



# Standard Specification for Composite Corrugated Steel Pipe for Sewers and Drains<sup>1</sup>

This standard is issued under the fixed designation A1042/A1042M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification covers composite corrugated steel pipe, intended for uses such as storm water drainage, sanitary sewers, underdrains, construction of culverts, and similar uses. The composite material used in fabrication of the pipe consists of a three-layer polymer protective coating on both sides of a steel sheet core. The three layers consist of an inner layer of fusion-bonded epoxy on the steel surface, an intermediate layer of polyethylene adhesive, and an outer layer of high-density polyethylene.

1.2 The three-layer polymer coating protects the base metal against corrosion or abrasion, or both. Severe environments are likely to cause corrosion problems to accessory items such as coupling band hardware unless supplemental protection is provided. Additional protection for composite steel pipe is available by use of coatings applied after fabrication of the pipe as described in Specification A849.

1.3 This specification does not include requirements for bedding, backfill, or the relationship between earth cover load and sheet thickness of the pipe. Experience with drainage products has shown that successful performance depends upon the proper selection of corrugation profile, sheet thickness, type of bedding and backfill, controlled manufacture in the plant, and care in installation. The installation procedure is described in Practice A798/A798M.

1.4 This specification is applicable to orders in either inch-pound units as A1042, or in SI units as A1042M. 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 the material is ordered to A1042M.

1.5 *This 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 requirements prior to use.*

<sup>1</sup> 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. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- A153/A153M Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- A307 Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
- A563 Specification for Carbon and Alloy Steel Nuts
- A563M Specification for Carbon and Alloy Steel Nuts (Metric)
- A568/A568M Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
- A742/A742M Specification for Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
- A796/A796M Practice for Structural Design of Corrugated Steel Pipe, Pipe-Arches, and Arches for Storm and Sanitary Sewers and Other Buried Applications
- A798/A798M Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
- A849 Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
- A902 Terminology Relating to Metallic Coated Steel Products
- B633 Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- B695 Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
- C443 Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- D1005 Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers
- D1056 Specification for Flexible Cellular Materials—Sponge or Expanded Rubber
- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- F568M Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners (Metric)

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

**TABLE 1 Pipe Sizes**

Nominal Inside Diameter		Corrugation Sizes			
in.	mm	2- <sup>2</sup> / <sub>3</sub> by 1/2 in. [68 by 13 mm]	3 by 1 in. [75 by 25 mm] 5 by 1 in. [125 by 25 mm]	1/2 by 1/4 in. [13 by 6.5mm]	9/16 by 3/8 in. [15 by 10 mm]
6	150			x	
8	200			x	
10	250			x	
12	300	x		x	x
15	375	x		x	x
18	450	x		x	x
21	500	x		x	x
24	600	x			x
27	675	x			x
30	750	x			x
33	825	x			x
36	900	x	x		x
42	1050	x	x		
48	1200	x	x		
54	1350	x	x		
60	1500	x	x		
66	—	x	x		
72	1800	x	x		
78	1950	x	x		
84	2100	x	x		
90	2250		x		
96	2400		x		
102	2550		x		
108	2700		x		
114	2850		x		
120	3000		x		
126	3150		x		
132	3300		x		
138	3450		x		
144	3600		x		

NOTE—An “x” indicates standard composite corrugated profiles for each nominal diameter of pipe.

## 2.2 AASHTO Standard:

**T249M** Test for Helical Lock Seam Corrugated Pipe<sup>3</sup>

## 2.3 ANSI/AWWA Standard:

**C213** Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines<sup>4</sup>

## 3. Terminology

3.1 *General Definitions*—For definitions of general terms used in this standard, refer to Terminology **A902**.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *fabricator*—the producer of the pipe.

3.2.2 *manufacturer*—the producer of the sheet.

3.2.3 *purchaser*—the person or agency that purchases the finished product.

