

# WESTERN UNDERGROUND COMMITTEE

## GUIDE 3.1 (3.1/01/0573)

### PLASTIC 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 plastic conduit and fittings for installation underground for communication and electrical wires and cables.

1.2 Classification – This specification covers the following types of 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, 1-1/2, 2, 3, 3-1/2, 4, 5, and 6 inches

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

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

<u>FITTINGS</u>	<u>NOMINAL SIZES, INCHES</u>
Couplings	1, 1-1/2, 2, 3, 3-1/2, 4, 5, 6
Reducers	2x1-1/2, 2x1, 3x2, 3-1/2x2, 4x3, 4x3-1/2, 5x4, 6x5

FITTINGS

NOMINAL SIZES, INCHES

	Adapters to G.C.,		
	F.C. or A.C.C.		1, 1-1/2, 2,
3, 3-1/2, 4, 5, 6		Elbows, 45°	
		1, 1-1/2, 2, 3, 3-1/2, 4, 5, 6	
		Elbows, 90°	1, 1-1/2, 2,
3, 3-1/2, 4, 5, 6		Bell Ends	
1, 1-1/2, 2, 3, 3-1/2, 4, 5, 6		Plugs	
	1, 1-1/2, 2, 3, 3-1/2, 4, 5, 6		Caps
		1, 1-1/2, 2, 3, 3-1/2, 4, 5, 6	Long
	Sweep Bends 90°	1, 1-1/2, 2, 3, 3-1/2, 4, 5, 6	
	Long Sweep Bends 45°	1, 1-1/2, 2, 3, 3-1/2,	
4, 5, 6	S Bends		1, 1-
1/2, 2, 3, 3-1/2, 4, 5, 6		Curved, Segments,	
	22-1/2°	1, 1-1/2, 2, 3, 3-1/2, 4, 5, 6	
	Clay Conduit Adapters	3-1/4, 3-1/2	

1.5 Specification for Radius or Curvature

	<u>RADII</u>			<u>Tangent or Minimum</u>
<u>Size</u>	<u>45° &amp; 90° Bends</u>		<u>Sweeps</u>	<u>Straight Length at End</u>
<u>Inches</u>	<u>Inches</u>		<u>Feet</u>	<u>Inches</u>
1	5-3/4	None	1-7/8 1-1/2 8-1/4	None 2 2 24 &
36	None	2		
3	30 & 36	12-1/2	3-1/4 3-1/2	36 & 60 12-1/2 3-
1/4	4	36 & 60	12-1/2 3-1/2	
5		36 & 60		12-1/2 3-1/2
6		48 & 60		12-1/2 3-1/2

**2.0 MATERIAL TO BE USED, APPLICABLE SPECIFICATIONS, STANDARDS AND OTHER PUBLICATIONS**

2.1 The material to be used for this conduit shall be virgin ABS or PVC plastic. The manufacturer may use reground material from manufacturer's own pipe products provided the end product is equal in quality to pipe from virgin material.

2.2 Publications – The following documents form a part of this specification. The issue in effect on date of invitation for bids shall apply.

Test Standards and References:

- D-543 Test for Resistance of Plastics to Chemical Reagents.
- D-618 Methods of Conditioning Plastics and Electrical Insulating Materials for Testing.
- D-648 Test Run Deflection Temperature.
- D-883 Definitions and Terms.
- D-2122 Determine Dimensions of Thermo Plastic Pipe.
  - D-2412 Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading.
  - A-101 Impact Testing Method of Western Plumbing Officials Association Stand WPOA TSC 6-61 (Trailer Standard Committee).

All definitions and terms used in this specification are in accordance with ASTM D-883.

(Copies of the standards may be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pennsylvania.)

**3.0 REQUIREMENTS**

3.1 Materials – The conduit and fittings shall be made of materials as specified in Section 2.1 capable of meeting the physical and chemical requirements. This plastic may contain stabilizers, lubricants, dyes, pigments, and fillers.

