

ANSI/AWWA **C602-23**
(Revision of ANSI/AWWA C602-17)

AWWA Standard

Cement–Mortar Lining of Water Pipelines in Place—4 In. (100 mm) and Larger

Effective date: June 1, 2023.

First edition approved by Board of Directors June 17, 1955.

This edition approved Jan. 12, 2023.

Approved by American National Standards Institute Jan. 12, 2023.



American Water Works
Association



AWWA Standard

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ISBN-13, print: 978-1-64717-121-8

ISBN-13, electronic: 978-1-61300-658-0

DOI: <http://dx.doi.org/10.12999/AWWA.C602.23>

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Foreword

This foreword is for information only and is not part of ANSI/AWWA C602.*

I. Introduction.

I.A. Background. Cement–mortar lining provides the interior of a ferrous-metal pipe with a smooth finish that protects it from corrosion and tuberculation. The lining can significantly retard the recurrence of these problems in previously used pipe if the pipe has been properly cleaned and repaired before application of the lining. Furthermore, the lining can increase the pipeline's carrying capacity because of the reduction in friction resulting from streamlining surface irregularities.

The use of cement mortar as a protective lining for water mains was reported by the French Academy of Science in 1836. Fourteen years later, cement-lined coated sheet-metal pipe was introduced in the United States. Some of the early pipelines were in use for the better part of a century, but it was not until the 1930s that a practical method was developed for lining pipe in place.

The first field trial of in-place cement–mortar lining (of pipe that had been in service) was conducted in Jersey City, N.J., in 1933. The pipe was a short section 72 in. (1,830 mm) in diameter. The favorable outcome of the trial led to the cleaning and lining of more than 27,000 ft (8,230 m) of aged 48-in. (1,220-mm) riveted-steel pipe supplying Newark, N.J. The lining stopped all leakage and, as a result of streamlining the surface over large rivets, also increased the Hazen-Williams flow coefficient by 14 points (estimated by the engineer).

For many years, the smallest-diameter pipe that could be reconditioned by the centrifugal process was 24 in. (600 mm) because a man was required to ride the lining machine through the pipe. In 1950, a remote-control centrifugal-lining machine was introduced that made in-place lining of progressively smaller-diameter pipe possible. Presently, pipelines ranging from 4 in. (100 mm) to 28 ft (9.2 m) in diameter can be cleaned and cement–mortar lined in place.

I.B. History. The first American Water Works Association (AWWA) standard for cement–mortar lining of pipe in place was published in 1939 as part of AWWA C605-41 (formerly 7A-7-41), Cement–Mortar Protective Lining and Coating for Steel Water Pipe. That standard was primarily concerned with in-plant lining and coating, a completely different process from in-place lining. Therefore, in 1951, the in-place

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

lining portion was withdrawn and expanded into a separate standard under the direction of the late H.A. Price, who authored most of the new document. That standard, AWWA C602, Cement–Mortar Lining of Water Pipelines in Place—Sizes 16 In. and Larger, was approved as tentative in 1954 and made standard in 1955.

In 1962, Price suggested to the AWWA Steel Water Pipe Manufacturers Technical Advisory Committee (SWPMTAC) that AWWA C602-55 should be revised in view of the extended competence of the centrifugal-lining process, which at that time included pipe as small as 4 in. (100 mm) in diameter. The assignment was given to SWPMTAC Subcommittee 8 and resulted in the revision of the standard adopted and published in 1967.

In 1972, the standard was again considered for revision to reflect the state of the art of in-place cement–mortar lining. The more frequent use of in-place cement–mortar lining in new large-diameter steel pipelines prompted the committee to note some of the standard procedures used in this application. The standard was revised in 1976, 1983, 1988, 1995, 2000, 2006, 2011, and 2017. This edition was approved on Jan. 12, 2023.

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 Water Research Foundation (formerly 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. Specific policies of the state or local agency.

Four standards developed under the direction of NSF:[‡] NSF/ANSI/CAN[§] 60, Drinking Water Treatment Chemicals—Health Effects; NSF/ANSI/CAN 61, Drinking Water System Components—Health Effects; NSF/ANSI/CAN 372, Drinking Water

[†] Persons outside the United States should contact the appropriate authority having jurisdiction.

[‡] NSF International, 789 North Dixboro Road, Ann Arbor, MI 48105.

[§] Standards Council of Canada, 55 Metcalfe Street, Suite 600, Ottawa, ON K1P 6L5 Canada.

System Components—Lead Content; and NSF/ANSI/CAN 600, Health Effects Evaluation and Criteria for Chemicals in Drinking Water.

3. Other references, including AWWA standards, *Food Chemicals Codex*, *Water Chemicals Codex*,⁵ 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/CAN 61. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdictions. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

NSF/ANSI/CAN 600 (which formerly appeared in NSF/ANSI/CAN 60 and 61 as Annex A, “Toxicology Review and Evaluation Procedures”) 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 (noncarcinogens) and risk characterization methodology (carcinogens). Use of NSF/ANSI/CAN 600 procedures may not always be identical, depending on the certifier.