## 4. Classification

4.1 The composite corrugated steel pipe covered by this specification is classified as follows:

<sup>3</sup> Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001.

<sup>4</sup> Available from American Water Works Association, 6666 West Quincy Ave., Denver, CO 80235.

4.1.1 *Type IC*—This pipe shall have a full circular cross section, with a single thickness of corrugated sheet, fabricated with helical corrugations.

4.1.2 *Type ICS*—This pipe shall have a full circular cross section, with an outer shell of corrugated sheet, fabricated with helical corrugations and lock seams, and an inner liner of high-density polyethylene.

## 5. Ordering Information

5.1 Orders for material to this specification shall include the following information as necessary, to adequately describe the desired product.

5.1.1 Name of material (composite corrugated steel pipe),

5.1.2 ASTM designation and year of issue, as A 1042-XX for inch-pound units or as A 1042M-XX for SI units,

5.1.3 Type of pipe (4.1),

5.1.4 Diameter of circular pipe (Table 1),

5.1.5 Length, either total length or length of each piece and number of pieces,

5.1.6 Description of corrugations (7.2),

5.1.7 Sheet thickness (8.1.2),

5.1.8 Coupling bands, number, and type (9.1) if special type is required,

**TABLE 2 Corrugation Requirements**

Nominal Size	Maximum Pitch <sup>A</sup>	Minimum Depth <sup>B</sup>	Nominal Inside Radius <sup>C</sup>	Minimum Inside Radius
inches				
2- <sup>2</sup> / <sub>8</sub> by 1/2	2- <sup>7</sup> / <sub>8</sub>	0.48	<sup>1</sup> / <sub>16</sub>	0.50
3 by 1	3- <sup>1</sup> / <sub>4</sub>	0.95	<sup>9</sup> / <sub>16</sub>	0.50
5 by 1	5- <sup>5</sup> / <sub>16</sub>	0.95	1.57	1.4
1/2 by 1/4	<sup>9</sup> / <sub>16</sub>	0.24	<sup>1</sup> / <sub>8</sub> <sup>D</sup>	0.09
<sup>9</sup> / <sub>16</sub> by <sup>3</sup> / <sub>8</sub>	5/8	0.40	<sup>1</sup> / <sub>8</sub>	0.09
millimetres				
68 by 13	73	12	17	12
75 by 25	83	24	14	12
125 by 25	135	24	40	36
13 by 6.5	14	6.1	3.2 <sup>D</sup>	2.3
15 by 10	16	10.2	3.2	2.3

<sup>A</sup> Pitch is measured from crest to crest of corrugations, at 90° to the direction of the corrugations.

<sup>B</sup> Depth is measured as the vertical distance from a straightedge resting on the corrugation crests parallel to the axis of the pipe to the bottom of the intervening valley. If the depth measurement of one or more corrugations is less than the value indicated herein, the depth of all corrugations between the seams shall be measured, and the requirements of [Table 3](#) shall be applied (see [7.2.1](#)).

<sup>C</sup> Minimum inside radius requirement does not apply to a corrugation containing a lock seam. The term “outside” refers to the outside surface of the pipe.

<sup>D</sup> Average of nominal inside radius (0.162 in.) [4.1 mm] of outer corrugations and nominal inside radius (0.094 in.) [2.4 mm] of inner corrugations.

5.1.9 Gaskets for coupling bands, if required ([9.5](#)),

5.1.10 Certification, if required ([14.1](#)), and

5.1.11 Special requirements.

## 6. Materials and Manufacture

6.1 *Steel Sheet for Pipe*—All pipe fabricated under this specification shall be formed from polymer coated sheet conforming to [Annex A1](#) of this specification.

6.2 *Steel Sheet for Coupling Bands*—The sheet used in fabricating coupling bands shall be one of the following: the same material as that specified for fabrication of the pipe furnished under the order, with the same three-layer polymer coating; polymer precoated sheet conforming to Specification [A742/A742M](#); stainless steel sheet of a grade selected by the fabricator.

