	<b>UNDERGROUND CONDUITS</b>		<b>062288</b>
	<b>Asset Type:</b> Electric Distribution	<b>Function:</b> Design and Construction	
<b>Issued by:</b> Lisseth Villareal (LDV2) <i>Lisseth Villareal</i>	<b>Date:</b> 11-01-18		
<b>Rev. #18:</b> This document replaces PG&E Document 062288, Rev. #17 For a description of the changes, see Page 23.			

### Purpose and Scope

This document covers steel and plastic conduit for electric underground installations, with or without concrete encasement.

### General Information

1. Applications for underground conduit are as follows:
  - A. Residential: All residential installations requiring conduit should be made without concrete encasement.
  - B. Light Commercial, Industrial, and Underground Residential Distribution (URD) Feeder: Installation of circuits of this type, which are three-way or less, should normally be made without concrete encasement. In densely populated urban areas, conduit banks involving more than three primary conduits will normally require concrete encasement.
  - C. Severe exposure to “dig-ins” and other hazards may require concrete encasement of conduit lines.
  - D. For any rail road crossings, single wall or co-extruded cellular core wall PVC Schedule 40, UL 651 conduit is required.
2. When conduit, including service conduit, is to be installed for PG&E by others, the following are acceptable alternatives to the [American Society of Testing and Materials \(ASTM\) F512 \(DB-120\)](#) conduits listed in this document:
  - A. Single wall and co-extruded cellular core wall PVC Schedule 40 or 80 UL 651 conduit that is so marked.
  - B. Hot-dip galvanized rigid steel conduit conforming to American National Standards Institute (ANSI) Specification C80.1.  
It is the installer’s responsibility to use the proper fitting to join conduits. This transition may involve changes in both conduit type and size. If equal diameter conduits of different wall thicknesses are joined, the inside edge of the spigot end must be chamfered.
3. The current carrying capacity of an insulated cable is reduced if it is surrounded by other loaded cables. For this reason, conduit banks should be arranged so that each conduit is in an outside position.
4. Every effort should be made to obtain a straight, watertight conduit line.
5. In commercial distribution systems, consideration should be given to providing one or more spare conduits in the original construction for future load growth requirements. The addition of such conduits at a later time is much more costly.
6. A mandrel must be used to prove that all conduits are free and clear of dirt, rocks, and other debris. For further information refer to [Greenbook 3.4.1](#).
7. A pulling tape with sequential footage markings (**Material Code M560154**) must be installed in all conduits and attached to an end cap. The tape must be proven free and not glued or caught on joints.
8. All conduits must be capped. All conduits not terminating in a subsurface enclosure, pedestal, or vault are to be capped with unglued rigid caps (see Table 12 on Page 8). Conduits terminating in a subsurface enclosure, pedestal, or vault must be capped with temporary plugs (see Table 12 on Page 8).
9. When the intrusion of water into buildings can be reasonably expected through lateral service ducts, PG&E is responsible for sealing both ends of the conduit (refer to [Document 063927](#) and [Document 063928](#)). The

Rayflate Duct Sealing System (RDSS) conduit sealing system can be ordered for this purpose. RDSS must be used when waterproofing a subsurface transformer enclosure is required. Refer to [Document 072149](#).

10. For the design requirements of conduits installed on bridges see [Utility Procedure TD-2310P-10](#).

**Material Specifications**

- 11. Plastic conduits and fittings must comply with the latest revision of [ASTM Standard F512](#) for PVC, and must also meet the following specific requirements:
  - A. Single wall conduit cell classification of 12164-B or 12264-B, tensile modulus of 500,000 psi.
  - B. Co-extruded cellular core wall conduit cell classification of 12254-B, minimum average tensile modulus of 445,000 psi.
  - C. Fittings cell classification of 12234-B.
  - D. Marking must conform to [ASTM Standard F512](#) requirements.
  - E. The inside edge of conduit ends (spigot-end only in the case of belled-end conduit) must be beveled to eliminate sharp edges and minimize the possibility of cable damage.
  - F. PVC conduit and fittings must be gray in color.