3.2 Heat Distortion – The maximum deflection of the conduit shall be 5% when tested in accordance with Section 4.4.

3.3 Impact Resistance – The minimum Impact Values for Types EB and DB Underground Conduit when tested in accordance with Section 4.5 of these specs. shall be:

		<b><u>FOOT – POUNDS</u></b>	
	<u>Size – Inches</u>	<u>Type EB</u>	<u>Type DB</u>
2	8	17	
3	8	22	
	3-1/2	8	22
		4	8
		40	
5	8	40	
6	8	40	

- 3.4 Conduit Stiffness – The 5 percent conduit stiffness factor shall not be less than the values given when tested in accordance with Section 4.6.
- 3.5 Joint Tightness – When joined by solvent welding or other approved methods, the joints shall be watertight, and shall not leak when tested at an internal pressure of 25 PSI when tested in accordance with Section 4.7.
- 3.6 Dimensions – Diameters and lengths of each type of conduit shall be those shown in Table I and II, pages 10 and 11. Wall thickness tolerance shall be limited to 12% - 0%. All tolerances shall be as specified in Table I and II. Variances from specification shall be measured in accordance with Section 4.8.
- 3.7 Fittings – Fittings shall be manufactured from material capable of meeting the physical and chemical requirements of this specification. Fittings may be either molded or formed by swedging, and shall be capable of being solvent welded to the conduit. Fittings shall be capable of freely passing mandrel ¼” less in diameter than the normal bore of the conduit or ball.
- 3.8 Workmanship – Conduit and fittings shall be free within commercial tolerance of objectionable lines, striations, bubbles, welds and other manufacturing defects which would impair the service of the conduit.
- 3.9 Chemical Resistance – The conduit and fittings shall not increase in weight more than 0.50 percent to change in conduit stiffness more than plus or minus 15 percent when immersed in selected chemicals. (See Section 4.9).
- 3.10 Water Resistance
  - 3.10.1 Water Absorption – The conduit and fittings shall not increase in weight more than 0.60 percent when immersed in water in accordance with Section 4.10.
  - 3.10.2 Wet Strength – The minimum conduit stiffness of wet specimens of conduit and fittings shall be within plus or minus 5 percent of the actual conduit stiffness of dry specimens as determined in Sections 3.4 and 4.10.

#### **4.0 SAMPLING, INSPECTION AND TEST PROCEDURES**

4.1 Samples – The manufacturer shall certify on each lot or shipment that the plastic conduit and fittings supplied meet all of 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 in Section 4.0 on each lot or shipment as may be directed by the purchaser. When requested by the purchaser, test reports shall be certified by an independent laboratory and submitted to the purchaser.

4.2 Inspection – Conduit shall be examined for compliance with dimensional requirements and for freedom from manufacturing defects.

### 4.3 Test Methods

4.3.1 Test Specimens – Test specimens shall be cut from conduit samples as specified.

4.3.2 Conditioning Test Specimens – The specimens shall be conditioned prior to test at 23°C plus or minus 1°C (73.4° F plus or minus 1.8°F) and 50 plus or minus 2 percent relative humidity for not less than 48 hours in accordance with Procedure A in Standard Method of Conditioning Plastics and Electrical Insulation Materials for Testing (ASTM Designation: D-618) for those tests where conditioning is required and in all cases of disagreement.

4.3.3 Test Conditions – Test shall be conducted in a laboratory atmosphere of 23° C, plus or minus 1°C, (73.4° F plus or minus 1.8°F), and 50 plus or minus 2 percent, relative humidity, unless otherwise specified.

4.4 Heat Distortion – Determine the heat distortion on two 3-inch samples of the same lot. Place these samples between two rigid, parallel flat plates and measure and mark the vertical diameter of both specimens to the nearest 0.001-inch. Load the top plate symmetrically to the load specified below. Place the specimens in a circulating air oven, maintained at 140° F ± 3.6°F for 24 hours. At the end of this period remove the load and test specimens from the oven and test fixture and allow cooling in air to standard laboratory conditions as specified in Section 4.3.3 for 1 ± ¼ hour. Measure the inside diameter between the same two points as the original measurement. Record the change in diameter to the

nearest 0.001 inch and examine for conformance to the requirements of Section 3.2.