6.3 *Steel Sheet for Connecting Straps*—The sheet used in fabricating connecting straps for flange type couplings shall be one of the following: carbon steel sheet meeting the steel substrate requirements of [Annex A1.3](#) or stainless steel sheet of a grade selected by the fabricator.

6.3.1 Except for stainless steel straps, connecting straps shall be zinc coated after fabrication by one of the processes of [6.4.1](#).

6.4 *Hardware for Couplings*—Bolts and nuts for couplings shall conform to the following requirements:

	Bolts	Nuts
For A XXX pipe	<b>A307</b>	<b>A563, Grade A</b>
[For A XXXM pipe]	[ <b>F568M</b> , Class 4.6]	[ <b>A563M</b> , Class 5]

6.4.1 Bolts, nuts, and other threaded items used with couplings shall be zinc coated by one of the following processes: hot-dip process as provided in Specification [A153/A153M](#); electroplating process as provided in Specification [B633](#), Class Fe/Zn 8; or mechanical process as provided in Specification [B695](#), Class 8. Other hardware items used with coupling bands shall be zinc coated by one of the following processes: hot-dip process as provided in Specification [A153/A153M](#); electroplating process as provided in Specification [B633](#), Class Fe/Zn 25; or mechanical process as provided in Specification [B695](#), Class 25.

6.4.2 As an alternative to the materials in [6.4](#) and coating processes in [6.4.1](#), stainless steel bolts and nuts of a grade selected by the fabricator are permitted to be used.

6.5 *Gaskets*—If gaskets are used in couplings, they shall be a band of expanded rubber that meets the requirements of Specification [D1056](#) for the “RE” closed cell grades, O-rings meeting the requirements of Specification [C443](#), or other material approved by the purchaser.

## 7. Fabrication

7.1 *General Requirements*—Pipe shall be fabricated in full circular cross section.

7.1.1 Type IC pipe shall be fabricated with helical corrugations and a continuous lock seam extending helically from end to end of each length of pipe.

7.1.2 Type ICS pipe shall be fabricated with helical corrugations and a continuous helical lock seam extending from end to end of each length of pipe, and with a smooth high-density polyethylene liner thermally bonded to the pipe polymer coating at each interior corrugation crest over the length of the pipe. The minimum thickness of the liner shall be 0.020 in. [0.50 mm].

7.2 *Corrugations*—The corrugations shall be helical as provided in [7.1.1](#). The direction of the crests and valleys of the helical corrugations shall not be less than 60° from the axis of the pipe for pipe diameters larger than 21 in. [525 mm], and not less than 45° from the axis for pipe diameters of 21 in. [525 mm] and smaller.

7.2.1 The corrugations shall form smooth continuous curves, or curves and tangents. The dimensions of the corrugations shall be in accordance with [Table 2](#) for the nominal size indicated on the order. If the depth measurement of one or more corrugations is less than the specified minimum depth in [Table 2](#), the depth of all the corrugations between adjacent seams shall be measured and the values in [Table 3](#) for minimum average depth and minimum corrugation depth shall apply.

NOTE 1—Inspection frequently consists of measurement of the depth of one or a few corrugations. If such measurement indicates insufficient

**TABLE 3 Referee Requirements for Corrugation Depth<sup>4</sup>**

Nominal Size	Diameter	Minimum Average Depth	Minimum Corrugation Depth
inches			
2- <sup>2</sup> / <sub>3</sub> by 1/2	12 through 21	0.48	0.40
2- <sup>2</sup> / <sub>3</sub> by 1/2	over 21	0.49	0.44
3 by 1	all	0.98	0.92
5 by 1	all	0.98	0.92
1/2 by 1/4	all	0.25	0.23
3/16 by 3/8	all	0.41	0.39
millimetres			
68 by 13	300 through 525	12.1	10
68 by 13	over 525	12.4	11
75 by 25	83	24.9	23
125 by 25	all	24.9	23
13 by 6.5	all	6.4	5.8
15 by 10	all	10.4	9.9

<sup>4</sup> See 7.2.1 for application of Table 3.

depth, application of the requirements in Table 3 provides for acceptance where greater depth of some corrugations compensates for lack of depth of others. These measurements would normally be made at one location between the seams on a length of pipe.

