revision to this edition of the standard is summarized as follows:

1. Sec. 4.6 was added covering cement–mortar overcoat requirements.

V. Comments. If you have any comments or questions about this standard, please call the AWWA Volunteer & Technical Support group, (303) 794-7711 ext. 6283, FAX (303) 795-7603, or write to the group at 6666 W. Quincy Ave., Denver CO 80235.

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

American Water Works Association

ANSI/AWWA C205-00
(Revision of ANSI/AWWA C205-95)

AWWA STANDARD FOR 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 all 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 lining 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, when specified by the purchaser, shall receive a reinforced cement–mortar coating applied by mechanical placement, pneumatic placement, or a method known to provide equivalent results.

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

1.1.4 *Field application.* For field application of cement–mortar lining, refer to ANSI/AWWA C602, Standard for Cement–Mortar Lining of Water Pipelines—4 In. (100 mm) and Larger—In Place.

1.1.5 *Welded steel pipe.* For the fabrication criteria for welded steel pipe, refer to ANSI/AWWA C200, Steel Water Pipe—6 In. (150 mm) and Larger.

1.1.6 *Design considerations.* For design considerations for either welded steel pipe or for cement–mortar linings and cement–mortar coatings, refer to AWWA Manual M11, *Steel Pipe—A Guide for Design and Installation.*

Sec. 1.2 Purpose

The purpose of this standard is to provide purchasers, manufacturers, and constructors with the minimum requirements for shop-applied, cement–mortar lining and coating of steel water pipe, including material, application, inspection, handling, and field-jointing requirements.

Sec. 1.3 Application

This standard or sections of this standard can be referenced in specifications for purchasing and receiving steel water pipe and fittings that have been lined or coated with cement mortar. This standard can be used as a guide for the material requirements, material testing, cement–mortar application, inspection, handling, and field jointing of cement–mortar-lined-or-coated steel water pipe and fittings. The stipulations of this standard apply when this document has been referenced in the purchaser's specifications.

SECTION 2: REFERENCES

This standard references the following documents. In their latest editions, these documents form a part of this standard to the extent specified within this standard. In any case of conflict, the requirements of this standard shall prevail. When specific standards are cited without dates, the designation shall be construed to refer to the latest revision under the same standard number or to superseding standards under a new number, effective at the time of contract, except for provisions in the revised standards that clearly are inapplicable.

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

ASTM* A82—Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

ASTM A185—Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

ASTM A497—Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.

ASTM C31/C31M—Standard Practice for Making and Curing Concrete Test Specimens in the Field.

ASTM C33—Standard Specification for Concrete Aggregates.

ASTM C35—Standard Specification for Inorganic Aggregates for Use in Gypsum Plaster.

ASTM C39—Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

ASTM C94—Standard Specification for Ready-Mixed Concrete.

ASTM C150—Standard Specification for Portland Cement.

ASTM C172—Standard Practice for Sampling Freshly Mixed Concrete.

ASTM C309—Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

ASTM C494—Standard Specification for Chemical Admixtures for Concrete.

ASTM C497/C497M—Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.

ASTM C511—Standard Specification for Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes.

ASTM C881—Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

ANSI†/AWWA C200—Standard for Steel Water Pipe—6 In. (150 mm) and Larger.

ANSI/AWWA C602—Standard for Cement–Mortar Lining of Water Pipelines—4 In. (100 mm) and Larger—In Place.

AWWA Manual M11—*Steel Pipe—A Guide for Design and Installation.*

---

*American Society for Testing and Materials, 100 Barr Harbor Dr., West Conshohocken, PA.

†American National Standards Institute, 11 W. 42nd St., New York, NY 10036.

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

SECTION 3: DEFINITIONS

The following definitions shall apply in this standard:

1. *Accelerated curing:* The process of maintaining a constantly moist surface by creating a humid atmosphere at an elevated temperature.

2. *Autogenous healing:* The process by which cracks in concrete or cement mortar are healed by the formation of calcium carbonate in the presence of moisture.

3. *Constructor:* The party that provides work and materials for placement or installation.

4. *Free water:* Total water content of the cement–mortar mix in excess of moisture absorbed by the mix.

5. *Manufacturer:* The party that manufactures, fabricates, or produces materials or products.

6. *Mechanical placement:* The process of applying cement mortar by projecting the cement mortar at a high velocity against the surface or by any mechanically operated system that provides equivalent results.

7. *Pneumatic placement:* The process of applying cement mortar by propelling the cement mortar against any surface using compressed air.

8. *Purchaser:* The person, company, or organization that purchases any materials or work to be performed.

