UL 1990

STANDARD FOR SAFETY

Nonmetallic Underground Conduit with Conductors

UL Standard for Safety for Nonmetallic Underground Conduit with Conductors, UL 1990

Third Edition, Dated November 22, 2013

Summary of Topics

This revision was issued to incorporate the following changes:

1. Revised Title for Section 13

2. Add a Test Temperature Requirement into Clause 13.2

3. Revised Table 13.1

The revisions are substantially in accordance with Proposal(s) on this subject dated November 18, 2016.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

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Standard for Nonmetallic Underground Conduit with Conductors

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This ANSI/UL Standard for Safety consists of the Third Edition including revisions through January 20, 2017.

The most recent designation of ANSI/UL 1990 as an American National Standard (ANSI) occurred on January 20, 2017. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover nonmetallic underground conduit with conductors. These products consist of a factory assembly of conductors or cables inside a coilable, smooth-wall, continuous length conduit with a circular cross section. The conduit is Schedule-40, Schedule-80, EPEC-A or EPEC-B High Density Polyethylene (HDPE) in trade sizes 1/2 (16) – 4 (103). This product is intended for installation in accordance with the National Electrical Code, NFPA 70. The values in parentheses are metric trade designators of conduit. The designations Schedule-40, Schedule-80, EPEC-A and EPEC-B refer to conduit having specific outside diameters and wall thicknesses.

1.2 This product is for aboveground use where encased in not less than 2 inches (51 mm) of concrete and for underground use by direct burial or encasement in concrete.

2 Undated References

2.1 Where reference is made to other publications, such reference shall be considered to refer to the latest edition and all amendments published to that edition up to the time when this standard was published.

UL Standards

UL 746A
Standard for Polymeric Materials – Short Term Property Evaluations

ANSI Standards

NFPA 70
National Electrical Code

ASTM Standards

D 570
Standard Test Method for Water Absorption of Plastics

D 638
Standard Test Method for Tensile Properties of Plastics

D 648
Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position

D 2412
Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading

D 3350
Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

3 Units of Measurement

3.1 When a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement.

CONSTRUCTION

4 General

4.1 Conduit shall be essentially circular in cross section. The inside surface of conduit shall be without indentations (normal convolutions are not to be considered as indentations), projections, roughness, or other features that could damage or impede wires and cables being pulled into the conduit.

4.2 Both ends of each length of conduit shall be perpendicular to the longitudinal axis of the conduit.

4.3 Conduit shall provide a smooth raceway for the pulling in of wires and cables. It shall not have any features that can abrade or otherwise damage wires and cables. The outside surfaces of conduit shall be smooth and without any chips, blister, cracks, or other defects. There shall not be any tendency for the conduit to peel, scale, flake, chalk, or crumble.

5 Materials

5.1 The HDPE compound of which the conduit is made shall equal or exceed the cell classification PE334420C or E as described in the Standard Specification for Polyethylene Plastics Pipe and Fittings Materials, ASTM D 3350.

6 Dimensions

6.1 Limits on the outside diameter of Schedule-40, Schedule-80, EPEC-A, and EPEC-B conduit are specified in Table 6.1. Limits on the wall thicknesses of Schedule-40, Schedule-80, EPEC-A, and EPEC-B conduit are specified in Tables 6.2 and 6.3.