**Application**

- 12. Plastic conduit may be cut with a hacksaw or a fine-toothed wood saw. Clean off burrs. Bevel the inside to eliminate sharp edges.
- 13. Apply a thin, uniform coat of cement to both surfaces to be glued. Avoid excessive use of cement to prevent the formation of a bead of cement on the interior shoulder of the joint since, when hardened, the bead can cause cable damage during installation. Immediately after applying the coat of cement to the conduit, insert the conduit into the fitting socket until it bottoms at the fitting shoulder. Turn the conduit 1/4 turn during insertion to distribute the cement evenly. Hold the conduit in place for about 1 minute to prevent backing out in case of tight interference fit joints. Wipe any excess cement away from the outside of the joint. Weather conditions may vary the curing time. When using cement in confined areas, adequate ventilation must be provided.

**Table 1 Cement for Use With Plastic Conduits**

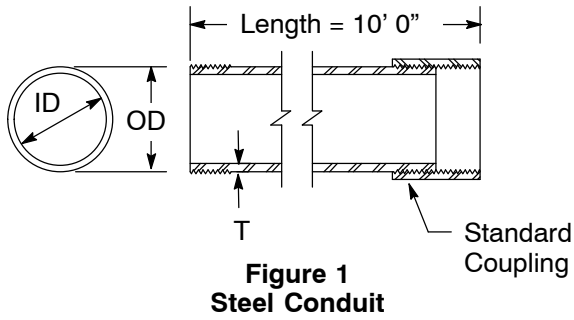
Application	Quantity	Approved Manufacturer and Part Number		Material Code
		Oatey	Weld-on Duit 413	
PVC to PVC	1 Quart	30886	12089	490157
	1 Pint	30885	12090	490151

- 14. Backfill containing large rock, paving material, cinders, large amounts of sharply angular substance, or corrosive material must not be placed in excavations where such material may damage conduits, prevent adequate compaction of the fill, or contribute to corrosion of the conduits.
- 15. Use end bells to terminate all conduits, unless the conduit has been terminated in an enclosure equipped with duct terminators. Use cable protectors on reconstruction projects only, when end bells cannot be installed.
- 16. In applications where a conduit dead-ends, cap the end of the conduit and place a marker ball (material code **M374947**) at the location. Refer to [M-60](#) for more information.
- 17. Conduits shown in Table 10 (HDPE) and Table 11 (Bore-Gard) on Page 7 are for horizontal directional drilling (HDD) applications only.
- 18. **Caution:** When pulling conduits in boring applications, be certain to cut the conduits allowing sufficient extra length for the conduit to relax. It may take as long as 72 hours for an excessively stretched conduit to fully relax.
- 19. **Caution:** Do not use Snap-N-Stack Combo Spacers in concrete encased application.
- 20. Conduit shown on Table 20 through Table 23 (flexible conduit) on Page 11 through Page 14 are for use in areas with minor soil settlement issues, and for large radius sweeps or re-routes.
- 21. Single wall conduit PVC DB-120 is not allowed for 2" conduit size. For 2" conduit size use co -extended cellular core PVC DB 120 or schedule 40 or schedule 80.

## Underground Conduits

References	Location	Document
<a href="#">Underground Duct Lines Concrete Encased</a> .....	<a href="#">FRO: UG Conduit</a> .....	<a href="#">031792A</a>
<a href="#">Underground Conduit Without Concrete Encasement</a> .....	<a href="#">FRO: UG Conduit</a> .....	<a href="#">031793A</a>
<a href="#">Methods and Requirements for Installing Residential Underground Electric Services 0-600 V to Customer-Owned Facilities</a> .....	<a href="#">UG-1: Services/Greenbook</a> .....	<a href="#">063927</a>
<a href="#">Methods and Requirements for Installing Commercial Underground Electric Services 0-600 Volts to Customer-Owned Facilities</a> .....	<a href="#">UG-1: Services/Greenbook</a> .....	<a href="#">063928</a>
<a href="#">Selection of the Type of Underground Equipment</a> .....	<a href="#">UG-1: General/Greenbook</a> .....	<a href="#">072149</a>
<a href="#">Engineering Material Specification 64, "Polyvinyl Chloride (PVC), Conduits, and Fittings"</a> .....	<a href="#">TIL</a> .....	<a href="#">EMS64</a>
<a href="#">Engineering Material Specification 99, "Underground Electric Duct System (installed by applicant)"</a> .....	<a href="#">TIL</a> .....	<a href="#">EMS99</a>
<a href="#">Engineering Material Specification 4123, "Backfill Sand</a> .....	<a href="#">TIL</a> .....	<a href="#">EMS4123</a>
<a href="#">Electric Distribution Conduits Installed on Bridges</a> .....	<a href="#">TIL</a> .....	<a href="#">TD-2310P-10</a>
<a href="#">Request for Variance from Electric Distribution Standards</a> .....	<a href="#">TIL</a> .....	<a href="#">TD-2951P-01</a>
<a href="#">Approved "Mark and Locate" Instruments, Equipment, Accessories, and Products</a> .....	<a href="#">TIL</a> .....	<a href="#">M60</a>

