

WESTERN UNDERGROUND COMMITTEE
GUIDE 3.7 (3.7/00/0577)

**HIGH DENSITY POLYETHYLENE CONDUIT
AND FITTINGS**

NOTE: This "Guide" summarizes the opinions, recommendations, and practices of the Western Underground Committee members and is issued only to assist these members in preparing their own specifications, or in making recommendations to specification agencies. Thus, this "Guide" may not reflect the complete requirements of each individual utility and is not binding upon them.

1.0 SCOPE, CLASSIFICATION AND SIZES

1.1 Scope – This specification covers high-density polyethylene plastic conduit and fittings for installing underground for communication and electrical wires and cable.

1.2 Classification – This specification covers the following types of high-density polyethylene plastic conduit as specified in the invitation for bids.

Type EB – Designed to be encased in concrete when installed (formerly referred to as Type I).

Type DB – Designed for installation without encasement in concrete (formerly referred to as Type II).

1.3 Sizes – The conduit shall be made in the following nominal iron pipe sizes (IPS) as specified in the invitation for bids.

Type EB sizes 1-1/2, 2, 3, 3-1/2, 4, 5 and 6 inches

Type DB sizes 1-1/2, 2, 3, 3-1/2, 4, 5 and 6 inches

1.4 Kind and Size of Fittings – Fitting shall be of the kind and nominal sizes as indicated below:

<u>FITTING</u>	<u>NOMINAL SIZES, INCHES</u>						
Couplings	1-1/2	2	3	3-1/2	4	5	6
Straight Couplings	1-1/2	2	3	3-1/2	4	5	6
Elbows, 45° Std. Radius	1-1/2	2	3	3-1/2	4	5	6

FITTING

NOMINAL SIZES, INCHES

Elbows, 90° Std. Radius	1-1/2	2	3	3-1/2	4	5	6
Tapered Plugs	1-1/2	2	3	3-1/2	4	5	6
Caps	1-1/2	2	3	3-1/2	4	5	6
Long Sweep Bends 45°	1-1/2	2	3	3-1/2	4	5	6
Long Sweep Bends 90°	1-1/2	2	3	3-1/2	4	5	6
Bell Ends	1-1/2	2	3	3-1/2	4	5	6
Expansions Couplings	1-1/2	2	3	3-1/2	4	5	6

1.5 Specification for Radius of Curvature

Field Bend Radius

<u>Size</u>	<u>Angle</u> 45° or 90°		<u>Fields Bends</u> Minimum Rad., Ft.		<u>Minimum</u> <u>Tangent</u> <u>Inches</u>
	<u>Factory Made, In.</u>		<u>EB</u>	<u>DB</u>	
1-1/2	16 or 24		5	5	4
2	24 or 36		6	5	4
3	30 or 36		9	6-1/2	5
3-1/2	36,	48 or 60	10	7-1/2	6
4	36,	48 or 60	11	8-1/2	6
5	36,	48 or 60	14	12-1/2	6
6	36,	48 or 60	20	17-1/2	6

2.0 APPLICABLE SPECIFICATIONS, STANDARDS AND OTHER PUBLICATIONS

- ASTM - Publications
- D618 - Conditioning Plastics and Electrical Insulating Materials for Testing
- D648 - Test for Deflection Temperature of Plastics under Flexural Load
- D883 - Definition of Terms Relating to Plastics
- D1248 - Specification for Polyethylene Molding and Extrusion Materials

- D1600 - Abbreviation of Terms Relating to Plastics
- D2122 - Determining Dimensions of Thermoplastic Pipe and Fittings
- D2412 - Test for External Loading Properties of Plastic Pipe By Parallel Plate Loading
- D2444 - Test for Impact Resistance of Thermoplastic Pipe and Fittings By Means of a Tup (Falling Weight)
- D3350 - Polyethylene Plastic Pipe & Fittings Material

Copies of ASTM standards may be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103

3.0 MATERIAL

- 3.1 The material to be used for this conduit and fittings shall be virgin high-density polyethylene compound, which meets cell classification PE436620C as defined in ASTM D3350. Other polyethylene compounds which have cell classification numbers that are greater than those listed be used.

Reground materials from the manufacturer’s own production of conduit products may be used by the manufacturer provided the end product is equal in quality to conduit made from virgin material. The plastic may contain stabilizers, lubricants, dyes, pigments and fillers.

