Designation: A 979/A 979M – 03

Standard Specification for Concrete Pavements and Linings Installed in Corrugated Steel Structures in the Field[1]

This standard is issued under the fixed designation A 979/A 979M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification covers the minimum material requirements and describes the procedures for installing concrete pavements and linings in corrugated steel pipes and structural plate structures in the field. Specific designs with additional or greater requirements shall be detailed in the contract documents. This specification is applicable to paving or lining new pipes and for rehabilitating existing structures. The pipe to be paved or lined is described in Specifications A 760/A 760M, A 761/A 761M, and A 762/A 762M.

1.2 This specification covers pipes 48 in. [1 200 mm] and larger for pavements and 24 in. [600 mm] and larger for full linings.

1.3 New pipes are to be designed in accordance with Practice A 796 and installed in accordance with Practice A 798 for factory-made pipes and Practice A 807 for structural plate structures. Structures to be rehabilitated shall be structurally stable.

1.4 Pipes with plant installed concrete pavements and linings are covered under Specification A 849.

1.5 This specification is applicable to product in either inch/pound units as A 979 or in SI units as A 979M. Inch/pound units and SI units are not necessarily equivalent. SI units are shown in brackets in the text for clarity, but they are the applicable values when materials are ordered to A 979M.

1.6 *This standard may involve hazardous materials, operations and equipment. The standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

A 185 Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement[2]

A 615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement[2]

A 760/A 760M Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains[3]

A 761/A 761M Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches[3]

A 762/A 762M Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains[3]

A 796 Practice for Structural Design of Corrugated Steel Pipe, Pipe-Arches, and Arches for Storm and Sanitary Sewers and Other Buried Applications[3]

A 798/A 798M Practice for Installing Factory-Made Corrugated Steel Pipe for Swers and Other Applications[3]

A 807/A 807M Practice for Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications[3]

A 849 Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe[3]

A 902 Terminology Relating to Metallic Coated Steel Products[3]

C 31/C 31M Practice for Making and Curing Concrete Test Specimens in the Field[4]

C 33 Specification for Concrete Aggregates[4]

C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens[4]

C 150 Specification for Portland Cement[5]

C 309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete[4]

C 595M Specification for Blended Hydraulic Cements[5]

C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete[4]

[1] This specification is under the jurisdiction of ASTM Committee A05 on Metallic Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.17 on Corrugated Steel Pipe Specifications.

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[2] *Annual Book of ASTM Standards*, Vol 01.04.

[3] *Annual Book of ASTM Standards*, Vol 01.06.

[4] *Annual Book of ASTM Standards*, Vol 04.02.

[5] *Annual Book of ASTM Standards*, Vol 04.01.

***A Summary of Changes section appears at the end of this standard.**

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D 3405 Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements[6]

2.2 *American Water Works Association Standards:*

AWWA C 602 Standards for Cement-Mortar Lining of Water Pipelines-4 in. (100 mm) and larger-in place[7]

3. Terminology

3.1 *Definitions*—For definitions of general terms used in this specification, see Terminology A 902.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *contractor, n*—the installer or applicator of the concrete pavement of lining.

3.2.2 *engineer, n*—the designer of the work and its details.

3.2.3 *fabricator, n*—the producer of the pipe.

3.2.4 *lining, n*—for corrugated metal pipe, a layer of nonmetallic material applied uniformly to the interior of a fabricated pipe, of sufficient thickness to fill and cover the corrugations.

3.2.5 *pavement, n*—for corrugated metal pipe, a lining applied only to a portion of the interior circumference, usually located in the lower portion (as the pipe is installed).

3.2.6 *purchaser, n*—the person or agency purchasing the finished product.

