American Water Works Association

AWWA C603–78

(Revision of
AWWA C603–65)

AWWA STANDARD

for

INSTALLATION OF ASBESTOS–CEMENT PRESSURE PIPE

First edition approved by AWWA Board of Directors Jan. 27, 1964.
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AMERICAN WATER WORKS ASSOCIATION
6666 West Quincy Avenue, Denver, Colorado 80235

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Foreword

This foreword is for information only and is not part of AWWA C603.

I. History of Standard

A new pipe material consisting of an intimate mixture of portland cement and asbestos fibers was introduced into the North American market in 1931 following several years of usage in other countries, particularly Italy.

In the ensuing years this type of pipe gained popularity, and in 1949 AWWA established a committee on standard specifications for asbestos–cement pipe under the chairmanship of S.M. Clarke of Greeley and Hanson, Chicago.

The committee developed a standard for asbestos–cement water pipe which was approved by the AWWA Board of Directors as *tentative* (AWWA C400–53T) May 15, 1953. In 1958 the committee was reactivated as Committee 8340D on Asbestos–Cement Pipe under the chairmanship of Roy H. Ritter, Whitman, Requardt and Associates, Baltimore.

The committee concluded that an installation guide was desirable to bring to the attention of users certain important requirements on the inspection, handling, installation, and field testing of asbestos–cement pressure pipe. In 1963 the committee submitted its final draft which received approval as *tentative* (AWWA C603–64T) Jan. 27, 1964. It was advanced to *standard* (AWWA C603–65) without revision Aug. 9, 1965.

In early 1968 the committee was reactivated as the Standards Committee on Asbestos–Cement Pressure Pipe to review and revise all AWWA standards on asbestos–cement pipe. The committee considered numerous recommendations for changes resulting in this current standard that has a completely revised format and takes into account various users' bedding methods.

II. Information Regarding Use of This Standard

If AWWA C603 is to be used in its published form, the engineer should prepare and include as part of the project specifications an addendum entitled, "Addendum to the Standard for Installation of Asbestos–Cement Pressure Pipe." Since the standard includes the various standard materials and methods that may be used, the engineer should select the materials and methods that apply to the project and, by reference to the sections in AWWA C603, indicate in the addendum those that are applicable or not. The engineer should include in the addendum information pertaining to subject matter referred to in certain sections of the standard that cannot therein be covered completely and made applicable to all projects. The engineer may also include in the addendum information that covers work and materials not included in the standard.

Although installation of pipe that is laid on earth mounds is included in this standard, caution should be exercised, particularly in small sizes, to ensure (1) that proper clearance is maintained between the pipe or coupling and the trench bottom, and (2) that after pipe placement, the earth beneath the entire length of the pipe including the coupling is properly placed beneath the pipe and is compacted to a uniform density.

III. Major Revisions

The major changes from the 1965 standard made in this revision are:

1. A change in the title calling for "Installation of Asbestos–Cement *Pressure* Pipe" instead of *water* pipe. Therefore, this standard covers both asbestos–cement distribution pipe (AWWA C400) and asbestos–cement transmission pipe (AWWA C402).

2. A major change in format so as to follow "Procedures and Style for Preparation of AWWA Standards."

3. The inclusion of notes in paragraph 3.2.3, Preparation of Trench, to give further assistance in the installation of asbestos–cement pressure pipe.

4. A revision to the section, Pressure and Leakage Tests, to include both asbestos–cement distribution pipe (AWWA C400) and asbestos–cement transmission pipe (AWWA C402).

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AWWA Standard for

Installation of Asbestos–Cement Pressure Pipe

Section 1—General

Sec. 1.1 Scope

This standard covers the installation of water pipelines of asbestos–cement pressure pipe with fittings and appurtenances of asbestos–cement, cast iron, other materials, or combinations of any of these. For specific projects, a thorough review of this standard is recommended for the purpose of supplementing it with provisions for special requirements not included herein. These requirements should be incorporated into the contract requirements.