- 3.2 O-Ring Gasket – The O-ring gasket shall be manufactured from a rubber compound of synthetic rubber or a blend of synthetic and natural rubber compounds. The O-rings shall be extruded or molded and cured in such a manner that any cross section will be dense, homogenous and free of porosity, blisters, pitting or other imperfections. The gaskets for each nominal size of conduit shall be as follows:

<u>Nominal Conduit Size</u>	<u>Diameter of Cross Section</u>
2	3/16” ± 1/64
3	1/4” ± 1/64
3-1/2	1/4” ± 1/64
4	1/4” ± 1/64
5	1/4” ± 1/64
6	1/4” ± 1/64

The gasket shall meet the following requirements for physical properties:

Tensile strength, psi min. - 2300	ASTM D-412
Elongation at break, percent, min. – 425	ASTM D-412
Shore durometer hardness – 40 ± 5 pts.	ASTM D-2240
Accelerated aging	
Decrease in tensile strength	
Max. percent of original – 15	ASTM D-578
	96 hrs. @ 70°C
Decrease in elongation	
Max. percent of original – 20	
Low temperature Brittleness	
After 3 minutes exposure @ -40°F – Non-Brittle	

4.0 REQUIREMENTS

- 4.1 Conduit Dimensions – The outside diameter, wall thickness, out-of-roundness, and length dimensions shall be determined in accordance with ASTM D2122. The dimensions of each size of conduit shall be in accordance with those listed in Table I and Table II.

TABLE I

Conduit Dimensions and Tolerances

NOMINAL <u>SIZE</u>	OUTSIDE DIAMETER			WALL THICKNESS			
	<u>AVERAGE</u>	OUT-OF-ROUNDNESS		MINIMUM		MAXIMUM	
		<u>MINIMUM</u>	<u>MAXIMUM</u>	<u>EB</u>	<u>DB</u>	<u>EB</u>	<u>DB</u>
1-1/2	1.900 ± 0.006	1.860	1.930	.070	.070	.090	.090
2	2.375 ± 0.006	2.345	2.405	.070	.080	.080	.100
3	3.500 ± 0.008	3.470	3.530	.086	.118	.098	.141
3-1/2	4.000 ± 0.008	3.950	4.050	.098	.133	.111	.159
4	4.500 ± 0.009	4.450	4.550	.110	.150	.125	.180
5	5.563 ± 0.010	5.513	5.613	.136	.185	.155	.222
6	6.625 ± 0.011	6.575	6.675	.162	.221	.184	.265

TABLE II

Bell End & Length Dimensions of Conduit

Size	<u>A</u>	<u>B</u>	<u>C</u>	<u>L</u>
1	3	2	3-1/8	19' or 38'
2	4	2-5/8	4-1/8	19' or 38'
3	4	3-7/8	4-1/8	19' or 38'
3-1/2	4-1/2	4-3/8	4-5/8	19' or 38'
4	4-1/2	4-7/8	4-5/8	19' or 38'
5	4-1/2	5-15/16	4-5/8	19' or 38'
6	5	7	5-5/8	19' or 38'

A – Bell Depth – Inches – Min.

B – Bell Entrance Diameter – Inches – Min.

C – Insertion Length – Inches – Min.

L – Laying Length – Feet – 0" + 1/4"

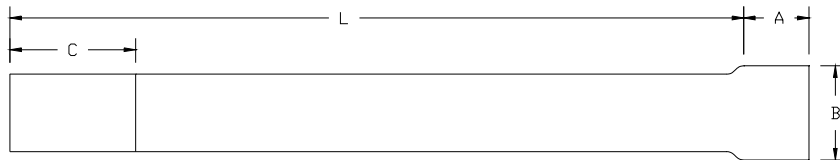


FIGURE 1
CONDUIT DIMENSIONS AND TOLERANCES

- 4.2 Workmanship – The conduit and fittings shall be free within commercial tolerance of objectionable lines, striations, bubbles, welds or other manufacturing defects which would impair the service of the conduit or fittings.
- 4.3 Fittings – Fittings shall be manufactured from material capable of meeting the material requirements of this specification. Fabricated fittings shall be made from DB Conduit as a minimum.

4.4 Impact Resistance – The minimum impact values in foot-pounds for types EB and DB conduit shall be as listed in Table III, below, when tested as follows: The specimens to be tested shall be conditioned at a temperature of $-17.8^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($0^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$) for five hours. The test apparatus shall be at room temperature $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($73.4^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$). The specimens shall be removed from the cold chamber and tested within 15 seconds after removal from the cold chamber.