	<u>Size – Inches</u>		<u>LOAD – POUNDS/LINEAR FOOT</u>					
			<u>Type EB</u>		<u>Type DB</u>			
1	-	19	1-1/2	-	19	2	6	24
3	7.5	25	3-1/2	7.5	40	4	11.5	45
5			14.4			56		
6			17.5			67		

4.5 Impact Strength – The resistance to impact shall be determined by a falling weight striking the conduit. The conduit specimen or fitting shall be subjected to impact on the standard drop weight impact tester described in Western Plumbing Officials Association Standard WPOA TCS 6-61 and WPOA A-101. The falling weight shall weight five pounds and have a striking head 0.500” in diameter. Five (5) specimens from each lot, six (6) inches in length shall be tested. If one fails, an additional five (5) shall be tested – all shall pass, making 9 out of 10 acceptable. Failure shall be considered as visible cracking of the conduit. The test results shall be expressed in foot-pounds.

4.6 Conduit Stiffness – Test three 6-inch samples in accordance with ASTM Method D-2412. (Test for External Loading Properties of Plastic Pipe by Parallel Plate Loading.) Calculate the 5 percent conduit stiffness and examine for conformance with the following table. Calculate conduit stiffness at 5% deflection as follows:

$$\text{Conduit Stiffness (psi)} = \frac{F}{Y}$$

Where F = Load in pounds at 5% deflection.

Y= Vertical deflection of inside diameter in inches.

	<u>Normal Conduit</u>		<u>Type EB</u>		<u>Type DB</u>			
	<u>Size, Inches</u>		<u>in 2 lb/in.</u>		<u>in 2 lb/in.</u>			
1	-	90	1-1/2	-	60	2	15	60
3	15	60	3-1/2	15	60	4	15	60
5			15				60	
6			15				60	

4.7 Joint Tightness – Two pieces of conduit shall be joined together with a fitting by solvent welding or other method recommended by the manufacturer and allowed to stand for 12 hours at room temperature.

The specimen shall then be subjected to an internal pressure of 25 PSI, with water as the medium for 12 hours. The conduit and the joints shall show no leakage.

4.8 Dimensions – Measurements shall be taken on three (3) samples of each lot. The outside diameter, wall thickness, length dimensions, shall be determined in accordance with ASTM D-2122.

4.9 Chemical Solution CONCENTRATION IN WATER

Sodium Carbonate	0.1N	Sodium Sulfate	0.1N
Sodium Chloride	5 percent	Sulfuric Acid	0.1N
Hydrochloric Acid	0.2N		
	Sodium Hydroxide		0.2N
	Acetic Acid		5 percent

The test specimen shall be one foot long and cleanly cut. Three specimens shall be tested with each reagent. The specimens shall be weighed to the nearest 0.1 gram and completely immersed in the chemicals. The immersion period shall be 72 hours. On removal from the chemicals, the specimens shall be wiped with a dry cloth, conditioned for 2 hours, minus 0 plus 15 minutes, and reweighed. The increase in weight shall be calculated to the nearest 0.01 percent on the basis of the initial weight. The specimen shall then be tested to determine the conduit stiffness in accordance with Section 3.4 within 30 minutes after weighing. The results obtained in both the weight and strength tests for each specimen shall meet the requirements.

4.10 Water Absorption – Three test specimens at least 6 inches long of conduit or three complete fittings, cleanly cut shall be weighted to plus or minus 0.1 gram, and immersed in water at 23 plus or minus 1°C (73.4 plus or minus 1.8°F) for 48 hours. The specimens shall be removed, wiped dry with a clean, dry cloth, and reweighed immediately. The average percent gain in weight shall be calculated on the basis of the initial weight.

## **5.0 PREPARATION FOR DELIVER**

The conduit 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.

## **6.0 ORDERING DATA**

Purchaser should specify the kind and size of conduit, the kind and size of the fittings required and should exercise any desired options offered herein.

## **7.0 MARKING, IDENTIFICATION AND INSPECTION**

Each length of conduit and fitting shall be identified with a marking showing the name of the extruder or the extruder's trade mark, ABS or PVC, nominal size and Type EB or DB. No order of marking is specified.

Any additional information deemed necessary by the extruder is permitted. The resin used for each lot or shipment of conduit or fittings shall be identified by stating in the letter of certification the lot or control number of the resin and the manufacturer's name. All tests required for samples in this specification shall be filed or mailed to purchaser as requested on purchase order. Any conduit that does not compare with the test results for that unit will give sufficient reason for rejecting the entire unit.