NOTE 2—The nominal dimensions and properties for pipe wall corrugations are given in Practice A796/A796M.

7.3 *Helical Lock Seams*—The lock seam shall be formed in the pipe wall near mid-depth.

7.3.1 The edges of the sheets within the cross section of the lock seam shall lap as follows, but with an occasional tolerance of –10 % of lap width allowable. For the 2-<sup>2</sup>/<sub>3</sub> by 1/2 in. [68 by 13 mm], 3 by 1 in. [75 by 25 mm], or 5 by 1 [125 by 25 mm] corrugations, the lap shall be at least 5/16 in. [7.9 mm]. For the 1/2 by 1/4 in. [13 by 6.5 mm] and 3/16 by 3/8 in. [15 by 10 mm] corrugations, the lap shall be at least 0.125 in. [3.2 mm].

7.3.2 The lapped surfaces shall be in tight contact. The profile of the sheet shall include a retaining offset adjacent to the 180° fold (as described in AASHTO T249) of one sheet thickness on one side of the lock seam, or one-half sheet thickness on both sides of the lock seam, at the fabricators option. There shall be no visible cracks in the metal, loss of metal-to-metal contact, or excessive angularity on the interior of the 180° fold of metal at the completion of forming the lock seam. Damage to the polymer coating is subject to repair in conformance with Section 11.

7.3.3 Specimens cut from production pipe normal to and across the lock seam shall develop the tensile strength listed in Table 4, when tested according to AASHTO T249M.

7.4 *End Finish*—If flange type couplings or bands with annular corrugations are to be provided, the pipe ends shall be embedded in a high-density polyethylene flange with dimensions as specified in Table 5. If bell and spigot type couplings are provided, the pipe ends shall be embedded in end devices with dimensions suitable for providing mating surfaces. Such end devices for bell and spigot couplings shall be of high-density polyethylene, polyvinyl chloride, or other suitable polymer material.

## 8. Pipe Requirements

### 8.1 *Types IC and ICS Pipe:*

8.1.1 *Pipe Dimensions*—The nominal diameter of the pipe shall be as stated in the order, selected from the sizes listed in

Table 1. The size of corrugations that are standard for each size of pipe are also shown in Table 1. The average inside diameter of circular pipe, shall not vary more than 1 % or 1/2 in. [13 mm], whichever is greater, from the nominal diameter when measured on the inside crest of the corrugations.

8.1.2 *Sheet Thickness*—Sheet thickness shall be as specified by the purchaser from the specified sheet thicknesses listed in Table A1.1, Annex A1.

## 9. Coupling Systems

9.1 *Types of Coupling Systems*—Field joints for each type of composite corrugated steel pipe shall maintain pipe alignment during construction and prevent infiltration of fill material during the life of the installation. Coupling systems of the following types are permitted: flange type, bell and spigot type, band type with annular corrugations, flat band type, and smooth sleeve type. Coupling systems for sanitary sewers shall be of the flange type as specified in 9.1.1, shall be furnished with watertight gaskets as specified in 9.5, and shall have stainless steel connecting straps and connecting bolts of a grade selected by the fabricator unless the straps and bolts are isolated from the sewage. For other applications, except as provided in 9.1.1 through 9.1.5, the type of coupling furnished shall be the option of the fabricator unless the type is specified in the order.