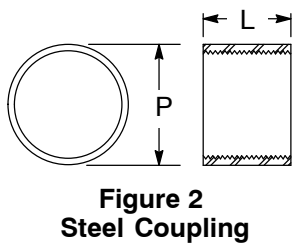
**Rigid Steel Conduit and Fittings**



**Table 2 Material Material Codes for Rigid Steel Conduit**

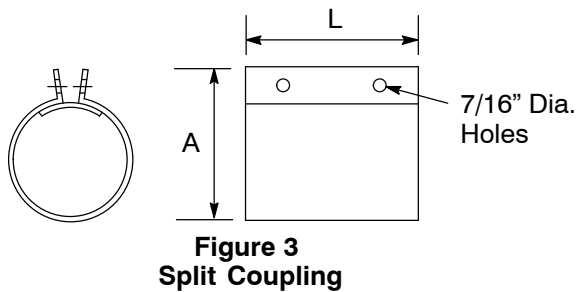
Conduit Size (inches)	Dimensions (inches)			Weight (lbs.) <sup>1</sup>	Material Code
	OD	ID	T		
2	2.4	2.06	0.154	33	362103
3	3.5	3.06	0.216	69	362092
4	4.5	4.02	0.237	98	362093
5	5.6	5.04	0.258	134	362104
6	6.6	6.06	0.280	177	362141

<sup>1</sup> Weight for one 10-foot length, including one standard coupling furnished with each length.



**Table 3 Material Codes for Standard Steel Coupling**

Conduit Size (inches)	Dimensions (inches)		Material Code
	P	L	
2	2.73	2.18	362105
3	4.00	3.25	362094
4	5.00	3.50	362095
5	6.29	3.75	362106
6	7.39	4.00	362142



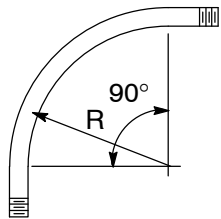
**Table 4 Material Codes for Galvanized Steel Split Coupling**

Conduit Size (inches)	Dimensions (inches)		Material Code
	A	L	
2	2.5	9	362019
3	3.5	9	362021
4	4.5	9	362023
5 <sup>1</sup>	5.5	9	362107
6 <sup>1</sup>	6.5	9	362143

<sup>1</sup> These sizes are made of zinc-plated malleable iron. Can be installed on rigid steel conduits.

Underground Conduits

*Rigid Steel Conduit and Fittings (continued)*



**Figure 4**  
**Conduit Sweep**  
**Threaded Both Ends**

**Table 5 Material Codes for 90° Steel Conduit Sweeps, TBE**

Conduit Size (inches)	Radius (inches)	Material Code
2	24	360081
3	36	362091
4	36	362090
	60	360812
5	36	362109
6	36	362144
	48	362145
	60	360813

**Plastic Conduit and Fittings**

**Notes**

1. The depth of all couplings, adapters, swedge reducers, and bell ends must conform to the requirements listed in Table 2 of [ASTM Standard F512](#).