Failure shall be considered as visible cracking of the conduit on any surface. Also, all specimens must pass a circular gauge having a diameter equal to 85% of the nominal size being tested within 10 minutes after being struck by the falling Tup. (During the 10-minute recovery period, the specimen shall remain in the room temperature climate.) Test five specimens each 6" ($\pm \frac{1}{4}$ ") long in accordance with Section 10 of ASTM D2444 using the Tup C weighting 20 lbs. and holder B.

If one specimen fails either test, five additional specimens shall be tested. All five must pass both tests, making 9 out of 10 acceptable.

TABLE III

Impact Resistance Values

<u>Size (inches)</u>	<u>Foot Pounds</u>	
	<u>Type EB</u>	<u>Type DB</u>
1-1/2	100	100
2	50	125
3	60	150
3-1/2	60	150
4	80	150
5	80	150
6	80	150

4.5 Compression and Recovery – The minimum load to compress the conduit specimen shall be listed in Table IV, below, when tested as follows: Five specimens of the conduit each 6 inches ($\pm 1/4$ "") long, shall be flattened between parallel plates at a rate of $1/2$ " per minute in a suitable press until the distance between the plates is 50% of the average outside diameter of the conduit. The specimens, test apparatus and the surrounding air shall be in thermal equilibrium with one another at a temperature of $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($73.4^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$) during the test. When the load is removed, the specimens shall recover to the least 85% of their original inside diameter within 10 minutes. There shall be no splitting or cracking of any of the specimens. If one specimen fails either test, five additional specimens shall be tested. All five must pass both tests making 9 out of 10 acceptable.

TABLE IV

MINIMUM LOAD REQUIRED TO COMPRESS
SPECIMEN TO 50% OF ORIGINAL DIAMETER

<u>NOMINAL SIZE</u>	<u>LOAD – POUNDS PER</u>	
	<u>Type EB</u>	<u>Type DB</u>
1-1/2	340	340
2	340	480
3	260	390
3-1/2	260	380
4	260	380
5	260	380
6	260	380

4.6 Joints – Two pieces of conduit be joined together using either of the two following methods used for joining polyethylene conduit.

4.6.1 Mechanical Method – A piece of conduit with an integral bell shall be joined to a piece of plain end conduit using a rubber O-ring gasket. The rubber O-ring shall meet the requirements of this specification. The joint shall be made in accordance with the manufacturer's recommendations. The resulting joint shall have an axial pull resistance equal to or greater than 85 pounds. Also, this type of joint shall be capable of withstanding a pressure test, using water as the medium, of 60 psi for 12 hours. The joint shall not leak. The testing apparatus shall be so arranged as to prevent pull out of the two pieces of conduit.

4.6.2 Butt Fusion Method – Two pieces of conduit shall be joined following the procedures recommended by the conduit

manufacturer. The resulting joint shall be capable of withstanding an axial pull strength of 200 pounds and be able to withstand an internal strength of 200 pounds and be able to withstand an internal pressure of 60 psi for 12 hours. The joint shall not leak.

5.0 SAMPLING AND INSPECTION

- 5.1 Sampling – The manufacturer shall certify on each lot or shipment that the plastic conduit and fittings supplied meet all the requirements of this specification. The letter of certification shall state the lot or control number and manufacturer of resin used. In addition, the manufacturer shall perform such individual tests described by the purchaser. When requested by the purchaser, test reports shall be certified by an independent laboratory and submitted to the purchaser.
- 5.2 Inspection – Conduit shall be examined for compliance with dimensional requirements and for freedom from manufacturing defects.

6.0 PREPARATION FOR DELIVER

The duct and fittings shall be packed to insure carrier acceptance and safe delivery to destination in accordance with Uniform Freight Classification Rules or with other rules and regulations applicable to the mode of transportation.

7.0 NOTES

- 7.1 Marking, Identification and Inspection. Each length of duct and fitting shall be identified with a marking showing the name of the extruder or the extruder's trademark, HDPE, nominal size, Type EB or DB, WUC 3.7, and a control number. Additional information deemed necessary by the extruder is permitted. Minimum size of lettering shall be ¼ inch for 2" and larger and 1/8" for 1-1/2".
- 7.2 Referee Test Conditions – Shall be per Standard Method of Conditioning Plastics and Electrical Insulation.

Materials for Testing (ASTM Designation: D618) for those tests when conditioning is required in all cases of disagreement.

In addition to the O-Ring Gasket method of making a joint, fusing butt-welding as an alternate method is acceptable for joining polyethylene pipe.