## **8.0 NOTES/REVISIONS**

8.1 Joints – All connections shall be made with the solvent weld compound recommended by the conduit manufacturer.

8.2 It is believed that this specification adequately describes the characteristics necessary to secure the desired items and that normally no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated. This specification is to apply in all other respects.

8.3 Suggestions for revision and correspondence concerning this Specification should be addressed to the:  
Chairman,  
Western Underground Committee.  
(For address, see any member of the committee)

8.4 This specification may be reproduced in whole provided proper credit is given the Western Underground Committee.

### **TABLE 1 CONDUIT DIMENSIONS AND TOLERANCES**

Nominal Size	Nominal O.D.	Tolerance O.D.	Out of Round	Minimum Wall Thickness Type EB	Type DB Lengths		
<u>Inch</u>	<u>Inch</u>	<u>Inch</u>	<u>Inch</u>	+12% -00%	+12%	- 0%	<u>Feet</u>
<u>Inches</u>	<u>Inches</u>				ABS&PVC	PVC	ABS
				±.015	10,20 1 .060 .060	1.315 .070	±.005 25,30
1-1/2	1.900	±.006	±.030	.060	.075 .090		10,20 25,30
2	2.375	±.006	±.030	.060	.090 .110		
				±.030	10,20 3 .075 .105	3.500 .125	±.008 25,30
3-1/2	4.000	±.008	±.050	.080	.120 .140		10,20 25,30
4	4.500	±.009	±.050	.095	.130 .160		
				±.050	10,20 5 .100 .145	5.563 .180	±.010 25,30
6	6.625	±.011	±.050	.125	.195 .213		10,20 25,30

**TABLE 2  
CONDUIT BELL END DIMENSIONS**

	A			B			C		
SIZES, DUCT	SOCKET ENTRANCE			INSIDE DIAMETER, INCHES			SOCKET BOTTOM INSIDE		
DIAMETER, INCHES	SOCKET DEPTH, INCHES								

INCHES	Ave.			Medium			Max.				
	Ave.	Medium	Max.	Ave.	Medium	Max.	Ave.	Medium	Max.		
1	1.331	1.326	1.336	1.320	1.315	1.325	1.125	1.000	1.250	1 ¼	1.677
		1.672	1.682	1.665	1.660	1.670	1.125	1.000	1.312		
1	½	1.921	1.916	1.926	1.906	1.901	1.911	1.500	1.375	1.623	

2	2.400	2.395	2.405	2.381	2.376	2.386	1.875	1.750	2.000		
3	3.538	3.533	3.543	3.508	3.503	3.513	3.000	2.875	3.125	3 1/2	4.041
		4.036	4.046	4.008	4.003	4.013	3.250	3.125	3.375		
4	4.544	4.539	4.549	4.509	4.504	4.514	3.500	3.375	3.625		
5	5.614	5.609	5.619	5.573	5.568	5.578	4.125	4.000	4.250		
6	6.687	6.682	6.692	6.636	6.631	6.641	5.125	5.000	5.250		

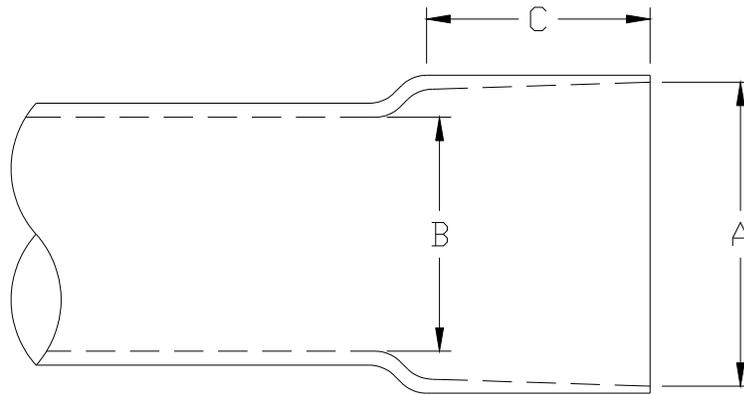


FIGURE 1  
CONDUIT BELL END