Sec. 1.2 Definitions

Under this standard, the following definitions shall apply:

1.2.1 *Compacted backfill.* Job-excavated material or other such granular bedding material that is not frozen but is free from debris, organic matter, rocks, and stones, and which, in the opinion of the engineer, is suitable for backfilling. It shall be placed in not more than 6-in. layers and compacted to not less than 90 per cent standard density as defined in ASSHTO T-99.

1.2.2 *Drawings.* Drawings prepared by the owner to show the location and details for the construction of the pipeline and appurtenances.

1.2.3 *Supplementary specifications.* Supplementary specifications prepared by the owner to define which of the alternate materials and procedures provided in the standard apply and to provide for conditions, materials, and procedures not covered by this standard.

Sec. 1.3 References

This standard references the following documents. They form a part of this standard to the extent specified herein. In any case of conflict, the requirements of this standard shall prevail.

AASHTO * T-99
—*Standard Method of Test for Moisture-Density Relationship for Soils*

ANSI A21.11
(AWWA C111)
—*American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings*

ASTM † B29
—*Specifications for Pig Lead*

AWWA C400
—*Standard for Asbestos–Cement Distribution Pipe, 4 in. Through 16 in., for Water and Other Liquids*

AWWA C401
—*Standard Practice for Selection of Asbestos–Cement Distribution Pipe, 4 in. Through 16 in.*

AWWA C402
—*Standard for Asbestos–Cement Transmission Pipe, 18 in. Through 42 in., for Water and Other Liquids*

AWWA C403
—*Standard Practice for the Selection of Asbestos–Cement Transmission and Feeder Main Pipe, Sizes 18 in. Through 42 in.*

AWWA C601
—*Standard for Disinfecting Water Mains*

Section 2–Material Acceptance, Storage, and Handling

Sec. 2.1 Acceptance

At the time of delivery all material shall be examined for defects and damage, and any material that is defective or damaged shall be rejected and removed from the job site.

2.1.1 *Replacement of damaged pipe.* Material that is supplied by the owner and is rejected at the point of delivery because of defects or damage shall be replaced by the owner. Material that is supplied by the contractor and is rejected at the point of delivery because of defects or damage shall be replaced by the contractor. Material damaged subsequent to acceptance by the contractor shall be replaced by the contractor.

Sec. 2.2 Storage

Safe storage shall be provided for material until it has been incorporated into the completed project. The interior of all pipe, couplings, rings, fittings, and other accessories shall be kept free from dirt and other foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

* American Association of State Highway and Transportation Officials, 341 National Press Building, Washington, D.C. 20045.

† American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103.

Sec. 2.3 Handling

At all times material shall be handled with care to avoid damage. Whether moved by hand, skidways, or hoists, material shall not be dropped, bumped, or allowed to impact on itself.

2.3.1 *Rehandling.* All materials to be supplied by the owner shall be claimed at the locations designated in the supplementary specifications and hauled to and distributed at the site.

2.3.2 *Unloading at work site.* In distributing the material at the work site, it shall be unloaded adjacent to or near the location where it is to be installed.

Section 3—General and Detailed Work to be Performed

Sec. 3.1 Alignment and Grade

All pipe shall be laid to and maintained at the lines and grades required by the engineer. Fittings, valves, air vents, and hydrants shall be installed at the required locations with joints centered, spigots home, and valve and hydrant stems plumb. No deviation shall be made from the required line or grade without approval from the engineer or his representative.

Sec. 3.2 Excavation and Preparation of Trench

The trench shall be excavated to the required alignment and depth shown on the drawings, or as subsequently approved in writing by the engineer, and only so far in advance of pipelaying as permitted by the supplementary specifications.

3.2.1 *Excavation methods.* When necessary to prevent caving, trench excavations shall be sheeted and braced or sloped in accordance with applicable laws and ordinances. When sheeting and bracing are used, the trench width shall not be less than that specified in paragraph 3.2.2. As backfill is placed and sheeting is withdrawn, it shall be withdrawn in increments of not more than 1 ft, and the void left by the withdrawn sheeting shall be filled and compacted before withdrawing the next increment. All excavated material shall be piled in a manner that will not endanger the work or obstruct sidewalks and driveways. Gutters shall be kept clear or other provisions made for surface drainage.