NOTE 3—Bands are classified according to their ability to resist shear, moment, and tensile forces as described in Practice A798/A798M and identified as “standard joints” and “special joints.” The types of bands listed in 9.1.1 and 9.1.3, which meet the requirements of 9.2 and 9.3 as applicable, are expected to meet the requirements for “standard joints.” Some may also be able to meet the requirements for “special joints,” but such capability should be determined by analysis or test.

9.1.1 *Flange Type*—Flange type couplings shall be used only with pipe that has ends with integral built-up flanges as provided in 7.4. Such flanges shall provide annular grooves to accommodate connecting straps of a special design.

9.1.2 *Bell and Spigot Type*—Bell and spigot type couplings shall be used only with pipe that has ends with integral end devices as provided in 7.4.

9.1.3 *Band Type with Annular Corrugations*—Coupling bands with annular corrugations shall be used only with pipe

**TABLE 4 Lock Seam Tensile Strength**

Nominal Pipe Thickness		Lock Seam Tensile Strength per Unit Width, Minimum	
Thickness			
in.	mm	lbf/in.	kN/m
0.009	0.23	40	7
0.012	0.30	50	9
0.016	0.41	70	12
0.024	0.61	110	19
0.036	0.91	175	30
0.048	1.22	240	42
0.060	1.52	340	60
0.075	1.90	520	91
0.105	2.67	700	122
0.134	3.40	880	154

**TABLE 5 Pipe Flange Dimensions**

Nominal Corrugation Depth	Nominal Pipe Diameter	Minimum Radial Flange Depth <sup>A</sup>	Minimum Flange Thickness <sup>B</sup>
inches			
½ and under	12 through 27	1.20	1.80
½ and under	30 and over	1.20	2.00
1	36 through 48	1.60	2.00
1	54 and over	1.80	2.20
millimetres			
13 and under	300 through 675	30	45
13 and under	750 and over	30	50
1	900 through 1200	40	50
1	1350 and over	45	55

<sup>A</sup> Measured from inside diameter of pipe to outer edge of flange, exclusive of recess for connecting strap. Such recess shall be suitable for engaging connecting straps of the dimensions specified in [Table 6](#), or for engaging corrugations for use with bands with annular corrugations of a special design.

<sup>B</sup> Longitudinal thickness measured on outer edge of flange, exclusive of recess for connecting strap.

that has ends with integral end devices as provided in [7.4](#). Such devices shall provide annular grooves to accommodate a band with corrugations of a special design. The corrugations in the band shall be designed to engage the grooves in the end device of each pipe.

**9.1.4 Sleeve Type**—Smooth sleeve-type couplers are permitted for use with pipe 12-in. [300-mm] diameter or smaller.

**9.1.5 Flat Band Type**—Flat bands are permitted for use with pipe 12-in. [300-mm] diameter or smaller and, when specified by the purchaser, with larger diameter pipe.

**9.2 Requirements for Flange Type Coupling Systems**—Coupling systems of the type described in [9.1.1](#) shall be furnished with a pair of connecting straps and a set of longitudinal connecting bolts for each field joint. Each connecting strap shall be fabricated with sleeves to accept the bolts. The coupling shall meet the requirements of [Table 6](#).

**9.3 Requirements for Band Type with Annular Corrugations and Flat Band Type**—Bands of the types described in [9.1.3](#) and [9.1.5](#) shall be fabricated to lap on an equal portion of each of the pipe sections to be connected. The ends of the bands shall lap or be fabricated to form a tightly closed joint upon installation. Band thickness shall conform to the requirements in [Table 7](#) based on the sheet thickness of the pipe to be connected. The band width shall be not less than 7 in. [180 mm]. The bands shall be connected in a manner approved by the purchaser with suitable galvanized devices such as: angles, or integrally or separately formed and attached flanges, bolted with galvanized or cadmium-plated bolts; bars and straps; wedge lock and straps; or lugs. Bands shall be fastened with the following size of bolts:

