



Standard Specification for Polyethylene of Raised Temperature (PE-RT) SDR 9 Tubing¹

This standard is issued under the fixed designation F2623; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This specification establishes requirements for polyethylene of raised temperature (PE-RT) SDR 9 tubing that is outside diameter controlled, and pressure rated for water at 73°F (23°C), 140°F (60°C) and 180°F (82.2°C). Included are requirements for material, workmanship, dimensions and tolerances, product tests, and markings for PE-RT tubing.

1.2 The text of this specification references notes, footnotes, and appendixes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the specification.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 The tubing produced under this specification shall be permitted for use in general fluid transport, including hydronics and irrigations systems.

1.5 The following safety hazards caveat pertains only to the test methods portion, Section 7, of this specification. *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 limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- D618 Practice for Conditioning Plastics for Testing
- D1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
- D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings

¹ This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.26 on Olefin Based Pipe.

Current edition approved Dec. 15, 2014. Published January 2015. Originally approved in 2007. Last previous edition approved in 2008 as F2623–08. DOI: 10.1520/F2623-14.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
- D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials
- D3895 Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
- F412 Terminology Relating to Plastic Piping Systems
- 2.2 ANSI Standard:
 - B36.10 Standards Dimensions of Steel Pipe (NTS)³
- 2.3 Federal Standard:
 - FED-STD-123 Marking for Shipment (Civil Agencies)⁴
- 2.4 Military Standard:
 - MIL-STD-129 Marking for Shipment and Storage⁴
- 2.5 PPI Standard:
 - PPI TR-4 PPI Listing of Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe⁵

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology F412, and abbreviations are in accordance with Terminology D1600, unless otherwise specified. The abbreviation for polyethylene of raised temperature is PE-RT. Plastic tubing denotes a particular diameter schedule of plastic pipe in which outside diameter of the tubing is equal to the nominal size plus 1/8 in. Plastic pipe outside diameter schedule conforms to ANSI B36.10.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *hydrostatic design stress (HDS)*—the estimated maximum tensile stress the material is capable of withstanding continuously with a high degree of certainty that failure of the

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

⁴ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

⁵ Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, http://www.plasticpipe.org.

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

tube will not occur. This stress is circumferential when internal hydrostatic water pressure is applied.

3.2.2 *pressure rating (PR)*—the estimated maximum water pressure the tube is capable of withstanding continuously with a high degree of certainty that failure of the tube will not occur.

3.2.3 *relation between dimensions, hydrostatic design stress, and pressure rating*—the following expression, commonly known as the ISO equation,⁶ is used in this specification to relate dimensions, hydrostatic design stress, and pressure rating:

$$2S/P = (D_o/t) - 1 \quad (1)$$

or

$$2S/P = R - 1$$

where:

- S = hydrostatic design stress, psi (or MPa),
- P = pressure rating, psi (or MPa),
- D_o = average outside diameter, in. (or mm),
- T = minimum wall thickness, in. (or mm), and
- R = standard dimension ratio, SDR.

3.2.4 *standard dimension ratio (SDR)*—the ratio of outside diameter to wall thickness. For PE-RT-tubing, it is calculated by dividing the average outside diameter of the tubing in inches or in millimeters by the minimum wall thickness in inches or millimeters. If the wall thickness calculated by this formula is less than 0.070 in. (1.78 mm) it shall be arbitrarily increased to 0.070 in. except for sizes 1/8 in. and smaller. The SDR values shall be rounded to the nearest 0.5.

3.2.5 *standard thermoplastic material designated code*—the pipe material designation code shall consist of the abbreviation for the type of plastic (PE) followed by Arabic numerals which describe the short term properties in accordance with Specification **D3350**, the hydrostatic design stress for water at 73.4°F (23°C) in units of 100 psi with any decimal figures dropped. Where the hydrostatic design stress code contains less than two figures, a zero is used before the number.

4. Tubing Classification

4.1 *General*—This specification covers one PE-RT tubing material in one standard dimension ratio, 9.0, and having pressure ratings for water at 73°F and 180°F and optionally at 140°F. The pressure ratings decrease as the temperature is increased.