**Table 6 Data and Material Codes for Rigid Plastic Conduit DB-120 <sup>1</sup>**

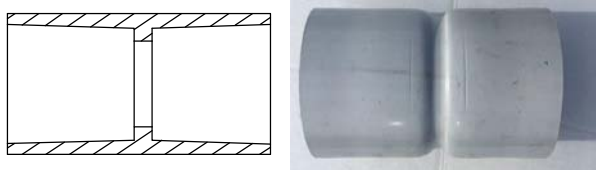
Conduit Size (inches)	Dimensions (inches)				Material Code
	Outside Diameter	Minimum ID	Wall Thickness		
			Minimum	Maximum	
2 <sup>2</sup>	2.375	2.189	0.083	0.113	360153
3	3.500	3.204	0.118	0.148	016471
4	4.500	4.132	0.154	0.184	016472
5	5.563	5.121	0.191	0.221	016473
6	6.625	6.111	0.227	0.257	016474

<sup>1</sup> See Note 11 on Page 2 for material specifications.

<sup>2</sup> Co-extruded cellular core DB-120.

**Table 7 Material Codes for PVC Couplings**

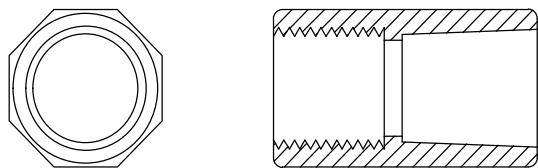
Standard Coupling		
Conduit Size (inches)	Material Code	Minimum Socket Depth
2	360321	1.75
3	360322	2.875
4	360323	3.375
5	360401	4.0
6	360482	5.0



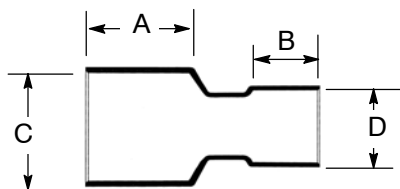
**Figure 5  
PVC Coupling**

**Table 8 Material Codes for Plastic-to-Steel Adapters**

Conduit Size (inches)	Material Code
2	360324
3	360325
4	360326
5	360402
6	360489



**Figure 6  
Plastic-to-Steel Adapter**



**Figure 7  
Swedge Reducer**

**Table 9 Data and Material Codes for PVC Reducers <sup>1, 2</sup>**

Reducer Size (inches)	Dimensions (inches)				Material Code
	Minimum Length		Typical Belled End ID		
	A	B	C	D	
3 x 2	2.875	1.750	3.515	2.393	018585
4 x 3	3.375	2.875	4.515	3.515	018584
5 x 4	4.000	3.375	5.593	4.515	360777
6 x 5	5.000	4.000	6.658	5.593	360778

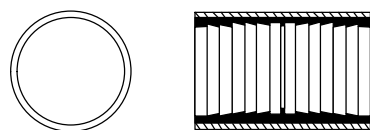
<sup>1</sup> Both belled ends must be chamfered 0.3 inches (min) by 45°.

<sup>2</sup> Reducers are made of PVC Schedule 40 .

## Underground Conduits

### Plastic Conduit and Fittings (continue)

**Table 10 High Density Polyethylene (HDPE) Conduit Directional Boring Conduit <sup>1</sup>**



**Figure 8  
HDPE Mechanical Coupling**

Conduit				Mechanical Couplings <sup>2, 3</sup>	
Size	Length (feet)	Description	Material Code	Size (inches)	Material Code
2" Sch 80	500	Coil <sup>4</sup>	360511	2	360690
2" Sch 80	40	Stick	360017		
3" Sch 80	500	Coil <sup>4</sup>	360644	3	360691
3" Sch 80	40	Stick	360018		
4" Sch 80	625	Coil <sup>5</sup>	360014	4	360692
4" Sch 80	40	Stick	360015		
5" SDR 13.5	450	Coil <sup>5</sup>	360012	5	360694
5" SDR 13.5	40	Stick	360013		
6" SDR 13.5	450	Coil <sup>5</sup>	360010	6	360695
6" SDR 13.5	40	Stick	360011		