3.2.2 *Trench width.* The trench width shall be ample to permit the pipe to be laid and jointed properly and the backfill to be placed and compacted as specified by the engineer. Trenches shall be of such extra width, when required, to permit the convenient placing of timber supports, sheeting and bracing, and the handling of specials.

3.2.3 *Trench preparation.* The trench shall be prepared for the direct placement of the pipe. This includes digging coupling holes in the trench bottom or bedding, or placing properly prepared mounds as specified by the engineer. (Illustrations of the various bedding conditions are in AWWA C401, "Standard Practice for the Selection of Asbestos-Cement Distribution Pipe, Sizes 4-in. Through 16-in.," and AWWA C403, "Standard Practice

for the Selection of Asbestos-Cement Transmission and Feeder Main Pipe, Sizes 18-in. Through 42-in.")

3.2.4 *Excavation in poor soil and refilling to grade.* Any part of the trench excavated below grade shall be backfilled to grade with thoroughly compacted material approved by the engineer. When an unstable subgrade condition is encountered and, in the opinion of the engineer, it cannot support the pipe, an additional depth shall be excavated and refilled to pipe foundation grade with crushed stone or other suitable material as required by the engineer to achieve a satisfactory trench bottom.

3.2.5 *Pipe laid on trench bottom or bedding.* Before the pipe is lowered into the trench,

1. A coupling hole shall be excavated with sufficient length, width, and depth to permit assembly and provide a minimum clearance of 2 in. below the coupling, and

2. The pipe shall be provided with continuous support between coupling holes.

NOTE: Use of approved granular material for bedding is recommended as a preferred method of preparing the trench bottom for pipe installation.

3.2.6 *Pipe laid on earth mounds.* Pipe shall be laid on earth mounds of approved backfill material compacted firmly in place and of a size adequate to hold the pipe in alignment and to maintain a 2-in. minimum clearance from coupling to trench bottom. Each pipe shall be laid on two mounds with the center of each mound placed approximately one fifth of the pipe length from each end. The trench shall be excavated a minimum of 2 in. below the grade of the bottom of the outside diameter of the coupling, and high spots between couplings shall be leveled in order to maintain a minimum of 2 in. under the pipe barrel. The clearance between the trench bottom and the bottom of the coupling and pipe shall be properly backfilled utilizing material approved by the engineer. The material shall be compacted utilizing appropriate equipment to provide a firm and uniform bedding throughout the entire length of the pipe.

NOTE: Earth mounds have been used in some areas with success. However, if this method is to be used, particularly in small sizes, caution should be exercised to ensure (1) that proper clearance is maintained between the pipe or coupling and the trench bottom, and (2) that after pipe placement, the earth beneath the entire length of the pipe including the coupling is properly placed beneath the pipe and is compacted to a uniform density.

Sec. 3.3 Laying of Pipe

3.3.1 *Lowering of pipe and accessories into trench.* Pipe shall not be lowered into the trench until the pipe bed has been brought to grade. All pipe and accessories shall be inspected for defects. Dirt and other foreign matter shall be removed from the interior and the machined ends before lowering into the trench. Pipe and accessories shall be lowered carefully into the trench by hand or with suitable equipment in a manner that will prevent damage to pipe and fittings or injury to the installers. The sealing surfaces of all materials shall be kept clean during installation.

3.3.2 *Pipe joints.* The machined ends of pipe to be jointed, coupling grooves, and rubber rings shall be cleaned immediately before assembly, and assembly shall be made as recommended by the manufacturer. Care

should be taken not to reverse the gasket when placed in the bell. Each pipe joint shall be sealed with a coupling consisting of an asbestos–cement sleeve and two rubber rings or an equivalent coupling or joint of equivalent strength and performance. The pipe joint shall not be deflected either vertically or horizontally beyond the limits recommended by the manufacturer.

3.3.2.1 When pipelaying is not in progress, the open ends of installed pipe shall be closed to prevent entrance of trench water into the line.

3.3.2.2 Whenever water is excluded from the interior of the pipe, enough backfill shall be placed on the pipe to prevent floatation. Any pipe that has floated shall be removed from the trench and the bedding corrected to conform to paragraph 3.2.3. No pipe shall be laid when the weather is unsuitable for proper installation as determined by the engineer.