4.2 *Standard Thermoplastic Pipe Dimension Ratio (SDR)*—This specification covers PE-RT tubing in one standard dimension ratio (SDR 9) and nominal tubing sizes (NTS) from 1/8 in. through 6 in. with a maximum continuous use temperature that shall be 180°F (82.2°C). The pressure ratings are uniform for all nominal tubing sizes.

5. Materials

5.1 *General*—The plastic used to make tubing shall be virgin plastic or reworked plastic, as specified in **5.3**, and shall

have Plastics Pipe Institute (PPI) long-term hydrostatic design stress and pressure ratings at 73°F and 180°F. The ratings at 140°F are an optional standard.

5.2 *Barrier Layers*—PE-RT tubing may incorporate an optional interior wall, mid wall or outer wall layer or a combination of such layers of non-PE-RT material for the express purpose of providing gas barrier properties to the pipe. The tubing shall meet the minimum wall thickness requirements of this standard without using the barrier layer thickness in the determinations. PE-RT tubing with a barrier layer within the wall of the tubing (neither exterior layer nor interior layer) shall demonstrate a hydrostatic design stress (HDS) rating equivalent to that of PE-RT tubing without a barrier layer. This determination shall be made in accordance with policies no less restrictive than those of the PPI HSB and meet the requirements of this standard.

5.3 *Rework Material*—Clean rework material of the same commercial designation, generated from the manufacturer's own tubing production shall not be used unless the tubing produced meet all the requirements of this specification.

5.4 *Classification*—Polyethylene materials suitable for use in the manufacture of tubing under this specification shall be classified in accordance with Specification **D3350** and as shown in **Table 1**. The material shall have minimum HDS and pressure ratings as per **Table 2**. The ratings at 140°F are optional.

5.5 *Tubing Material Designation*—The tubing meeting the requirements of this specification shall be designated PE-RT.

6. Requirements

6.1 *Workmanship*—The tubing shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other defects. The tubing shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.

6.2 *Dimensions and Tolerances:*

6.2.1 *Outside Diameters of Tubing*—The outside diameters and tolerances shall be as shown in **Table 3**, when measured in accordance with **7.4** and **7.4.1**.

6.2.2 *Wall Thickness of Tubing*—The wall thickness and tolerances shall be as shown in **Table 4**, when measured in accordance with **7.4** and **7.4.2**.

6.3 *Sustained Pressure*—The tubing shall not fail, balloon, burst, or weep as defined in Test Method **D1598**, at the test pressures given in **Table 5** when tested in accordance with **7.5**.

6.4 *Burst Pressure*—The minimum burst pressure for PE-RT plastic tubing shall be as given in **Table 6**, when determined in accordance with **7.6**.

TABLE 1 Required D3350 Cell Classifications for PE-RT

Physical Properties:	
Density	2, 3, or 4
Melt index	2, 3, 4, or 5
Flexural modulus	3 or 4
Tensile strength	2 or 3
Slow crack growth resistance	7
Hydrostatic design basis	3 or 4

⁶ ISO 161-1.

TABLE 2 Minimum Hydrostatic Design Basis and Pressure Ratings for PE-RT SDR 9 Tubing for Water at Different Temperatures

Rated Temperature		Hydrostatic Design Basis		Pressure Rating for Water	
°F	°C	psi	(MPa)	psi	(MPa)
73.4	23	1250	(8.62)	160	(1.10)
140	60	800	(5.52)	100	(0.69)
180	82.2	630	(4.34)	80	(0.55)

6.5 *Oxidative Resistance*—PE-RT tubing shall have a minimum extrapolated time-to-failure of 50 years when tested and evaluated in accordance with 7.7.

6.6 *Bent Tube*—PE-RT tubing, up to and including 1 in. nominal diameter, can be installed bent by the technique described in Appendix X3 provided the following requirements are met. Bent tubing, with a radius of 6 times the outside diameter and consisting of a continuous bend length inducing not less than 90° angle, shall meet the 180°F (82.2°C) minimum hydrostatic sustained pressure strength requirements shown in Table 5 when tested in accordance with 7.8. The bend length and bend angle is kept throughout the testing period by rigid secures immediately outside the bend. The minimum test duration shall be 1000 h without failure.