9. *Rebound:* Cement mortar that does not adhere to the pipe during the application of the cement–mortar coating.

10. *Spinning:* The process of applying cement mortar to the inside surfaces of the pipe and compacting the cement mortar by the centrifugal force resulting from spinning the pipe about its longitudinal axis until the cement mortar has consolidated sufficiently to allow removal of the pipe from the equipment.

SECTION 4: REQUIREMENTS

Sec. 4.1 General

4.1.1 *Equipment.* The equipment for applying cement mortar and for carrying and transporting lined, coated, or lined-and-coated pipe shall permit workers to follow the procedure and obtain results required by this standard.

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

4.1.2 *Materials and workmanship.* All materials provided by the manufacturer shall be new and of the quality specified. All work shall be done in a thorough, professional manner by workers skilled in their various trades.

4.1.3 *Manufacture.* During the entire period of the application of the lining and coating and the curing thereof, the pipe section shall be carefully supported and handled to avoid damage to the cement mortar. If a pipe section must be moved, this procedure shall be done to protect against damage. Any damaged portion of the lining or coating shall be cut out and replaced.

Sec. 4.2 Material

4.2.1 *Reinforcement.*

4.2.1.1 Wire. Steel wire shall be a minimum size of W0.5 (0.080 in. [2 mm]). The wire shall conform to the requirements of ASTM A82. Reinforcing wire need not be galvanized unless otherwise specified by the purchaser.

4.2.1.2 Wire fabric. Reinforcement shall be 2 × 4 W0.5 × W0.5 welded wire fabric. The wire shall conform to the requirements of ASTM A185 or ASTM A497. Unless otherwise specified by the purchaser, wire-fabric reinforcement may be either crimped or uncrimped.

4.2.1.3 Ribbon mesh. Ribbon mesh shall be 1-in. × 1-in. (25-mm × 25-mm) mesh of 18-gauge wire or 1 1/2 in. × 1 1/2 in. (38-mm × 38-mm) mesh of 17-gauge wire. The wire shall conform to the requirements of ASTM A82. The mesh shall not be crimped.

4.2.2 *Portland cement.*

4.2.2.1 Type. Cement for mortar shall conform to ASTM C150. Type I, Type II, or Type V may be used, unless the purchaser specifies a particular type. Sampling and testing shall conform to the individual ASTM specifications designated in that standard. The maximum alkali content shall be limited to 0.60 percent when experience indicates the aggregate sources are reactive to alkalis.

4.2.2.2 Inspection. Satisfactory facilities shall be provided for identifying, inspecting, and sampling cement at the mill, warehouse, and at the site of lining and coating. The purchaser shall have the right to inspect the cement and obtain samples for testing at any of these points.

4.2.2.3 Storage. Cement shall be stored in a weather-tight, dry, well ventilated structure.

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

4.2.2.4 Unsuitable cement. Cement containing lumps shall be rejected and shall immediately be removed from the work site.

4.2.2.5 Temperature. If the temperature of the cement exceeds 150°F (66°C), it shall be stored until cooled to or below that temperature.

4.2.3 *Fine aggregate.*

4.2.3.1 General. Fine aggregate for cement mortar shall consist of natural sand or sand obtained by crushing stone or gravel and shall comply with the requirements of ASTM C33.

4.2.3.2 Gradation. Gradation may be modified by the manufacturer, as approved by the purchaser, to provide a lining and coating of maximum density.

4.2.3.3 Mortar-lining fine aggregate. For cement–mortar-lining thicknesses ½ in. (13 mm) or less, 100 percent of the fine aggregate shall pass a US Standard Sieve No. 4.

4.2.4 *Water.*

4.2.4.1 General. The water used for cement mortar and for curing linings or coatings shall conform to the applicable requirements of ASTM C94. The water may be fresh or recycled concrete process water and shall be free from injurious amounts of oil, acid, strong alkalies, salts, and organic matter.

4.2.5 *Admixtures.* Cement mortar may contain a water-reducing, set-controlling admixture conforming to ASTM C494. No admixture shall contain injurious amounts of chlorides. The purchaser shall be advised of the type and amount of any admixtures if required in the purchaser's specifications.

4.2.6 *Curing compound.* Curing compound for curing cement–mortar linings and coatings shall comply with ASTM C309.

4.2.7 *Paint.* The paint or other materials used to prevent the rusting of steel surfaces at holdbacks of mortar lining or coating before pipe installation shall be of a quick-drying, corrosion-resistant material with good bonding properties to steel and shall dry tack-free and smooth within 4 hr after application. The paint shall be applied, without sags or runs, to a thickness that will not impair the clearances required for proper installation of the joint.