3.3.3 *Pipe cutting.* Pipe-cutting methods that produce a smooth, square cut end without damage to the pipe and that minimize or eliminate airborne particles shall be employed. Rotating blades, hand saws, or similar materials, when properly used, are acceptable. Abrasive disks are not recommended unless special precautions are taken.

3.3.4 *End preparation.* Whenever it is necessary to cut a length of pipe in the field, the end shall be prepared as follows:

3.3.4.1 The pipe end of random lengths shall be machined by commercially available field lathes designed for this purpose to ensure that the diameter, profile, and roundness meet the pipe manufacturer's specifications. The machined surface on which the compression ring seals shall be smooth and cylindrical to ensure joint integrity.

3.3.4.2 The pipe end of machined overall lengths shall be beveled in accordance with the pipe manufacturer's specifications.

3.3.5 *Length of pipe at fittings and rigid structures.* When rigid joints are formed by caulked materials or by bolts with rubber ring seals, such as at fittings, the length of 8-in. diameter and smaller pipe fitted into the bell of the fittings shall not exceed 3 ft 3 in. and the length of 10-in. diameter and larger pipe shall not exceed 6 ft 6 in. At least one flexible joint shall be used between two adjacent rigid joints. A coupling shall be cast in the wall of rigid structures at the point of entry of pipelines to provide flexibility at the wall. To provide additional flexibility, the pipe at the point of entry shall have a laying length of not more than 6 ft 6 in.

Sec. 3.4 Jointing of Pipe to Valves, Hydrants, and Fittings

3.4.1 *General.* Each valve, hydrant, or fitting connected to asbestos–cement pipe shall either be equipped with a bell of an inside diameter large enough to receive the pipe and caulking of at least ¼-in. thickness around the full circumference of the pipe, or shall have a profile that permits a seal to be made between the machined pipe and the bell of the fitting with a rubber ring.

3.4.1.1 Before valves, hydrants, or fittings are laid, all lumps, blisters, and excess coating shall be removed from the bell. The inside of the bell shall then be wire-brushed and both the inside of the bell and the spigot end of the pipe shall be wiped clean and dry. All surfaces to be jointed shall be kept clean until the joints are made.

3.4.2 *Push-on joints.* The push-on joint is a single rubber-gasket joint.

It shall be assembled by positioning a continuous rubber ring gasket in the annular groove in the fitting bell and pulling the machined pipe end into the bell. A lubricant approved by the pipe manufacturer must be used. Care should be taken to ensure obtaining the correct size of gasket for the fitting bell for use with the correct size of asbestos–cement pipe. Cast-iron bell gaskets and asbestos–cement coupling gaskets are not interchangeable. An asbestos–cement coupling gasket shall not be used in a cast-iron fitting bell.

3.4.3 *Mechanical joint.* The mechanical joint is a bolted joint of the stuffing box type. In some sizes and classes, an adaptor is required between the asbestos–cement pipe and the mechanical joint. The joints shall conform to the current revision of ANSI A21.11 (AWWA C111), "Rubber-Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings," and shall be assembled as required in Appendix A, Notes on Installation of Mechanical Joints, of that standard.

3.4.4 *Poured joints.*

3.4.4.1 The yarning or packing material shall be as specified by the engineer. It shall consist of molded rubber rings. Asbestos rope or treated paper rope may be used only with the approval of the engineer when the space between the bell and spigot will not permit the use of a rubber ring.

3.4.4.2 The yarning material shall be placed around the spigot of the pipe and shall be of proper dimensions to center the spigot in the bell. When the spigot is shoved home, the yarning material shall be driven tightly against the inside base or hub of the bell with suitable yarning tools.

3.4.4.3 When a single strand of yarning material is used, it shall have an overlap at the top of not more than 2 in. When more than a single strand is required for a joint, each strand shall be cut to sufficient length so that the ends will meet without causing overlap. The ends of the strands shall meet on opposite sides of the pipe and not on the top or at the bottom. Successive strands of yarning material shall be driven home separately.