NOTE 1—PE-RT tubing, larger than 1 in. nominal diameter, is typically installed as main distribution lines and is installed in straight runs. Fittings are used when a change in direction of 90° or greater and a bend radius of less than 6 times the outside diameter is needed. The test procedures in 6.6 are intended to evaluate PE-RT tubing installed in tight bend applications in accordance with the procedure in Appendix X3. This application applies to tubing up to and including 1 in. nominal diameter only.

7. Test Methods

7.1 *Conditioning*—Condition the specimens at $73.4 \pm 3.6^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and $50 \pm 5\%$ relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D618, for those tests where conditioning is required. In cases of disagreement, the tolerances shall be $\pm 1.8^\circ\text{F}$ ($\pm 1^\circ\text{C}$) and $\pm 2\%$ relative humidity.

7.2 *Test Conditions*—Conduct the test in the standard laboratory atmosphere of $73.4 \pm 3.6^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and $50 \pm 5\%$ relative humidity, unless otherwise specified in the test methods or in this specification. In cases of disagreement, the tolerances shall be $\pm 1.8^\circ\text{F}$ ($\pm 1^\circ\text{C}$) and $\pm 2\%$ relative humidity.

7.3 *Sampling*—A sufficient quantity of tubing, as agreed upon by the purchaser and the seller, shall be selected and tested to determine conformance with this specification. In the case of no prior agreement, random samples selected by the testing laboratory shall be deemed adequate.

7.3.1 *Test Specimens*—Unless otherwise specified in this standard or as agreed upon by the purchaser and the seller, the quantity and size of the specimens to be tested shall be as specified by the test method referred to in this standard.

7.4 *Dimensions and Tolerances*—Use any length of tubing to determine the dimensions. Measure in accordance with Test Method D2122.

7.4.1 *Outside Diameter*—Measure the outside diameter of the tubing in accordance with Test Method D2122. The referee method of measurement is to be by circumferential wrap tape. The tolerance for out-of-roundness shall apply only to tubing prior to shipment. Averaging micrometer or vernier caliper measurements, four (4) maximum and minimum diameter measurements at any cross section, may be used for quality control checks if desired.

7.4.2 *Wall Thickness*—Make micrometer measurements of the wall thickness in accordance with Test Method D2122 to determine the maximum and minimum values. Measure the wall thickness at both ends of the tubing to the nearest 0.001 in. (0.025 mm).

7.5 *Sustained Pressure Test*—Select the test specimens at random. Test six specimens as per Test Method D1598 in water at 73°F (23°C) and 180°F (82.2°C) as shown in Table 5. If the optional 140°F rating is desired, perform an additional test at 140°F (60°C) in accordance with Table 5. Each specimen of tubing shall be at least five times the nominal diameter in length and not less than 12 in. (25 cm) or more than 3.0 ft (91 cm) between end closures. Maintain the specimens at the pressures indicated for the appropriate temperatures for a period of 1000 h. Failure of two of the six specimens tested at either temperature constitutes failure in the test. Failure of one of six specimens tested at either temperature is cause for retest of six additional specimens at that temperature. Failure of one of six specimens tested at either temperature in retest constitutes failure in the test. Failure of the tubing shall be defined in accordance with Test Method D1598.

7.6 *Burst Pressure*—Determine the sample complies with the minimum burst pressure requirements by testing at least five specimens in accordance with Test Method D1599 Method B. The pressure values are given in Table 6.

7.7 *Oxidative Resistance*—The test shall be conducted and the extrapolated time-to-failure shall be determined in accordance with Test Method F2023. The test fluid shall be prepared in accordance with 9.1.1 of Test Method F2023. The extrapolated time-to-failure shall be calculated in accordance with 13.3 of Test Method F2023.

7.7.1 *Significance*—The test need only be performed once and only once for the original validation of a compound tested in the form of a tube. A compound is defined as the PE-RT resin and the stabilization system. It shall not be required to perform plant or extrusion line verification testing.

7.8 *Bent Tube Test*—Determine in accordance with Test Method D1598, except for the following: Test at least six specimens, from randomly selected specimens assembled per the manufacturer’s instructions with at least 5-pipe diameters between joints. Test temperature shall be 180°F (82 °C).