4. Requirements

4.1 *Concrete Pavements*—Concrete pavements shall be placed after the pipe has been installed. For new pipes, pavements shall be placed after the pipe is backfilled to final grade. If the depth of fill exceeds four feet, the pavement may be placed after four feet of backfill over the pipe has been placed. If the paving is placed prior to completion of the entire fill, any gaps between the pipe and pavement shall be filled with heated joint sealer conforming to Specification D 3405. Special pavement designs, which exceed the minimum requirements of this specification, shall be detailed in the job plans and specifications. In lieu of special designs, pavements shall extend over the area to be protected or rehabilitated. Invert pavements shall cover a minimum of the bottom 25 % of a round pipe's circumference and 40 % of the circumference of a pipe-arch (the invert of the pipe-arch), unless a special design is detailed in the plans and specifications.

4.1.1 The concrete for pavements shall have a minimum 28-day compressive strength of 3250 psi [22.4 MPa] when tested in accordance with Specification C 31 and Test Method C 39. The pavement shall have a minimum 3 in. [75-mm] thickness above the crests of the corrugations or structural plate bolts or nuts as applicable.

4.1.2 A minimum pavement thickness of 1-½ in. [38 mm] above the crests of the corrugations or structural plate bolts or nuts as applicable is required if concrete with a 28-day minimum compressive strength of 5 000 psi [34.5 MPa] when tested in accordance with Specification C 31 and Test Method C 39, is used.

NOTE 1—For rehabilitation applications, greater concrete pavement thicknesses may be required to replace necessary pipe ring compression strength lost due to service conditions.

4.2 *Concrete Linings*—Concrete linings shall be placed after the pipe has been installed and backfilled to final grade. Concrete linings shall cover 100 % of the circumference of round pipes.

4.2.1 The concrete for linings shall have a minimum 28-day compressive strength of 5 000 psi [34.5 MPa] when tested in accordance with Specification C 31 and Test Method C 39. The lining shall have a minimum thickness of ⅛ in. [3.2 mm] above the crests of the corrugations or structural plate bolts or nuts as applicable.

4.3 *Concrete Materials*—Concrete materials for pavements and linings shall consist of portland cement, fly ash (when used), aggregates and water. Special additives for air entrainment, sulfate resistance, etc., may be included as part of a specific mix design that meets or exceeds the requirements of this specification.

4.3.1 The cement for pavements shall be Type II portland cement conforming to Specification C 150 with an alkali content not more than 0.60 % expressed as Na_2O.

4.3.2 The cement used for linings shall conform to the requirements of Specification C 150 for Type I or Type II.

4.3.3 Type IP portland Pozzolan cement conforming to Specification C 595 shall be permitted in concrete for pavements or linings, in lieu of the requirements of 4.3.1 or 4.3.2, if no fly ash is used in the mix.

4.3.4 Aggregates shall be clean, hard, and durable conforming to the requirements of Specification C 33 except that for concrete linings, the requirements for grading do not apply. For linings, the aggregates shall be well graded with 100 % passing the No. 16 [1.18 mm] sieve with no more than 5 % passing the No. 100 [150-µm] sieve.

4.3.5 Fly ash shall conform to the requirements of Specification C 618 for Class C or Class F. When used for pavements or linings, fly ash shall not exceed 20 % weight of the total cementitious materials in the mix.

4.3.6 Potable water shall be used.

4.3.7 Steel reinforcement, when required for pavements, shall be billet-steel bars conforming to Specification A 615, Grade 40 minimum or welded wire fabric reinforcement conforming to Specification A 185.

4.4 *Concrete Mix*—The concrete mix shall be uniform and homogeneous. The water content shall be the minimum quantity that produces a workable mixture with full allowance made for condensation forming on the interior of the pipe. The water-cement ratio of the mix shall not exceed 0.50 by weight.

NOTE 2—Guidance as to concrete mix consistency requirements for various types of equipment used to place full concrete linings is provided in the American Water Works Association (AWWA) C 602.

4.5 *Surface Finish*:

4.5.1 Pavements shall have a troweled or untroweled surface finish as specified in the contract documents. Full linings shall have a troweled surface finish.

4.5.1.1 Untroweled pavements shall be uniform and regular in appearance, meeting the requirements of 4.1 unless the plans

[6] Discontinued and replaced by Specification D 6690; see 2001 *Annual Book of ASTM Standards*, Vol 04.03.