Table 6.1
Conduit outside diameter

Trade size	Metric Designator	Outside diameter, inches (mm)					
		Average		Maximum		Minimum	
1/2	(16)	0.84 ±0.004	(21.34±0.10)	0.855	(21.72)	0.825	(20.96)
3/4	(21)	1.050 ±0.004	(26.67 ±0.10)	1.070	(27.18)	1.030	(26.96)
1	(27)	1.315 ±0.005	(33.40 ±0.13)	1.340	(34.04)	1.290	(32.77)
1-1/4	(35)	1.660 ±0.005	(42.16 ±0.13)	1.685	(42.80)	1.635	(41.53)
1-1/2	(41)	1.900 ±0.006	(48.26 ±0.15)	1.930	(49.02)	1.870	(47.50)
2	(53)	2.375 ±0.006	(60.32 ±0.15)	2.410	(61.21)	2.340	(59.44)
2-1/2	(63)	2.875 ±0.007	(73.02 ±0.18)	2.910	(73.91)	2.840	(72.14)
3	(78)	3.500 ±0.008	(88.90 ±0.20)	3.540	(89.92)	3.460	(87.88)
3-1/2	(91)	4.000 ±0.008	(101.60 ±0.20)	4.045	(102.74)	3.955	(100.46)
4	(103)	4.500 ±0.009	(114.30 ±0.23)	4.550	(115.57)	4.450	(113.03)

Table 6.2
Conduit wall thickness, types Schedule-40 and Schedule-80

Trade size	Metric Designator	Wall thickness, inches (mm)							
		Schedule-40				Schedule-80			
		Maximum		Minimum		Maximum		Minimum	
1/2	(16)	0.129	(3.28)	0.109	(2.77)	0.167	(4.24)	0.147	(3.73)
3/4	(21)	0.133	(3.38)	0.113	(2.87)	0.174	(4.42)	0.154	(3.91)
1	(27)	0.153	(3.89)	0.133	(3.38)	0.200	(5.08)	0.179	(4.55)
1-1/4	(35)	0.160	(4.06)	0.140	(3.56)	0.214	(5.44)	0.191	(4.85)
1-1/2	(41)	0.165	(4.20)	0.145	(3.68)	0.224	(5.69)	0.200	(5.08)
2	(53)	0.174	(4.42)	0.154	(3.91)	0.244	(6.20)	0.218	(5.54)
2-1/2	(63)	0.227	(5.57)	0.203	(5.16)	0.309	(7.85)	0.276	(7.01)
3	(78)	0.242	(6.15)	0.216	(5.49)	0.336	(8.53)	0.300	(7.62)
3-1/2	(91)	0.253	(6.43)	0.226	(5.74)	0.356	(9.04)	0.318	(8.08)
4	(103)	0.265	(6.73)	0.237	(6.02)	0.377	(9.58)	0.337	(8.56)

Table 6.3
Conduit wall thickness, Types EPEC-A and EPEC-B

Trade size	Metric Designator	Wall thickness, inches (mm)							
		EPEC-A				EPEC-B			
		Maximum		Minimum		Maximum		Minimum	
1/2	(16)	0.080	(2.03)	0.060	(1.52)	0.096	(2.44)	0.076	(1.93)
3/4	(21)	0.080	(2.03)	0.060	(1.52)	0.098	(2.49)	0.078	(1.98)
1	(27)	0.095	(2.41)	0.075	(1.91)	0.117	(2.97)	0.097	(2.46)
1-1/4	(35)	0.120	(3.05)	0.100	(2.54)	0.143	(3.63)	0.123	(3.12)
1-1/2	(41)	0.135	(3.43)	0.115	(2.92)	0.161	(4.09)	0.141	(3.58)
2	(53)	0.165	(4.19)	0.145	(3.68)	0.197	(5.00)	0.176	(4.47)
2-1/2	(63)	0.223	(5.66)	0.203	(5.16)	0.238	(6.05)	0.213	(5.41)
3	(78)	0.236	(5.99)	0.216	(5.49)	0.290	(7.37)	0.259	(6.58)
3-1/2	(91)	a		a		a		a	
4	(103)	0.265	(6.73)	0.237	(6.02)	0.373	(9.47)	0.333	(8.46)

[a] To be developed.

6.2 Conduit on which measurements are made is to be finished, smooth, and clean wherever it is to touch any part of a measuring device or tool. While measurements are being made, the conduit and the air around it are to be in thermal equilibrium with one another at a temperature of 23.0 ±2.0°C (73.4 ±3.6°F). All of the average and individual outside diameter measurements are to be performed both at the center and at least one end of the conduit.