8. Retest and Rejection

8.1 If the results of any test(s) do not meet the requirements of this specification, the test(s) shall be conducted again only by agreement between the purchaser and seller. Under such agreement, minimum requirements shall not be lowered, changed, or modified, nor shall specification limits be changed.

TABLE 3 Outside Diameters and Tolerances for PE-RT Tubing

Nominal Tubing Size		Average Outside Diameter		Tolerances for Average Diameter		Out-of-Roundness ^A	
in.	mm	in.	mm	in.	mm	in.	mm
1/8	3	0.250	6.35	±0.003	±0.08	0.008	0.20
1/4	7	0.375	9.52	±0.003	±0.08	0.008	0.20
5/16	8	0.430	10.92	±0.003	±0.08	0.008	0.20
3/8	10	0.500	12.70	±0.003	±0.08	0.012	0.32
1/2	13	0.625	15.88	±0.004	±0.10	0.016	0.40
5/8	16	0.750	19.05	±0.004	±0.10	0.016	0.40
3/4	19	0.875	22.22	±0.004	±0.10	0.016	0.40
1	25	1.125	28.58	±0.005	±0.12	0.020	0.48
1 1/4	32	1.375	34.92	±0.005	±0.12	0.020	0.48
1 1/2	38	1.625	41.28	±0.006	±0.16	0.024	0.60
2	51	2.125	53.98	±0.006	±0.16	0.030	0.76
2 1/2	64	2.625	66.68	±0.007	±0.18	0.038	0.95
3	76	3.125	79.38	±0.008	±0.20	0.045	1.14
3 1/2	89	3.625	92.08	±0.008	±0.20	0.046	1.16
4	102	4.125	104.78	±0.009	±0.23	0.052	1.32
4 1/2	114	4.625	117.48	±0.009	±0.23	0.059	1.49
5	127	5.125	130.18	±0.010	±0.25	0.065	1.65
6	152	6.125	155.58	±0.011	±0.28	0.072	1.83

^A The Out-of-Roundness specification applies only to tubing prior to coiling.

TABLE 4 Wall Thickness and Tolerances for PE-RT SDR 9 Tubing^A

Nominal Tubing		Minimum Wall Thickness		Tolerance	
in.	mm	in.	mm	in.	mm
1/8	3	0.047 ^B	1.19 ^B	+0.007	+0.18
1/4	7	0.062 ^B	1.57 ^B	+0.010	+0.25
5/16	8	0.064	1.63	+0.010	+0.25
3/8	10	0.070 ^B	1.78 ^B	+0.010	+0.25
1/2	13	0.070 ^B	1.78 ^B	+0.010	+0.25
5/8	16	0.083	2.12	+0.010	+0.25
3/4	19	0.097	2.47	+0.010	+0.25
1	25	0.125	3.18	+0.013	+0.33
1 1/4	32	0.153	3.88	+0.015	+0.38
1 1/2	38	0.181	4.59	+0.019	+0.48
2	51	0.236	6.00	+0.024	+0.61
2 1/2	64	0.292	7.41	+0.030	+0.76
3	76	0.347	8.82	+0.033	+0.84
3 1/2	89	0.403	10.23	+0.035	+0.89
4	102	0.458	11.64	+0.040	+1.02
4 1/2	114	0.514	13.05	+0.045	+1.14
5	127	0.569	14.46	+0.050	+1.27
6	152	0.681	17.29	+0.060	+1.52

^A The minimum is the lowest wall thickness of the tubing at any cross section. The maximum permitted wall thickness, at any cross section, is the minimum wall thickness plus the stated tolerance. All tolerances are on the plus side of the minimum requirement.

^B For tubing sizes of 1/2 in. and below, wall thickness minimums are not functions of SDR.

If upon retest, failure occurs, the quantity of product represented by the test(s) does not meet the requirements of this specification.

9. Marking

9.1 Marking on the tubing shall include the following, spaced at intervals of not more than 5 ft:

9.1.1 Nominal tubing size (for example, 2 in.).

9.1.2 The material designation, PE-RT.

9.1.3 The material designation code as determined per 3.2.5, for example, PE 2706.

9.1.4 Standard dimension ratio, SDR 9.

9.1.5 Pressure rating for water at 73°F (23°C), 140°F (60°C) (optional) and 180°F (82.2°C) established by this specification.