3.4.4.4 Lead-joint bells shall provide a jointing material space of not less than 2¼ in. for pipe of 20 in. diameter and smaller and 2½ in. for pipe 24–42 in. in diameter.

3.4.4.5 Lead for caulking purposes shall meet the current requirements of ASTM B29, "Standard Specifications for Pig Lead, in the Common Desilverized Grade."

Sec. 3.5 Setting of Hydrants, Valves, and Fittings

3.5.1 *General.* Hydrants, valves, and fittings shall be provided and installed as shown on the drawings or as specified in the supplementary specifications. They shall be inspected carefully and cleaned as required in paragraph 3.4.1.1 prior to lowering into the trench.

3.5.2 *Reaction or thrust backing.* A reaction or thrust backing shall be provided at each hydrant, valve, bend, and tee and at reducers or fittings where changes in pipe diameter occur. They shall be centered on the longitudinal axis and extended to solid undisturbed ground. Hydrants may be tied to the water main with rods. The size and shape of the thrust backing or the number and size of the tie rods shall be as shown on the drawings or as specified in the supplementary specifications.

Sec. 3.6 Plugging of Dead Ends

Plugs shall be inserted into the bells of all dead-end fittings. Spigot ends of fittings and plain ends of pipe shall be capped. A reaction or thrust backing shall be provided at all dead ends of pipe that are capped or plugged. Capped or plugged outlets to fittings shall be tied to the fittings and shall be restrained according to the fitting manufacturer's recommendations.

Section 4—Pressure and Leakage Tests

Sec. 4.1 General

The field pressure and leakage tests should be conducted on each section as soon as possible after the following requirements have been met.

4.1.1 *Backfilling.* Backfill sufficient to prevent the lifting of the pipe shall be placed prior to filling with water and field testing. When local conditions require that the trenches be backfilled immediately after the pipe has been laid, the testing may be conducted after backfilling has been completed and before placement of permanent surface.

4.1.2 *Concrete curing time.* Before testing, or as specified by the engineer, at least 36 hr shall elapse after the last concrete thrust or reaction backing has been cast with high-early-strength cement, and at least seven days shall elapse after the last concrete thrust or reaction backing has been cast with standard cement.

Sec. 4.2 Test Pressure

Unless otherwise specified, the test pressure for distribution pipe (AWWA C400, sizes 4 in. through 16 in.) shall be double the operating pressure at the lowest elevation of the system or the class designation of the pipe plus 50 psi, whichever is less. The test pressure for transmission pipe (AWWA C402, sizes 18 in. through 42 in.) shall be the design pressure (operating pressure plus surge) times 1½.

Sec. 4.3 Procedure

The following procedure is based on the assumption that the pressure and leakage tests will be performed at the same time. The total time for the combined pressure and leakage tests for each section shall be a minimum of 2 hr unless otherwise specified. If separate tests are made, the pressure test shall be made first. The duration of the pressure test shall be a minimum of 1 hr. The duration of the leakage test shall be a minimum of 4 hr. The pressure of the leakage test may be reduced to 150 per cent of the maximum working pressure that will occur on that portion of the line or shall equal the test pressure (Sec. 4.2), whichever is less.

4.3.1 *Filling.* After the pipeline has been laid it shall be filled with water for a minimum of 24 hr before being subjected to the hydrostatic pressure test. Each section of the pipeline shall be filled slowly with water and all air expelled by means of taps at points of highest elevation.