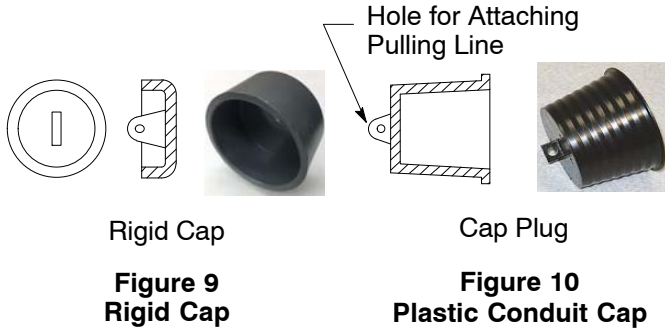
- <sup>1</sup> Color must be black with at least 3 red longitudinal strips.
- <sup>2</sup> May be used to connect PE conduit to PVC conduit (except in directional drilling apps.)
- <sup>3</sup> Mechanical couplings are not designed for directional drilling. Fusion joints are required.
- <sup>4</sup> No reel.
- <sup>5</sup> With reel.

**Table 11 PVC (Bore-Gard) Directional Boring Conduit**

Size (inches)	Description	Material Code
3	Conduit 10', Schedule 40	360055
3	Conduit 20', Schedule 40	360056
4	Conduit 10', Schedule 40	360026
4	Conduit 20', Schedule 40	360025
4	Replacement Locking Straps <sup>1</sup>	360031
4	Replacement Seal Gaskets <sup>1</sup>	360029
6	Conduit 10', Schedule 40	360027
6	Conduit 20', Schedule 40	360028
6	Replacement Locking Straps <sup>1</sup>	360032
6	Replacement Seal Gaskets <sup>1</sup>	360030

- <sup>1</sup> Package of 10.

**Plastic Conduit and Fittings (continued)**

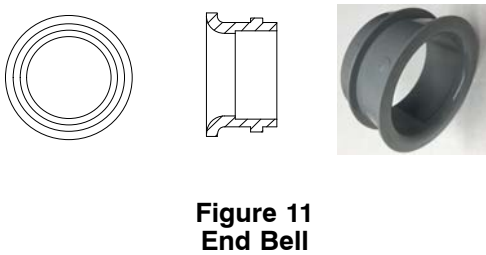


**Table 12 Material Codes for Rigid Conduit Caps and Cap Plugs**

Conduit Size (inches)	Material Codes	
	Rigid Cap	Cap Plug
2	360425	360440
3	360426	360441
4	360428	360443
5	360429	360444
6	360488	360494

**Table 13 Material Codes for End Bells**

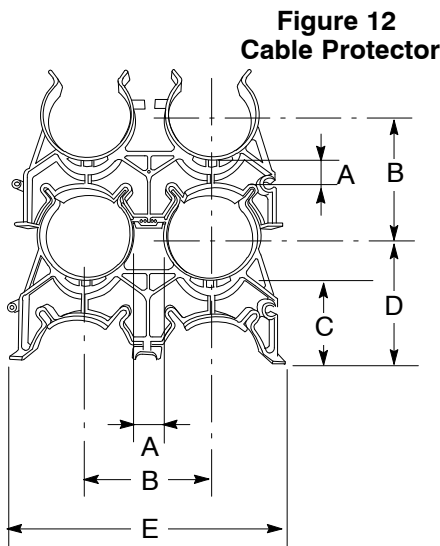
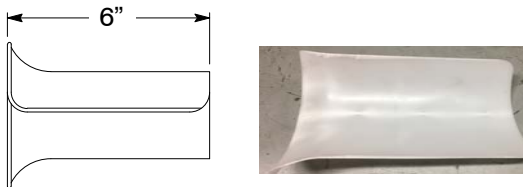
Conduit Size (inches)	Material Code
2	360420
3	360421
4	360423
5	360424
6	360487



**Table 14 Material Codes for Cable Protectors <sup>1</sup>**

Conduit Size (inches)	Material Code
2	382034
3	382045
4	
5	
6	

<sup>1</sup> Not for new installations; for replacement only.



**Table 15 Material Codes for Snap-N-Stack Combo Spacers <sup>1</sup>**

Conduit Size (inches)	Duct OD (inches)	Horizontal Duct Positions	Dimensions (inches)					Material Material Codes
			A	B	C	D	E	
3	3.5	2	2	5.5	3.63	5.38	11	360459
4	4.5	2	2	6.5	3.88	6.06	13	360460
5	5.5	2	2	7.56	4.38	7.25	15.12	360461
6	6.625	2	2	8.62	4.13	7.38	17.25	360491

<sup>1</sup> Cable spacers allow only for 2" separation between conduits. Cable spacers are used only where is required to route around existing obstructions. Thus, locations where cable spacers are needed are exempt from the requirement of maintaining 3" separation between 600 A distribution circuits.