TABLE 5 Sustained Water Pressure Test Condition for PE-RT SDR 9 Tubing

Nominal Tubing Size		Pressure Required for Test, psig ^A (MPa)				
in.	mm	73.4°F (23°C)	140°F (60°C) (optional)	180°F (82.2°C)		
1/8	3	600 (4.14)	405 (2.79)	300 (2.07)		
1/4	7	515 (3.55)	350 (2.41)	260 (1.79)		
5/16	8	455 (3.14)	310 (2.14)	230 (1.59)		
3/8	10	425 (2.93)	285 (1.97)	215 (1.48)		
1/2	13	330 (2.28)	220 (1.52)	165 (1.14)		
5/8 and larger	16 and larger	325 (2.24)	220 (1.52)	165 (1.14)		

^A The fiber stresses used to derive these test pressures are:

at 73.4°F (23.0°C) 1300 psi (8.96 MPa)

at 140°F (60.0°C) 880 psi (6.07 MPa)

at 180°F (82.2°C) 650 psi (4.48 MPa)

TABLE 6 Burst Pressure Requirements for Water at Different Temperatures for PE-RT SDR 9 Tubing

Nominal Tubing Size		Minimum Burst Pressures at Different Temperatures, psig ^A (MPa)				
in.	mm	73.4°F (23°C)	140°F (60°C) (optional)	180°F (82.2°C)		
1/8	3	880 (6.07)	575 (3.96)	335 (2.31)		
1/4	7	755 (5.21)	490 (3.38)	285 (1.97)		
5/16	8	665 (4.59)	435 (3.00)	250 (1.72)		
3/8	10	620 (4.27)	405 (2.79)	235 (1.62)		
1/2	13	480 (3.31)	315 (2.17)	180 (1.24)		
5/8 and larger	16 and larger	475 (3.28)	310 (2.14)	180 (1.24)		

^A The fiber stresses used to derive these test pressures are:

at 73.4°F (23.0°C) 1900 psi (13.10 MPa)

at 140°F (60.0°C) 1240 psi (8.55 MPa)

at 180°F (82.2°C) 720 psi (4.96 MPa)

9.1.6 ASTM designation F2623.

9.1.7 Manufacturer's name (or trademark) and production code.

9.1.8 Standard designation(s) of the fitting systems(s) for which the tubing is recommended for use by the tubing manufacturer.

9.1.9 Indent marking shall not be permitted.

10. Quality Assurance

10.1 When the product is marked with this designation, F2623, the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with this specification and has been found to meet the requirements of this specification.

11. Keywords

11.1 hydronic heating; hydrostatic stress; irrigation; PE-RT; pipe; plastic pipe; polyethylene of raised temperature; PPI; pressure; radiant heating; tubing

SUPPLEMENTARY REQUIREMENTS

GOVERNMENT/MILITARY PROCUREMENT

These requirements apply only to federal/military procurement, not domestic sales or transfers.

S1. Responsibility for Inspection

S1.1 Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. The producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless the purchaser disapproves. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

NOTE S1.1—In U.S. federal contracts, the contractor is responsible for inspection.

S2. Packaging and Marking for U.S. Government Procurement

S2.1 *Packaging*—Unless otherwise specified in the contract, the materials shall be packaged in accordance with the supplier's standard practice in a manner ensuring arrival at destination in satisfactory condition and which will be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification rules or National Motor Freight Classification rules.

S2.2 *Marking*—Marking for shipment shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

NOTE S2.1—The inclusion of U.S. Government procurement requirements should not be construed as an indication that the U.S. Government uses or endorses the products described in this specification.

APPENDIXES

(Nonmandatory Information)

X1. SOURCE OF HYDROSTATIC DESIGN BASIS

X1.1 The hydrostatic design basis recommended by the Plastics Pipe Institute and published in PPI TR4 is used to pressure rate PE-RT plastic tubing. These hydrostatic design basis are: 1250 psi (8.62 MPa) for water at 73.4°F (23°C), 800 psi (5.52 MPa) for water at 140°F (60°C), and 630 psi (4.34 MPa) for water at 180°F (82.2°C). These hydrostatic design basis apply only to tubing meeting all the requirements of this specification.