**9.3.1** Pipe diameters 18 in. [450 mm] and less, ⅜-in. [Metric M 10] diameter.

**9.3.2** Pipe diameters 21 in. [525 mm] and greater, ½-in. [Metric M 12] diameter.

**9.4 Requirements for Sleeve Type Coupling Systems**—Coupling systems of the type described in [9.1.4](#) shall be of steel having a nominal thickness of not less than 0.040 in. [1.02 mm], or as an option, a plastic sleeve to provide equivalent strength. The couplings shall fit closely, so as to hold the pipe firmly in alignment without the use of sealing compounds or gaskets. The couplings shall contain a device to provide for equal lap on the two pipes being joined. The overall length of the coupling shall be equal to or greater than the nominal diameter of the pipe. The ends of flat bands shall be connected by one of the devices described in [9.3](#).

**9.5 Gaskets**—Where infiltration or exfiltration is a concern, the couplings shall have gaskets when required. For flange type couplings, the gaskets shall be flat, continuous, closed-cell expanded rubber, 0.125-in. [3-mm] thick, for placement between opposing faces of flange ends. For bell-and-spigot couplings, the gaskets shall be rubber O-rings, 0.210-in. [5.33-mm] diameter, for placement in the joint. For bands with annular corrugations and flat bands, the gaskets shall be continuous closed-cell expanded rubber, approximately 7 in. [180 mm] wide by approximately ⅜ in. [9.5 mm] thick, for placement between the band and the pipe. Alternatively, rubber O-ring gaskets are permitted in lieu of flat rubber gaskets. For pipe having ½-in. [13-mm] deep end corrugations, such O-rings shall be 1⅜-in. [20-mm] diameter for pipe diameters of 36 in. [900 mm] or smaller, and ⅞-in. [22-mm] diameter for

**TABLE 6 Requirements for Connecting Straps and Bolts for Flange Type Couplings**

Nominal Pipe Diameter		Connecting Strap and Bolt Requirements		
in.	mm	Min. Thickness of Connecting Strap	Min. Width of Connecting Strap	Diameter and Length of Flange Bolts <sup>A</sup>
12 to 42	300 to 1050	2 times nominal pipe thickness	2 in. [50 mm]	5/8 in. [M16] diameter by 9.6 in. [240 mm] long
over 42	over 1050	3 times nominal pipe thickness	2 in. [50 mm]	5/8 in. [M16] diameter by 9.6 in. [240 mm] long

<sup>A</sup> Min. no. of flange bolts is 1 per 3.2 in. [80 mm] of nominal pipe diameter.

**TABLE 7 Thickness For Bands with Annular Grooves and Flat Bands**

Nominal Pipe Thickness		Nominal Coupling Band Thickness, Minimum	
in.	mm	in.	mm
0.105 and thinner <sup>A</sup>	2.67	0.048	1.22
0.134	3.40	0.060	1.52

<sup>A</sup> For thinner pipe, the thickness of the coupling band need be no greater than the thickness of the pipe.

larger pipe diameters. For pipe having 1-in. [25-mm] deep end corrugations, such O-rings shall be 1-3/8 in. [35 mm] in diameter.

9.6 Other types of coupling bands or fastening devices, which are equally effective as those described, and which comply with the joint performance criteria of Practice [A798/A798M](#), may be used when approved by the purchaser.

## 10. Workmanship, Finish and Appearance

10.1 The completed pipe shall show careful, finished workmanship in all particulars. Pipe that has been damaged, either during fabrication or in shipping, shall be subject to rejection unless repairs are made which are satisfactory to the purchaser. Among others, the following defects shall be considered as constituting poor workmanship, if of a magnitude likely to affect the integrity of the pipe:

- 10.1.1 Variation from a straight centerline.
- 10.1.2 Elliptical shape in pipe intended to be round.
- 10.1.3 Dents or bends in the metal.
- 10.1.4 Polymer coating that has been broken, disbonded, or otherwise damaged.
- 10.1.5 Lack of rigidity.
- 10.1.6 Illegible markings on the steel sheet.
- 10.1.7 Ragged or diagonal sheared edges.
- 10.1.8 Loosely formed lock seams.