[7] Available from American Water Works Association, 6666 West Quincey Avenue, Denver, CO 80235.

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and specifications require a specially roughened surface, energy dissipators, etc., to slow or impede flow.

NOTE 3—Concrete pavements including special surface roughening techniques (the placement of concrete bricks, blocks, etc., into the pavement to provide energy dissipating flow checks, etc.) are permitted. Such techniques must be detailed in the plans and specifications.

4.5.2 A troweled surface finish shall be accomplished using metal trowels and floats. The finished surface shall meet the requirements of 7.4.

4.6 *Pipe Repairs*:

4.6.1 When paving or lining new pipes, damaged pipe shall be replaced or repaired in accordance with the pipe Specifications A 760/A 760M, A 761/A 761M, or A 762/A 762M, as applicable.

4.6.2 Damaged or deteriorated pipes to be rehabilitated shall be repaired as directed by the engineer. Repairs are the responsibility of the paving or lining contractor or others as dictated by the contract documents.

5. Procedures

5.1 *Cleaning and Preparation*:

5.1.1 The interior surface areas of new pipes to be paved or lined shall be free or oil, grease, and accumulated or running water. Dirt and construction debris shall be removed. Brushing, sweeping, or flushing are appropriate cleaning means. Shot or sand blasting shall not be permitted.

5.1.2 For rehabilitating pipes in service, the areas to be paved or lined shall be cleaned by methods specified or approved by the purchaser to remove corrosion, chemical or other products, any loose or deteriorated remains of old coatings, oils, greases, dirt and all other debris, as well as accumulated or running water.

5.1.3 Casual or standing water except for naturally occurring condensation shall be removed from surfaces to be lined or paved. When running water or service flows are present, a bypass system carrying these flows around the portion of the pipeline to be paved or lined shall be provided by the contractor. The bypass system shall be approved by the purchaser and shall carry all the flows. The pavement or lining is to be placed in dry conditions and cured adequately to preclude erosion of the concrete, loss of cement or the formation of excessive laitance.

5.2 *Paving Methods*:

5.2.1 Pavements shall be placed by hand or slip forming methods. They must be placed in a full thickness, screeded and finished to the necessary smoothness.

5.2.2 Reinforcement shall be supplied and installed by the pipe fabricator if required by the purchase agreement for the pipe. Otherwise, for new pipe installations and all rehabilitation work the reinforcement shall be supplied and installed by the contractor or others designated in the contract documents.

5.2.3 Reinforcement shall be of the type, size, and spacing as required by the plans and specifications. If the type, size, and spacing of reinforcement are not given in the plans or specifications, a minimum 4×4 W1.4×W1.4 welded wire fabric shall be provided.

5.2.4 Reinforcement shall be securely fastened to the pipe.

NOTE 4—Reinforcement, when required, typically consists of longitudinal No. 3 or larger bars, located to provide a minimum of 0.2 % reinforcement area. Steel welded wire fabric, used in lieu of bars, is selected to provide this minimum, longitudinal steel reinforcement area with a mesh size that accommodates foot traffic during assembly and concrete placement. Specific designs including reinforcement must evaluate reinforcement location and pavement thickness to provide adequate concrete cover over the reinforcement for the intended application.

5.3 *Lining Methods*:

5.3.1 The lining for all straight pipe sections shall be placed, in one or more passes, by a machine that progresses uniformly through the pipe and applies concrete against the pipe surface fully filling the corrugation and providing a uniform thickness over the corrugation crests meeting the requirements of 4.2.1. The machine shall not segregate the mix and shall be provided with mechanical trowels to achieve the desired finish.

5.3.2 Linings shall be hand placed in sharp bends, or other areas where machine lining is not practicable. All handwork shall meet the requirements of 4.2. All hand placed lining work shall be completed within 24 h after completion of the machine application portion of the pipeline.