X1.2 Refer also to Test Method **D2837**. Additional information regarding the method of test and other criteria used in developing the hydrostatic design basis may be obtained from the Plastics Pipe Institute, 1825 Connecticut Ave., NW Suite 680, Washington, DC 20009. These hydrostatic design basis may not be suitable for materials that show a wide departure from a straight-line plot of log stress versus log time to failure. All the data available to date on PE-RT-tubing materials exhibit a straight-line plot under these plotting conditions.

X1.3 The hydrostatic design basis and pressure ratings in **Table 2** apply to PE-RT SDR 9 plastic tubing meeting the requirements of this specification.

X1.4 The hydrostatic design basis recommended by the Plastics Pipe Institute are based on tests made on tubing ranging in size from ½ to 2 in.

X1.5 *Stabilizer Verification*—The oxidation induction time (OIT) as described in Test Method **D3895** may be used to monitor stabilizer content of a PE-RT material or freshly extruded tubing. Once the initial OIT value has been established for a specific compound, subsequent OIT values can be used to validate the stabilizer level in the tubing or compound without the need to run additional temperature tests. It should be mentioned that OIT tests are not an indicator of life expectancy, nor should differences in OIT values between compounds be construed to indicate differences in the stabilizer effectiveness of respective formulations.

X2. UV LABELING GUIDELINES FOR PE-RT TUBING

X2.1 PE-RT tubing should be kept in original packaging until time of use, and it should not be used in direct sunlight. To inform customers and users about the need to prevent accidental overexposure of PE-RT tubing to sunlight (UV light), it is recommended that a UV CAUTION label be applied to all PE-RT tubing packaging by the manufacturer.

X2.2 The text and content of the recommended label is as shown X2.4. “X” is the maximum cumulative time period as recommended by the tubing manufacturer for direct sunlight exposure without harm to the long-term performance characteristics of the PE-RT tubing.

X2.3 The recommended text may be incorporated into existing labels with other information. The universal “no-sun” symbol may be shown in color, black-and-white or grayscale, and should be positioned close to the recommended text.

X2.4 Caution Label:

Do not store PE-RT tubing unprotected outdoors.

Keep PE-RT tubing in the original packaging or under protective cover until time of installation

Ensure that exposure to sunlight during installation does not exceed the maximum recommended UV exposure time of “X”.

X3. BENDING GUIDELINES FOR PE-RT TUBING

X3.1 *Cold Bending of Tubing* —PE-RT SDR 9 tubing shall be bent at room temperature without the use of bending tools down to a minimum bending radius of 6 times outside diameter. Outside diameter is equal to nominal diameter plus 1/8

in. (see 3.1). Normal precaution is taken to avoid buckling or flattening. Fix the tubing by supports on both sides of the bend at installation.

X4. OPTIONAL IN-PLANT QUALITY-CONTROL PROGRAM FOR PE-RT TUBING

X4.1 Scope

X4.1.1 The following program provides a model for performance qualification and in-plant quality control for PE-RT tubing to provide reasonable assurance that PE-RT hot-water tubing supplied under this specification consistently meets its requirements.

X4.2 Performance Qualifications

X4.2.1 Performance qualification tests to the requirements of this standard should be run initially on each design and formulation in accordance with the requirements of this specification. The test results should be independently certified and should be made available to the purchaser on request.

X4.3 In-Plant Quality Control

X4.3.1 *Material*—The tubing material should be PE-RT as defined in the Materials section of this specification. The manufacturer, upon request, should so certify.

X4.3.2 *Quality-Control Testing*—Tubing quality control tests should be run for each extrusion line in accordance with the requirements of this specification at a frequency agreed upon between the purchaser and the manufacturer. The program outlined in Table X4.1 is recommended. The test results should be recorded and filed for inspection on request. Should tubing fail to meet the requirement in any test, production should be sampled back to the previous acceptable test result and tested to determine which tubing produced in the interim do not meet the requirement. Tubing that does not meet the requirements of this specification should be rejected.

TABLE X4.1 Suggested Quality-Control Program

Property	Frequency
Workmanship	continuously
Dimensions	hourly
Burst Pressure	daily
Sustained Pressure	3 months
Bent Tube	yearly

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F2623–08) that may impact the use of this standard.

(1) **9.1.8** was added.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; <http://www.copyright.com/>