6.3 The measurements from which the average outside diameters of a length of finished conduit are to be determined are to be made by means of:

a) A machinist's micrometer caliper that has a flat-ended spindle, a flat anvil, and is calibrated to read directly to at least 0.001 inch or 0.01 mm;

b) A vernier caliper calibrated to read directly to at least 0.001 inch or 0.01 mm;

c) A vernier wrap tape, calibrated to read directly to at least 0.001 inch or 0.01 mm;

d) A tapered sleeve gauge accurate to ±1 percent of its taper and ±0.001 inch or ±0.01 mm of its diameter; or

e) A sleeve window gauge accurate to within ±1 percent of its tape and ±0.001 inch of its diameter.

6.4 When differences arise between measuring techniques, the vernier wrap tape is to act as the referee for determining compliance with the requirements for average outside diameters.

6.5 When using a tapered sleeve gauge, the entrance and exit diameters of the gauge shall correspond to the maximum and minimum outside diameters for the trade size of conduit being measured.

6.6 When using a sleeve window gauge, the window shall extend beyond the two scribed marks which shall represent the minimum and maximum permitted diameters.

6.7 The measurements from which the minimum and maximum outside diameters of finished conduit are to be determined are to be made by means of:

a) A machinist's micrometer caliper that has a flat-ended spindle, a flat anvil, and is calibrated to read directly to at least 0.001 inch or 0.01 mm;

b) A vernier caliper calibrated to read directly to at least 0.001 inch or 0.01 mm; or

c) An out-of-roundness gauge accurate to 0.001 inch or 0.01 mm.

6.8 When differences arise between measuring techniques, the vernier caliper is to act as the referee for determining compliance with the requirements for minimum and maximum outside diameters.

6.9 The measurements from which the wall thicknesses of a length of finished conduit are to be determined are to be made by means of a machinist's micrometer caliper that has a ratchet, a flat-ended spindle, and a hemispherical anvil. The caliper shall be calibrated to read directly to at least 0.001 inch or 0.01 mm.

6.10 When deemed necessary, equivalent methods, tools, and measurement techniques shall be used to determine compliance with the above dimensional requirements only when they are accurate to within ±0.001 inch or ±0.01 mm.

6.11 To determine the average outside diameter when using a micrometer caliper or vernier caliper, at least four measurements (every 45 degrees) are required at each location to make certain that the largest and smallest diameters are found. The average of all the recorded diameters is to be determined for the trade size of conduit involved. The average of the recorded diameters shall not differ from the average diameter in Table 6.1 by more than the specified tolerances.

6.12 To determine the average outside diameter when using vernier wrap tape, place the vernier wrap tape around the conduit making sure that it is at right angles to the conduit axis and is flat against the conduit surface. The observed reading shall not differ from the average diameter in Table 6.1 by more than the specified tolerances.

6.13 To determine the average outside diameter when using a tapered sleeve gauge or sleeve window gauge, cut the end of the conduit square and remove burrs. Insert the conduit into the sleeve gauge and observe the position of the end with respect to the ends of the tapered sleeve gauge or the position of the end with regard to the minimum and maximum scribed marks of the sleeve window gauge.

6.14 When using a tapered sleeve gauge, the end of the conduit shall enter the largest end of the gauge and shall not pass through the smaller end of the gauge.

6.15 When using a sleeve window gauge, the end of the conduit shall be visible between the two scribed marks when the conduit is inserted into the gauge.

6.16 The average of all of the recorded diameters is to be determined for the size of conduit involved. The average of the recorded diameters shall not differ from the average diameter in Table 6.1 by more than the specified tolerances.

6.17 The wall thickness is to be measured at one or both ends of the conduit by means of the caliper with the hemispherical anvil. At least four measurements are necessary at each end measured to make certain that the thickest and thinnest parts of the wall are found. The maximum and minimum of all the recorded thicknesses are to be determined. Neither limit shall be exceeded.

7 Conductors or Cable

7.1 The conductors or cable shall be suitable for use in wet locations.

7.2 All conductors shall have an insulation rating equal to at least the maximum nominal circuit voltage of any conductors or cable within the conduit.