TABLE 1

*Allowable Leakage per 100 Couplings**

Pipe Diameter *in.*	Average Test Pressure at Lowest Point in Line—*psi*								
	50	75	100	125	150	175	200	225	250
	Leakage—*gal/hr*								
4	0.71	0.87	1.00	1.12	1.23	1.32	1.42	1.51	1.58
6	1.06	1.29	1.51	1.68	1.84	1.98	2.12	2.25	2.37
8	1.42	1.72	2.00	2.24	2.45	2.64	2.84	3.00	3.16
10	1.77	2.15	2.50	2.79	3.07	3.40	3.54	3.75	3.95
12	2.12	2.58	3.00	3.35	3.68	3.96	4.24	4.52	4.74
14	2.48	3.01	3.50	3.91	4.28	4.62	4.96	5.26	5.50
16	2.83	3.44	4.01	4.47	4.89	5.27	5.68	6.00	6.32
18	3.18	3.87	4.52	5.02	5.52	5.93	6.37	6.75	7.11
20	3.54	4.30	5.00	5.58	6.12	6.58	7.08	7.51	7.90
21	3.73	4.54	5.24	5.88	6.40	6.92	7.42	7.86	8.28
24	4.24	5.16	6.00	6.69	7.34	7.91	8.50	9.01	9.47
27	4.77	5.83	6.74	7.56	8.23	8.90	9.54	10.12	10.66
30	5.30	6.45	7.51	8.37	9.18	9.88	10.62	11.26	11.84
33	5.83	7.13	8.24	9.25	10.06	10.88	11.67	12.36	13.02
36	6.37	7.75	9.01	10.07	11.02	11.88	12.74	13.50	14.22
39	6.88	8.42	9.74	10.83	11.90	12.96	13.79	14.61	15.40
42	7.42	9.08	10.48	11.78	12.82	13.85	14.86	15.74	16.58

* The data are based on 150 psi and represent a leakage of approximately 30 gpd per mile of pipe per in. of pipe diameter for pipe in 13-ft lengths.

4.3.2 *Pressurization.* The specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the engineer. The test pressure shall be maintained for the specified time during which all exposed pipe, couplings, fittings, valves, and hydrants shall be examined carefully.

4.3.3 *Cracked or defective elements.* All cracked or defective elements shall be removed and replaced and the test repeated until all visible leakage has been stopped and the requirements of Sec. 4.4 have been met.

Sec. 4.4 Allowable Leakage

No pipe installation will be accepted if the leakage for the section of line that is tested is more than the rate of leakage specified in Table 1. In determining the number of couplings, consideration should be given to allow for the additional number of joints if the pipe is less than 13 ft. If the test leakage in any section is greater than permitted, the leakage shall be located, repaired, and the test performed until the leakage is within the permitted allowance.

Section 5—Backfilling

Sec. 5.1 Backfill Procedure Before Tests

Backfill material approved by the engineer shall be free of any frozen lumps, rock that is 1½ in. or larger in size, and lumps of clay, large stones, boulders, or other unsuitable substances such as debris. The backfill shall be deposited in the trench up to the horizontal diameter of the pipeline in 6-in. thick compacted layers and shall be sufficiently damp to permit thorough compaction under and on each side of the pipe to provide support that is free from voids.

5.1.1 *Visual inspection not required.* If visual inspection during the hydrostatic tests is not required, then the pipe and joints shall be backfilled as specified previously and a cushion of material hand-placed over the pipe and joints to an average depth of 12 in. for all sizes of pipe.

5.1.2 *Visual inspection required.* If the joints are to be exposed during the test, additional backfill material shall be hand-placed between the joints in order to hold the line securely during the test. The average depth of material in this instance shall be 12 in. over the top of 8-in. diameter and smaller pipe, and 24 in. over larger pipe. In no case shall material with a diameter in excess of 1½ in. be placed in the trench in the first 12 in. above the pipe.

Sec. 5.2 Backfill Procedure After Tests

Upon completion of pressure and leakage tests, exposed couplings shall be covered and backfill hand-placed to a depth of 12 in. above the top of the pipe and couplings. The balance of backfill shall not contain stones that are more than 6 in. in their largest dimension, and the backfill mixture shall not be used for disposal of refuse. Trenches under pavements and sidewalks shall be backfilled to a compaction density of 90 per cent as determined by the American Association of State Highway and Transportation Officials Method T99 for compaction and density of soils. The balance of the backfill for other trenches and those trenches not in a right of way may be backfilled by machine without compaction unless otherwise specified in the supplementary specifications. Additional backfill material shall be supplied, if needed, to completely backfill the trenches or to fill depressions caused by subsequent settlement.

Section 6—Disinfection

Before the pipeline is placed into service, all new water systems, extensions to existing systems, valved sections of extension, replacements in the existing system, and any exposed section of the existing system shall be disinfected in accordance with AWWA C601, "Disinfection of Water Mains."

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