Underground Conduits

Plastic Conduit and Fittings (continued)

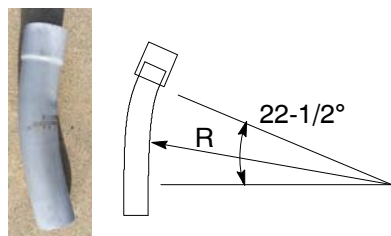


Figure 14  
22-1/2° PVC Conduit Bend

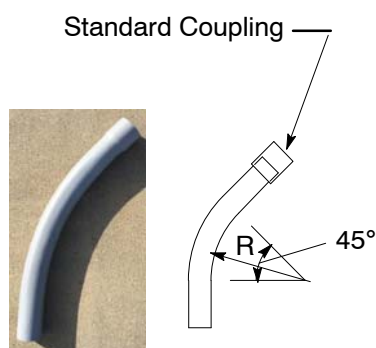


Figure 15  
45° PVC Conduit Bend

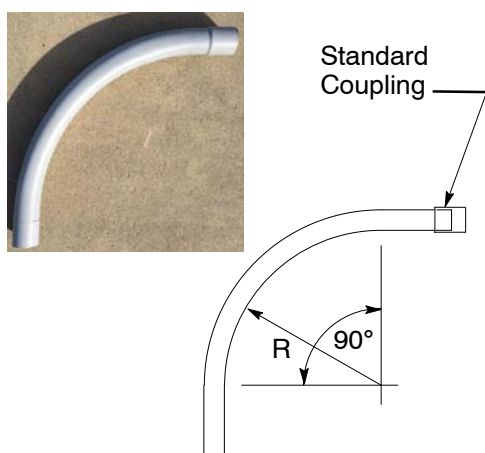


Figure 16  
90° PVC Conduit Bend

Table 16 Material Codes for DB-120 PVC Conduit Bends (sweeps) <sup>4</sup>

Conduit Size (inches)	Sweep		Material Code
	Degree	Radius <sup>2</sup> (inches)	
2 <sup>1,3</sup>	11-1/4	24	360155
		36	360156
	22-1/2	24	360157
		36	360158
	45	24	360159
		36	360160
	90	24	360161
		36	360162
3	11-1/4	36	360801
	22-1/2	36	360800
	45	36	360403
	90	24	360405
4 <sup>4</sup>	11-1/4	36	360804
		60	360805
	22-1/2	36	360760
		60	360761
	45	36	360412
	90	60	360413
		36	360414
	60	360415	
5	11-1/4	36	360808
		60	360809
	22-1/2	36	360806
		60	360763
	45	36	360416
	90	60	360417
		36	360418
	60	360419	
6	11-1/4	60	360811
	22-1/2	60	360765
	45	36	360485
		60	360486
	90	36	360483
		60	360484

<sup>1</sup> Co-extruded cellular core wall DB-120.

<sup>2</sup> For each conduit bend; first row shows minimum vertical radius, second row shows minimum horizontal radius.

<sup>3</sup> For 2" primary conduits, preferably use 36" vertical radius if field conditions allowed it.