7.3 Conductors or cable rated 600 V or less shall not occupy the same conduit as conductors or cable of circuits rated more than 600 V.

PERFORMANCE

8 General

8.1 Unless otherwise specified, all tests are to be conducted at a room temperature of 23 ±2°C (73 ±4°F) on conduit without conductors installed.

9 Identification of Compounds

9.1 An HDPE material used in conduit shall be subjected to the Infrared Spectroscopy (IR), Thermogravimetry (TGA), and Differential Scanning Calorimetry (DSC) Tests specified in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

10 Water Absorption Test

10.1 Finished conduit shall have a maximum ratio, W_2/W_1, of 1.0015 after immersion in distilled water for 24 hours (see 10.3). The test is to be as indicated in 10.2 – 10.4 (similar to the method described as Procedure A in the Standard Test Method for Water Absorption of Plastics, ASTM D 570).

10.2 Specimens are to be preconditioned by drying in a full-draft, circulating-air oven at a temperature of 50.0 ±3.0°C (122.0 ±5.4°F) for 24 hours, after which they are to remain in still air at room temperature for 24 hours.

10.3 A clean, dry specimen of finished conduit at least 6 inches (152 mm) long is to be preconditioned as indicated in 10.2, weighed, W_1, to within 5 mg of balance, and immersed for 24 hours in distilled water that is at room temperature. The specimen is then to be removed from the water, dried quickly inside and out with a clean piece of soft lintless cloth, and immediately reweighed, W_2, to within 5 mg of balance. W_2/W_1 shall not be larger than indicated in 10.1.

10.4 When a specimen is known or suspected to contain appreciable amounts of water-soluble material, two specimens are to be preconditioned by drying in a full-draft circulating-air oven at a temperature of 50.0 ±3.0°C (122.0 ±5.4°F) for 24 hours, cooled in a desiccator for 24 hours, and immediately weighed, W_1. The specimens are then to be immersed in distilled water for 24 hours with the water at room temperature. Immediately following this immersion, the specimens are to be reconditioned for 24 hours in the oven at 50.0 ±3.0°C, cooled in a desiccator for 24 hours, immediately reweighed, W_2, and the criteria in 10.1 applied.

11 Low Temperature Handling Test

11.1 The conduit shall not shatter, chip, or crack when tested in accordance with 11.2.

11.2 One 30-inch (760-mm) specimen is to be cut from lengths of each size of finished conduit. The ends of each specimen are to be smooth and perpendicular to the longitudinal axis of the conduit. The specimens are to be cooled in circulating air for five hours to a temperature of minus 20.0 ±1.0°C (minus 4.0 ±1.8°F). Within 15 seconds of removal from the low temperature, each specimen is to be dropped onto a concrete floor twice in quick succession from a height of 60 inches (1.53 m). The specimen is to be dropped at an angle of approximately 45 degrees to the floor so that one end of it hits the floor first. For the second drop, the specimen is to fall parallel to the floor.

12 Tensile Strength

12.1 General

12.1.1 The average tensile strength of three aged specimens of finished conduit shall equal or exceed 95 percent of the average tensile strength of three unaged specimens of conduit. The average tensile strength of the unaged specimens shall comply with the limit established for the compound used but, in any case, shall not be less than 2700 lbf/in^2 (18.6 MPa). The procedures (similar to those described in the Standard Test Method for Tensile Properties of Plastics, ASTM D 638) for preparing and conditioning the specimens, for making the measurements, and for calculating the average tensile strengths are indicated in 12.2.1 – 12.4.1.

12.2 Preparation of specimens

12.2.1 Six complete tubes are to be cut from lengths of the finished conduit. Each tube is to be 15 inches (380 mm) long. Each cut is to be made in a plane perpendicular to the longitudinal axis of the conduit.