Sec. 4.3 Surface Preparation

4.3.1 *Cleaning surfaces.* Surfaces to be cement–mortar lined or cement–mortar coated shall be cleaned to remove loose or other foreign matter that could interfere with the adherence of the cement mortar.

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

STD.AWWA C205-ENGL 2000 ■ 0783350 0511741 T90 ■
HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

Sec. 4.4 Cement–Mortar Lining

4.4.1 *General.* Cement mortar shall be composed of cement, sand, and water, well mixed and of proper consistency to obtain a dense, homogeneous lining that will adhere firmly to the pipe surface. Cement mortar for lining shall consist of one part cement to not more than three parts fine aggregate by weight. Only enough water to obtain proper placement characteristics of the batched cement mortar shall be used, and the free water content of the cement-mortar lining mix shall not exceed 7 1/2 gal (28.4L) per 94 lb (43 kg) of cement. The water-soluble chloride ion (Cl–) content of the cement–mortar lining mix, expressed as a percentage of the weight of cement, shall not exceed 0.15 percent.

4.4.2 *Thickness.* Cement–mortar lining shall be uniform in thickness, except at joints or other discontinuities in the pipe wall. Lining thickness shall be as listed in Table 1 or as specified by the purchaser. Ends of lining shall be left square and uniform with regard to the longitudinal axis of the pipe, and the lining holdback shall be as specified by the purchaser for the type of joint required. The lining thickness requirements shall be maintained by mechanical-end retaining rings and verified by physical measurements.

4.4.3 *Equipment.*

4.4.3.1 Lining. Straight sections of pipe shall be lined by using a spinning machine specifically designed and built for the purpose of rotating the pipe section and centrifugally applying cement–mortar linings to the interior of steel pipe or by a method known to provide equivalent results. Rotating the pipe and centrifugally applying the lining is the preferred method. Contact the manufacturer to determine diameter limitations.

4.4.3.2 Mixing. The cement mortar shall be mixed in batches. The amount of cement and sand entering into each batch shall be measured by weight. The quantity of water entering the mixer shall be measured automatically by an adjustable device, or it shall be otherwise measured to ensure that the correct quantity of water is being added.

Table 1 Cement–mortar-lining thickness

Nominal Pipe Size		Lining Thickness		Tolerance	
in.	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*
4–10	(100–250)	1/4	(6)	–1/16, + 1/8	(–1.6, +3.2)
11–23	(275–575)	5/16	(8)	–1/16, + 1/8	(–1.6, +3.2)
24–36	(600–900)	3/8	(10)	–1/16, + 1/8	(–1.6, +3.2)
over 36	(over 900)	1/2	(13)	–1/16, + 3/16	(–1.6, +4.8)

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

4.4.4 *Machine lining.*

4.4.4.1 Bracing. When required to prevent distortion or vibration during the spinning, each section of pipe shall be suitably braced with external or internal supports appropriate to the equipment.

4.4.4.2 Placement. During the application of the lining by a spinning machine, the entire quantity of mortar required for completion of the lining of the section of pipe shall be placed without interruption.

4.4.4.3 Finish. After the cement mortar has been distributed to a uniform thickness, the rotation speed shall be increased to produce a dense mortar with a smooth surface.

4.4.4.4 Surplus water. Provision shall be made for removal of surplus water by air blowing, tilting of the pipe, or other methods approved by the purchaser.

4.4.4.5 Lining ends. The lining at the ends of the pipe section shall be left square and uniform with regard to the longitudinal axis of the pipe, and the lining holdbacks shall be as specified by the purchaser for the type of joint required.

4.4.5 *Lining of specials.*

4.4.5.1 General. The application of cement–mortar lining 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.

4.4.5.2 Reinforcement. Wire-fabric reinforcement or ribbon-mesh reinforcement shall be applied to the interior of fittings larger than 24 in. (610 mm) and shall be secured at frequent intervals by tack welding to the pipe, by clips, or by wire. The wires on 2-in. (50-mm) spacing on the 2-in. × 4-in. (50-mm × 100-mm) fabric shall extend circumferentially around the fitting. Repaired areas of machine-applied linings at miters, pipe ends, outlets, and other cuts made in the lining for fabrication of the fitting need not be reinforced if the width of the repair area does not exceed 12 in. (300 mm). Repairs for widths exceeding 6 in. (150 mm) shall be bonded to the steel and adjacent faces of the lining with a bonding agent conforming to ASTM C881, Type II.

4.4.5.3 Thickness. Thickness shall be as required for spun lining of straight sections, except that it may be varied by feathering or filleting to a smooth transition with adjoining sections of pipe.