## 11. Repair of Damaged Coatings

11.1 Pipe on which the polymer coating or the fusion-bonded epoxy coating has been damaged in fabricating or handling shall be repaired. Damage to the polymer coating shall be repaired as described in [11.2](#). Damage that extends to the fusion-bonded epoxy coating shall be repaired as described in [11.3](#). Repairs shall be done so that the completed pipe shows carefully finished workmanship in all particulars. Pipe that, in the opinion of the purchaser, has not been cleaned or coated satisfactorily shall be subject to rejection. If the purchaser so elects, the repair shall be done in his or her presence. The coating material and method of application used for the repair must be approved by the pipe manufacturer.

11.2 *Polymer Coating*—Areas of damaged polymer coating shall be repaired with a polymer coating similar and compatible with respect to durability, adhesion, and appearance of the original polymer coating.

11.2.1 Polymer coating damaged during shipping or installation shall be repaired using materials as described in [11.2](#) or by the application of a protective coating material conforming to Specification [A849](#).

11.3 *Fusion-Bonded Epoxy Coating*—Areas of damaged fusion-bonded epoxy coating shall be repaired in accordance with Section 4.4 of ANSI/AWWA [C213](#).

## 12. Inspection

12.1 The purchaser or representative shall have free access to the finished product for inspection, and every facility shall be extended for this purpose. This inspection shall include an examination of the pipe for the items in [10.1](#) and the specific requirements of this specification applicable to the type of pipe.

12.2 On a random basis, samples shall be permitted to be taken for chemical analysis and polymer coating measurements for check purposes. These samples will be secured from fabricated pipe or from sheets or coils of the material used in fabrication of the pipe. The thickness of polymer coating shall be measured according to Test Method [D1005](#).

## 13. Rejection

13.1 Pipe failing to conform to the specific requirements of this specification, or that shows poor workmanship, shall be subject to rejection. This requirement applies not only to the individual pipe, but to any shipment as a whole where a substantial number of pipe are defective. If the average deficiency in length of any shipment of pipe is greater than 1 %, the shipment shall be subject to rejection.

## 14. Certification

14.1 When specified in the purchase order or contract, a manufacturer's or fabricator's certification, or both, shall be furnished to the purchaser stating that samples representing each lot have been tested and inspected in accordance with this specification and have been found to meet the requirements for the material described in the order. When specified in the order, a report of the test results shall be furnished.

## 15. Keywords

15.1 composite corrugated steel pipe; corrugated steel pipe; drainage pipe; sewer pipe

**ANNEX**
**(Mandatory Information)**
**A1. MATERIAL REQUIREMENTS**
**A1.1 Scope**

A1.1.1 This annex covers requirements for the material for fabrication of composite corrugated steel pipe under this specification.

**A1.2 Polymer Coated Sheet**

A1.2.1 The material shall be coated polymer sheet that conforms to the requirements of Specification **A742/A742M** except as modified in **A1.2.2** through **A1.2.5** and **A1.3**.

A1.2.2 In lieu of the metallic coating, the steel sheet shall be coated on both sides with a fusion-bonded epoxy layer having a minimum thickness of 0.0012 in. [30 μm]. The coating shall meet the requirements of ANSI/AWWA **C213** except as modified herein.

A1.2.3 The second layer shall be a polyethylene bonding material. The third layer shall be high-density polyethylene. The total thickness of the polyethylene layers shall be as specified in **A1.2.4**.

A1.2.4 The polymer coating grade shall be as shown in the tabulation. The thicknesses indicated are minimum values at any point not less than 3/8 in. [10 mm] from an edge.