12.2.2 Measurements are to be made by means of two machinist's micrometer calipers, each with a ratchet and a flat-ended spindle. The anvil is to be hemispherical on the caliper used for measurements of thickness and is to be flat on the caliper used for measurements of diameter. The calibration of the scale on each caliper is to facilitate estimation of each measurement to 0.0001 inch or 0.001 mm.

12.2.3 Each tube is to be smooth and clean wherever it is touched by a spindle or anvil. While measurements are being made, each tube and the air around it are to be in thermal equilibrium with one another.

12.2.4 The wall thickness is to be measured at each end of each tube by means of the caliper with the hemispherical anvil. At least four measurements are required at each end to make certain that the thickest and thinnest parts of the wall are found. Each measurement is to be estimated to the nearest 0.0001 inch or 0.001 mm and recorded. The average of all of the recorded thicknesses is to be determined to the nearest 0.001 inch or 0.01 mm for each tube and recorded as T.

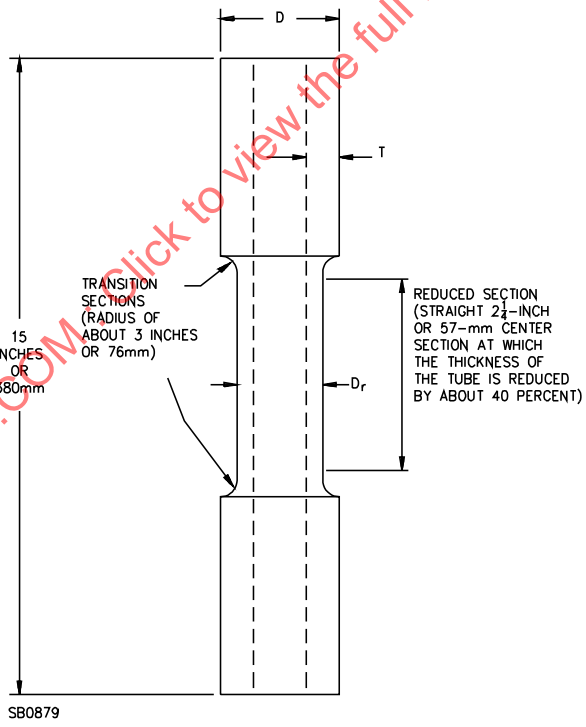
12.2.5 The outside diameter is to be measured at the center and at each end of each tube by means of the caliper with the flat anvil. At least four measurements (every 45 degrees) are required at each location to make certain that the largest and smallest diameters are found. Each measurement is to be estimated to the nearest 0.0001 inch or 0.001 mm and recorded. The average of all of the recorded diameters is to be determined to the nearest 0.001 inch or 0.01 mm for each tube and recorded as D.

12.2.6 The center 2-1/4-inch (57-mm) section of each specimen is to be reduced in diameter as illustrated in Figure 12.1. The diameter D_r to which the section is to be reduced is to be determined from the equation:

$$D_r = D - 0.8T$$

and recorded to the nearest 0.001 inch or 0.01 mm. With care being taken to maintain concentricity, a lathe is to be used to reduce the center section of each tube to D_r. As indicated in Figure 12.1, each end of the reduced-diameter section is to be joined to the outside diameter, D, by a transition section having a radius of 3 inches (76 mm). The transition and reduced-diameter sections are to be tangent to one another. Any marks left by the machining operation are to be removed by light sanding with No. 00 or finer abrasive paper. The direction of sanding is to be parallel to the longitudinal axis of the resulting specimen. On each specimen, the finished surface of the reduced-diameter section is to be smooth and is not to have any scratches or other visible imperfections. The diameter measured at any point in the straight 2-1/4 inch (57 mm) portion of the reduced-diameter section of any specimen is not to deviate more than 0.001 inch or 0.01 mm from the diameter measured at any other point of the straight portion of the reduced-diameter section. The diameter of the straight portion of the reduced-diameter section is to be measured in the manner indicated in 12.2.5 and is to be recorded as D_r for each specimen.