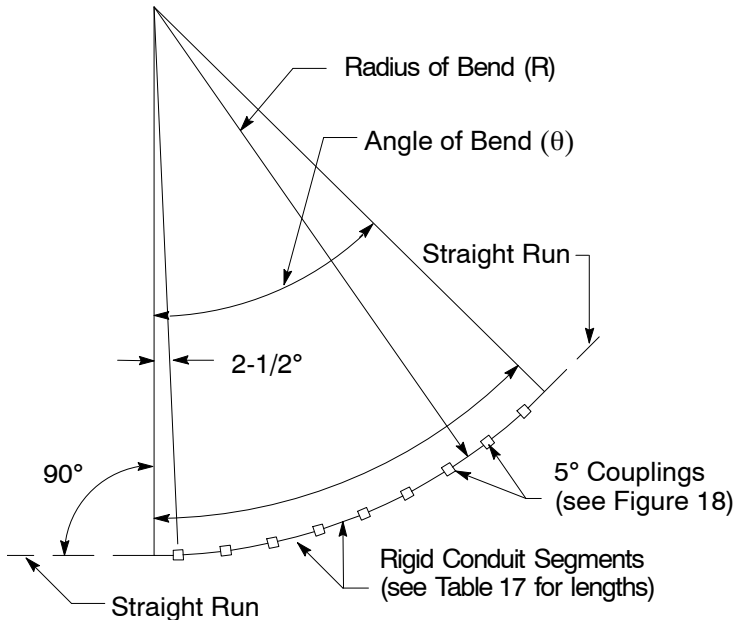
<sup>4</sup> See Notes 1 and 2 on Page 10.

**Plastic Conduit and Fittings (continued)**

Notes in reference to Table 16 on Page 9

1. A 36" may be allowed as the minimum horizontal radius when using 4" PVC conduits bends greater than 5° if field conditions make it not feasible to install 60" radius and if such field conditions are validated by PG&E inspectors.
2. Note 1 above does not apply to secondary service conduits installations. For secondary service conduits installations, 36" is the minimum horizontal radius for 4" conduit. See [Document 063927](#) and [Document 063928](#).

**Large Radius Sweeps**



**Figure 17**  
Typical Application of 5° Couplings

**Table 17 Length of Rigid PVC Conduit Segments**

Approximate Radius of Bend (R)	Length of Rigid Conduit Segments (feet)
11' 6"	1
17' 3"	1.5
23' 0"	2
28' 9"	2.5
34' 6"	3
40' 3"	3.5
46' 0"	4
51' 9"	4.5
57' 6"	5
69' 0"	6
80' 6"	7
92' 0"	8

**Example**

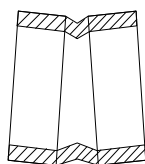
Radius Bend (R) = 60 Feet  
Angle of Bend ( $\theta$ ) = 45°

From Table 17 The nearest value to 60-foot radius is 57' 6".  
The length of conduit segments = 5 feet.

From Table 18 For a 45° angle bend:  
The number of 5° couplings required = 9.  
The number of conduit segments required = 8.

**Table 18 Number of Couplings and Conduit Segments Required**

Angle of Bend ( $\theta$ )	Number of Couplings and Outside Diameter Conduit Segments Required	
	Coupling	Conduit
15°	3	2
30°	6	5
45°	9	8
60°	12	11
75°	15	14
90°	18	17



**Figure 18**  
5° Coupling

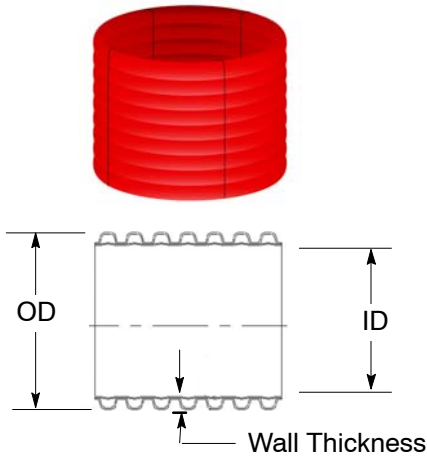
**Table 19 Material Codes for DB-120 PVC 5 Degree Coupling**

Coupling Size (inches)	Material Code
2 <sup>1</sup>	360154
3	360399
4	360400
5	360407
6	360495