ANSI/AWWA C602 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. This standard has no applicable information for this section.

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. Purchaser Options and Alternatives. The following information should be provided by the purchaser:

1. Standard used—that is, ANSI/AWWA C602, Cement–Mortar Lining of Water Pipelines in Place—4 In. (100 mm) and Larger, of latest revision.

⁵ Both publications available from National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20001.

2. Project. Diameter, length, and location of pipeline, including plan and profile drawings when available; limits of pipeline shutdowns, if service requirements make these limits necessary; location of access manholes; location, type, and size of valves; location of interconnecting pipelines, hydrant branches, and service pipes; location of fittings and restrictions that could interfere with cleaning and lining operations; location, diameter, and connections of temporary bypass, if required; and other details of the pipe within the scope of the contract between the purchaser and the constructor.

3. Services provided by purchaser. Description of services or field operations to be performed by the purchaser, such as locating the main to be cleaned and lined; removal and replacement of line valves; operation of valves; tagging valves that separate the main to be cleaned and lined from the water system to prevent accidental opening; shutting off inflow of water from connecting pipelines; locating and operating blowoffs; connecting and disconnecting temporary bypasses to customer services; obtaining permits required for the work; handling customer contact; disinfection; and conducting flow tests.

4. Additional work to be performed by constructor. Description of work, including repairs to deteriorated pipe; extra thickness of lining over the rivet heads and lockbar seams; excavation, backfill, and resurfacing work at access excavations; method of opening and closing access openings in the pipeline; supplying, laying, and removing temporary bypass pipe; and operation of main-line or blowoff valves.

NOTE: When it is necessary to repair deteriorated pipe before lining, the pipe will be repaired by the purchaser or under provisions of the contract between the purchaser and the constructor.

5. Water for cleaning and lining operations. Location of water sources, method of supplying, quantity available, and pressure information.

6. Disposal of cleaning water and debris. Requirements for the disposal of cleaning water, old lining, and other debris; instructions regarding permits from the responsible authorities.

7. Permissible cement–mortar materials. Preference for, or any restrictions on, type of cement or admixtures to be used in lining mortar.

Purchaser options. Options that may be specified by the purchaser after reviewing the following items in the sections noted:

- a. Whether compliance with NSF/ANSI/CAN 61, Drinking Water System Components—Health Effects, is required.
- b. Details of federal, state, provincial, territorial, and local requirements (Sec. 4.3.1).

- c. Cement (Sec. 4.3.2).
- d. Use of admixtures (Sec. 4.3.3, Sec. 4.4.1, and Sec. 4.4.2).
- e. Mortar lining thickness (Sec. 4.4.5).
- f. Access openings (Sec. 4.5.1).
- g. Traffic control (Sec. 4.5.1).
- h. Surface finish (Sec. 4.5.4).
- i. Cleaning of valves; new bolts and gaskets (Sec. 4.5.6.1 and Sec. 4.5.6.2).
- j. Curing by purchaser (Sec. 4.5.7.3).
- k. Temporary bypass to customers (Sec. 4.6).
- l. Disinfection of temporary bypass (Sec. 4.6.2).
- m. Leaking valves (Sec. 4.7.2).
- n. Access openings for lining for new pipe (Sec. 4.8.1).
- o. Surface finish for new pipe (Sec. 4.8.4).
- p. Affidavit of compliance (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 changes made to the standard in this edition include the following:

1. Updated Sec. I.C., Acceptance, in the foreword with the latest Standards Council language reflecting the addition of reference to NSF/ANSI/CAN 372 and 600.
2. In Sec. 3, Definitions, the definition of potable water was added.
3. Updated Sec. 4.3.1, Materials, with the latest Standards Council boilerplate language.
4. Sec. 4.3.2 was revised to include ASTM C595/C595M Type IL cement as an option.

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

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ANSI/AWWA C602-23
(Revision of ANSI/AWWA C602-17)

AWWA Standard

Cement–Mortar Lining of Water Pipelines in Place—4 In. (100 mm) and Larger

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes the requirements for the materials and application of a cement–mortar lining to the inside surface of 4-in. (100-mm) and larger new and old steel, ductile-iron, and cast-iron water pipelines that have been previously installed, as well as related work. The application requirements are that the lining of straight pipe sections and long-radius bends shall be performed by a machine that progresses uniformly through the pipe, applies cement mortar against the pipe surfaces, and is provided with an attachment for mechanically troweling the mortar to obtain a smooth lining of uniform thickness with smooth transitions over joints, and that the lining of bends, specials, and areas adjacent to valves shall be machine sprayed and hand troweled or, where machine placement is impractical, shall be performed manually.

Sec. 1.2 Purpose

The purpose of this standard is to define the minimum requirements for cement–mortar lining of water pipelines, 4 in. (100 mm) and larger, in place, including materials, design, and methods for construction.