Figure 12.1
Conduit specimen



12.2.7 The cross-sectional area of the straight portion of the reduced section is to be calculated and recorded in inches^2 (mm^2) for each tubular specimen from the following equation:

$$A = 0.7854 (D_r^2 - D^2 - 4T^2 + 4DT)$$

12.2.8 Three specimens are to be supported in a full-draft, circulating-air oven preheated at full draft to 113.0 ±1.0°C (235.4 ±1.8°F). The specimens are to be arranged and supported so that they do not touch each other or the oven walls. An acceptable method is to space the specimens on an open-mesh shelf about 2 inches (51 mm) above the oven floor to maintain the full circulation of air around and through the specimens. The oven is to be operated at full draft for 168 hours at 113.0 ±1.0°C. The specimens are then to be removed from the oven and given time to cool in still air.

12.3 Conduct of the test

12.3.1 No sooner than 16 hours and no later than 96 hours after the three specimens mentioned in 12.2.8 are removed from the oven, all six specimens are to be tested in succession. While the testing is in progress, the specimens, test equipment, and surrounding air are to be in thermal equilibrium with one another.

12.3.2 A right-circular metal plug is to be inserted in each end of each tubular specimen, if necessary, to keep the tubular specimens from being crushed by the grips on the testing machine. Each plug is to fit snugly for its entire length and is to extend 1 inch (25 mm) farther into the tubular specimen than the end of the grips.

12.3.3 Each tubular specimen is to be tested until it parts on a power-driven machine on which the grips separate at the rate of 1/2 ±1/8 inch/minute or 10.0 ±2.5 mm/minute. The maximum load, L, observed for each specimen is to be recorded in lbf (N).

12.4 Results

12.4.1 The tensile strength of each specimen in psi (N/cm^2) is to be calculated by dividing the maximum load, L, in lbf (N) by the cross-sectional area, A, in inches^2 (cm^2). The average tensile strengths of the three conditioned specimens and three unaged specimens are to be determined and recorded for comparison with the requirements in 12.1.1.

13 Deflection Test

13.1 Six-inch (150-mm) specimens of finished conduit shall not flatten under the load indicated in Table 13.1 to the point that they buckle. The minor axis measured inside each loaded specimen shall not be less than the Table 13.1 percentage of the inside diameter of the specimen measured before loading. The test is to be made as indicated in 13.2 (similar to the procedure described in the Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading, ASTM D 2412).

13.2 Three 6-inch (150-mm) specimens are to be cut from finished lengths of each size of conduit. The specimens, the testing machine, and the surrounding air are to be in the thermal equilibrium with one another at a temperature of 23.0 ±2.0°C (73.4 ±3.6°F) during the test. The inside diameter of each specimen is to be measured. The specimens are then to be tested separately between a pair of rigid, flat, steel plates that are at least 6 inches (150 mm) long and are horizontal and parallel to one another. One plate is to be moved toward the other at the rate of 1/2 ±1/8 inch/minute or 10.0 ±2.5 mm/minute until the load specified in Table 13.1 is applied as indicated on the dial on the machine. All specimens shall comply with the following:

a) The surface shall not pull away from contact with either plate during or after application of the load (buckle) and

b) The minor axis measured inside any flattened specimen shall not be less than the Table 13.1 percentage of the inside diameter of that specimen measured before loading.

Table 13.1
Minimum Deflection Load for HDPE Specimens

Trade size	Metric Designator	Deflection %[a]	lbf	N	kgf
1/2	(16)	70	665	2958	302
3/4	(21)	70	510	2268	231
1	(27)	70	405	1801	184
1-1/4	(35)	75	395	1757	179
1-1/2	(41)	75	345	1535	157
2	(53)	75	275	1223	125
2-1/2	(63)	75	230	1023	104
3	(78)	75	185	823	84
3-1/2	(91)	75	160	712	73
4	(103)	75	140	623	64

[a] The figure in this column is the percentage of its original inside diameter to which the minor axis of the loaded specimen can be reduced by the load and still be acceptable.