4.4.5.4 Handwork. Cement mortar for handwork shall be of the same materials and in the same sand–cement proportions as the cement mortar for

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

machine lining except that plaster sand conforming to ASTM C35 may be used in place of sand conforming to ASTM C33. Areas shall be cleaned to remove loose or other foreign matter that would interfere with the adherence of the cement mortar and, if necessary, shall be moistened with water just before the placing of the cement mortar.

4.4.6 *Defective lining.*

4.4.6.1 General. All defects, including, but not restricted to, sand pockets, voids, oversanded areas, blisters, and cracking as a result of impacts, shall be cut out and replaced by hand or pneumatic placement to the same thickness as required for the cement–mortar lining.

4.4.6.2 Lining cracks. Temperature and shrinkage cracks in the cement–mortar lining less than 1/16 in. (1.6 mm) in width need not be repaired. Cracks wider than 1/16 in. (1.6 mm) need not be repaired if it can be demonstrated to the satisfaction of the purchaser that the cracks will heal autogenously under continuous soaking in water. The autogenous healing process may be demonstrated by any procedure that keeps the lining of the pipe continually wet or moist. Pipe used in the demonstration shall be representative of the pipe to be supplied, and water for the moistening of the pipe shall be chemically similar to the water to be carried in the pipeline.

4.4.7 *Curing of lining.*

4.4.7.1 General. Immediately after completion of spinning, the pipe sections may be moved to a curing area. Care shall be exercised at all times to prevent damage to the lining. At the option of the manufacturer, linings shall be accelerated cured, moist cured, or cured by a combination of accelerated and moist curing. Accelerated curing or moist curing may be used interchangeably on a time-ratio basis of 5 1/3 hr of moist curing to 1 hr of accelerated curing. In any case, the total curing period shall be equivalent to 96 hr of moist cure and the minimum curing period before applying the exterior coating shall be equivalent to 24 hr of moist cure. The lining shall be kept continually moist until completion of the minimum specified curing period.

4.4.7.2 Moist curing. Moist curing may be used only if the minimum ambient temperature exceeds 40°F (4°C) continuously during the required minimum curing period. No credit shall be allowed for any time during which the temperature drops below 50°F (10°C).

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com

4.4.7.2.1 On arrival at the curing area, but not later than 30 min after completion of the lining operation, pipe ends shall be covered with plastic or wet burlap for a minimum moist-curing period of 24 hr before applying the exterior coating, if this coating is specified. If a cement–mortar exterior coating is not specified, the lining shall be moist cured for 96 hr before shipment. The ends of the pipe sections shall be kept closed with plastic end caps during the curing period, except when sprinkling heads are used, the reinforcement and outside coatings are being applied, or accelerated curing is being substituted. If the plastic end caps are installed at that time, they can be used for shipping to the jobsite as indicated in Sec. 6.2. The manufacturer shall exercise care and diligence to avoid drying out or cracking of the lining.

4.4.7.3 Accelerated curing. On arrival at the curing area, but not later than 30 min after completion of the lining operation, accelerated curing may begin. The temperature of the pipe shall not be raised above 95°F (35°C) by the introduction of heat for 4 hr after final placement or until the cement mortar has taken its initial set, whichever occurs first.

The ambient vapor shall then be maintained at a temperature between 90°F (32°C) and 125°F (52°C) at a relative humidity of not less than 85 percent for a minimum curing period of 6 hr, after which the exterior coating may be applied, if this coating is specified. The accelerated curing shall be maintained for a minimum period of 6 hr before applying exterior coatings or for a total of 18 hr before shipment.

4.4.7.4 Alternative curing methods. When allowed by the purchaser, alternative curing methods may be substituted, providing the method used by the manufacturer produces a cured lining equivalent to that set forth in Sec. 4.4.7.2 and 4.4.7.3.

Sec. 4.5 Cement–Mortar Coating

4.5.1 *General.* When specified, the external protection of steel pipe shall be a reinforced cement–mortar coating applied over the outer surfaces of the pipe sections and specials. If the pipe has been cement–mortar lined, the curing times specified in Sec. 4.4.7 must elapse before the coating is applied.

4.5.2 *Cement mortar.* Cement mortar applied by mechanical placement shall consist of not more than three parts sand to one part cement, by weight. The water in the mixture shall be carefully controlled. The moisture content of the mixture shall not be less than 7 percent of the total dry weight of the mix.

HUITONG LIMITED/HONGCHENG PIPE FITTING
Web:www.alloypipefitting.com | Email: alloypipefitting@gmail.com
Tel:+86 0317 6287569 | Fax:+86 0317 628756
仿