Grade	Total Polyethylene Coating Thickness	
	in.	μm
12/39 [305/990]	0.012/0.039	305/990

NOTE A1.1—The polymer coating is classified by grade corresponding to the thickness in mils (thousandths inch) on each side in inch-pound units and the thickness in micrometres on each side in SI units.

A1.2.5 *Alternate Marking*—An alternate method and frequency of marking coils or finished pipe that provides the same information described in Specification **A742/A742M** shall be permitted when approved by the purchaser.

**A1.3 Steel Substrate**

A1.3.1 The specified thickness of the steel substrate sheet, not including the thickness of any coatings, shall be selected from **Table A1.1**.

A1.3.2 *Base Metal Analysis*—The base metal heat or product analysis shall conform to the chemical requirements of **Table A1.2**.

A1.3.3 *Mechanical Properties*—The steel sheet shall conform to the mechanical requirements listed in **Table A1.3**.

A1.3.3.1 Two tension tests shall be made on random samples of finished material (flat unformed sheet) from each heat. One test is sufficient when the finished material from said heat is less than 50 tons [45 Mg]. The samples shall be prepared and tested in accordance with the method specified in Specification **A568/A568M**.

A1.3.4 *Other Tests*—The manufacturer shall make such tests and measures as deemed necessary to ensure that the sheet produced complies with this specification.

**TABLE A1.1 Steel Sheet Thickness Requirements**

Specified Thickness, in. [mm]	Minimum Thickness, in. [mm]
For 1/2 by 1/4 in. [13 by 6.5 mm] and 3/16 by 3/8 in. [15 by 10 mm] corrugations:	
0.009 [0.023]	0.009 [0.023]
0.012 [0.30]	0.012 [0.30]
0.016 [0.41]	0.016 [0.41]
0.024 [0.61]	0.024 [0.61]
For 2-3/8 by 1/2 in. [68 by 13 mm], 3 by 1 in. [75 by 25 mm], or 5 by 1 in. [125 by 25 mm] corrugations:	
0.036 [0.91]	0.032 [0.81]
0.048 [1.22]	0.042 [1.07]
0.060 [1.52]	0.053 [1.35]
0.075 [1.90]	0.068 [1.73]
0.105 [2.67]	0.097 [2.46]
0.134 [3.40]	0.126 [3.20]

**TABLE A1.2 Chemical Composition**

	Heat Analysis	Product Analysis
Sulfur, max, %	0.05	0.06
Sum of carbon, manganese, phosphorus, sulfur, and silicon, max, %	0.70	0.74

**TABLE A1.3 Mechanical Requirements (Properties of Flat Sheet Prior to Fabrication)<sup>A</sup>**

Tensile strength, min, ksi [MPa]	45.0 [310]
Yield strength, min, ksi [MPa]	33.0 [230]
Elongation in 2 in. [50 mm], min, %	20

<sup>A</sup> To determine conformance with this specification, round each value for tensile strength and yield strength to the nearest 0.1 ksi [1 MPa] and each value for elongation to the nearest 1 %, both in accordance with the rounding method of Practice **E29**.

A1.3.5 *Retention of Test Results*—The test results, including chemical composition and mechanical properties, for each heat, shall be maintained by the manufacturer for seven years. The test results shall be made available to the fabricator and purchaser upon request.

**A1.4 Alternative Application of Coating**

A1.4.1 For pipe manufactured from steel sheet having a specified thickness of 0.036 in. (0.91 mm) or greater, the alternative coating application method described in **A1.4.2** shall be permitted.

A1.4.2 The three layer coating system described in **A1.2** shall be applied to the pipe after forming the helical corrugations and continuous lock seam, as an integral part of the pipe manufacturing process.

A1.4.3 Testing of the polymer coating shall be in accordance with Specification **A742/A742M** except that the specimens shall be cut from the corrugated material instead of the flat sheet. Minor modifications of the testing arrangement to

accommodate the corrugated specimens shall be permitted if it can be shown that such modifications have no significant effect on the test results.

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