14 Impact Test

14.1 A crack or tear longer than 1/32 inch (0.8 mm) shall not appear in seven out of ten specimens of finished conduit as the result of the impact described in 14.2.

14.2 Ten 6-inch (150-mm) specimens with no cracks, tears, or other imperfections are to be cut from finished lengths of each trade size of conduit. The specimens are to be tested separately while resting on a solid, flat, steel plate that is at least 1/2 inch (13 mm) thick and is firmly anchored with its upper surface horizontal. A protective cage is to surround the plates and specimen to reduce the likelihood of injury from pieces of broken conduit in the event that the conduit flies apart. A steel weight of 20 lbs (9.7 kg) in the form of a solid, right-circular cylinder, with a diameter of 2 inches (51 mm) and a flat impact face having rounded edges, is to fall freely through a vertical guide from the height indicated in Table 14.1. The flat face of the weight is to strike the center of the specimen across the diameter and along the longitudinal axis once (provision is to be made for keeping the weight from striking the specimen more than once).

Table 14.1
Impact height

Trade size	Metric Designator	Height of the face of the weight above the specimen before the weight is released,	
		feet	(meters)
1/2	(16)	2-1/2	(0.762)
3/4	(21)	4	(1.22)
1	(27)	5	(1.52)
1-1/4	(35)	6	(1.83)
1-1/2	(41)	7-1/2	(2.29)
2	(53)	9-1/2	(2.90)
2-1/2	(63)	10-1/2	(3.20)
3 – 4	(78 – 103)	11	(3.25)

15 Moisture Penetration Test

15.1 There shall be no evidence of moisture within specimens of finished conduit that are bent 180 degrees around a mandrel of the diameter shown in Table 15.1 into a U-shape and then immersed in water at room temperature for 28 days.

Table 15.1
Moisture penetration mandrel diameter

Trade size	Metric Designator	Mandrel diameter,	
		inches	(mm)
1/2	(16)	6.5	(165)
3/4	(21)	8.5	(216)
1	(27)	13.0	(330)
1-1/4	(35)	16.0	(406)
1-1/2	(41)	18.0	(457)
2	(53)	22.2	(564)
2-1/2	(63)	22.1	(561)
3 – 4	(78 – 103)	a	a

[a] To be developed

15.2 Specimens of finished conduit are to be bent into the shape of a U around the mandrel. The ends of the conduit are to be taped or tied to hold them in the U shape, and the mandrel is to be removed. The specimens are then to be placed vertically in a tub or tank of water at room temperature with the ends projecting 2 inches (51 mm) out of the water. The specimens are to remain immersed for 28 days and are then to be removed from the water and examined. There shall not be any evidence of moisture within the conduit.

16 Deflection Under Heat and Load Tests

16.1 General

16.1.1 The average temperature at which simply supported center-loaded bar specimens machined from finished conduit deflect 0.010 inch (0.25 mm) shall not be lower than 70.0°C (158.0°F) at a stress of 66 psi (455 KPa). The specimens are to be prepared and the test conducted as indicated in 16.2.1 – 16.4.1. These procedures are similar to those described in the Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position, ASTM D 648.

16.2 Preparation of specimens

16.2.1 At least three rectangular specimens that are of any convenient but uniform thickness, 0.50 inch (13 mm) high, and 5.0 inches (127 mm) long are to be machined from lengths of the finished conduit of the largest available trade size. All adjacent surfaces of each specimen are to be mutually perpendicular, smooth, flat, and without any visible imperfections such as scratches.

16.3 Conduct of test

16.3.1 The apparatus is to consist of a container in which a specimen can be supported and loaded as shown in Figure 16.1 while immersed in a liquid heat-transfer medium as shown in Figure 16.2. The coefficients of linear thermal expansion of the rod through which the load is applied and the vertical members that connect the specimen supports to the upper plate are to be equal. A dial micrometer on whose scale the smallest division represents 0.0005 inch or 0.01 mm is to be coupled to the loading rod for the purpose of measuring the deflection at the center of the specimen.

Figure 16.1
Support mechanism