5.4 *Curing*:

5.4.1 Curing operations shall begin immediately following the completion of the placement of the pavement or lining in a section of pipeline and shall continue for a minimum period of 72 h or as directed by the engineer. The surface of the concrete shall be kept moist during the cure period. When practical, the pipeline shall be closed with airtight covers and the linings maintained in a moist condition.

5.4.2 Where airtight closures to prevent the evaporation loss are not practicable, proper cure shall be achieved by applying an intermediate water source or a surface membrane to limit evaporation loss from the concrete during cure.

5.4.2.1 Where an intermediate water source is used immediately after the pavement or lining has attained its initial set, it shall be either fully inundated, periodically sprayed, or covered with burlap, etc., that is kept wet for the cure period.

5.4.2.2 Alternatively, a liquid membrane-forming compound conforming to Specification C 309 shall be applied to the entire surface of the pavement or lining.

5.4.2.3 Unless a special mix design is required by the engineer, concrete shall not be placed when the ambient air temperature in the pipe is below 40°F [4°C].

6. Additional Considerations

6.1 For installations below existing or perched water tables, appropriate gasketed joints shall be used unless the pavement or lining has been designed to withstand the hydrostatic pressure. The pipe and gasketed coupling system shall be capable of eliminating infiltration under these conditions. If infiltration cannot be eliminated, well pointing or other drawdown methods shall control external hydrostatic head conditions until the pavement or lining is capable of supporting the hydrostatic pressures without blowout or other damage.

6.2 *Deflected and Distorted Pipes*:

6.2.1 For lined pipe, where localized distortions are present or the pipe deflection exceeds 1-½ % of the diameter, the engineer shall decide if reinforcement of the lining is required.

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7. Inspection

7.1 The entire procedure shall be open with free access to inspection by the purchaser, but such inspection shall not relieve the contractor of the responsibility to furnish material and provide workmanship in accordance with this specification.

7.2 The contractor shall furnish test specimen to demonstrate the compressive strength of the concrete used as required by the purchase documents.

7.3 Defects in pavements and linings include, but are not limited to, sand pockets, voids, cracked areas which cause loosening of the lining or pavement and spalled areas.

7.4 To determine acceptable smoothness of troweled surface finishes, a predetermined random sampling method shall be agreed to by the purchaser and the contractor. When gaps between a 12-in [300-mm] straight edge laid down the axis of the pipe and the concrete do not exceed ¼ -in. [6-mm] in 90 % or more of the tests, the finish is acceptable.

8. Repair

8.1 Defective areas shall be repaired such that the repair meets the requirements of the plans and specifications and this specification. All repairs shall require the defective materials to be removed, the exposed pipe to be cleaned, and new concrete to be placed. When suitable repairs are not made, the work shall be rejected by the purchaser.

8.2 Cracks that produce spalls or cause loosening of the pavement or lining shall be repaired to meet the requirements of 8.1.

NOTE 5—Temperature and shrinkage cracks are inherent in concrete pavements and linings. These cracks typically will heal autogenously when the concrete is kept wet.

9. Rejection

9.1 Pipe linings or pavement failing to conform to the specific requirements of this specification or that show poor workmanship shall be subject to rejection.

9.2 Defective pipe linings or pavements that are not repaired in accordance with 8.1 shall be rejected.

10. Certification

10.1 When specified in the purchase order or contract, a contractor's certification shall be furnished to the purchaser stating that the pavement or lining has been constructed, tested, and inspected in accordance with the requirements of the applicable plans and specifications and this specification.

11. Keywords

11.1 concrete linings; concrete linings–corrugated steel pipe; concrete pavements; concrete pavements–corrugated steel pipe; corrugated steel pipe; pipe rehabilitation; steel structural plate

SUMMARY OF CHANGES

This section identifies the location of selected changes to this specification. For the convenience of the user, Committee A05 has highlighted those changes that may impact the use of this specification. This section may also include descriptions of the changes or reasons for the changes, or both.

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(*1*) Revised paragraphs 4.1, 5.22, 5.2.3, and 6.1.

(*2*) Added Specification D 3405.

(*3*) Deleted paragraph 6.1.

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