<sup>1</sup> Co-extruded cellular core wall DB-120

Underground Conduits

**Flexible (HDPE) Conduit and Fittings**

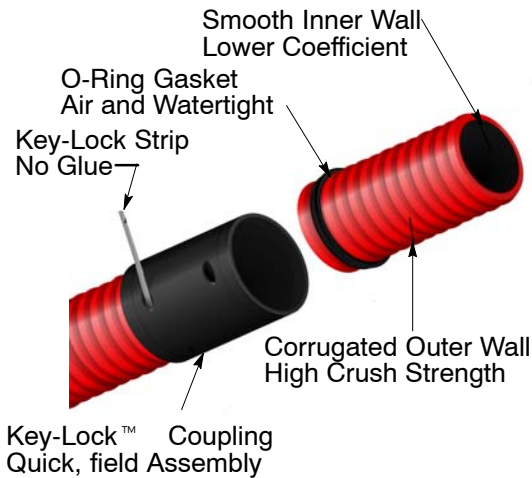


**Figure 19**  
**Corrugated Core Flex Conduit**

**Table 20 Data and Material Codes for Corrugated Core Flex Conduit With Couplers (250' coil) <sup>1, 2, 3</sup>**

Conduit Size (inches)	Dimension (inches)			Material Code
	Outside Diameter	Inside Diameter	Wall Thickness	
2	2.375	2.050	.163	360095
3	3.500	2.950	.275	360096
4	4.750	3.975	.387	360097

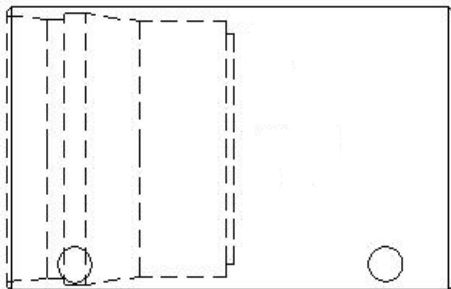
- <sup>1</sup> Conduit can be used in areas minor soil settlement issues or for re-routes.
- <sup>2</sup> Inside wall is corrugated.
- <sup>3</sup> Minimum bending radius is 24 inches for all sizes.



**Table 21 Data and Material Codes for Key-Lock™ Couplers <sup>1</sup>**

Conduit Size (inches)	Insertion Lengths (inches)	Material Code
2	2.725	360102
3	3.125	360103
4 <sup>2</sup>	2.875	360105

- <sup>1</sup> Kit has coupler, two locks and two gaskets.
- <sup>2</sup> Coupler to connect corrugated core flex to corrugated core flex.

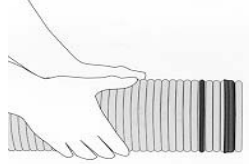


**Figure 20**  
**Key-Lock™ Couplers**

***Flexible (HDPE) Conduit and Fittings (continued)***

**Install the Key-Lock Coupler Following the Procedure Below**

1. Make certain the elastomeric gasket is seated in the second corrugation on 4" conduit and the first corrugation on 6" conduit. Be sure the gasket is positioned as shown on Figure 21.



**Figure 21**  
**Key-Lock™ Couplers Gasket Position**

2. Use only a water-based lubricant. Apply the lubricant to the outside surface of the gasket. A light coating of lubricant should also be applied to the chamfered leading edge of the coupler as shown on Figure 22.



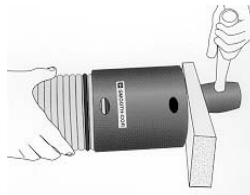
**Figure 22**  
**Key-Lock™ Couplers Lubricant Application**

3. Insert the gasketed end of the Smooth-Cor® conduit into the coupler. Note the black home-mark, which is used to identify proper coupling as shown on Figure 23.



**Figure 23**  
**Key-Lock™ Couplers Insertion**

4. Use a mallet and wood block to seat the coupler until the home-mark is covered. Note that the small lock ring on the inside surface of the coupler snaps into a matching corrugation as shown on Figure 24.

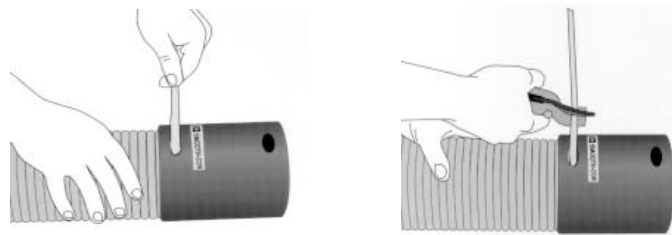


**Figure 24**  
**Key-Lock™ Couplers Locked in Place**

## Underground Conduits

### Flexible (HDPE) Conduit and Fittings (continued)

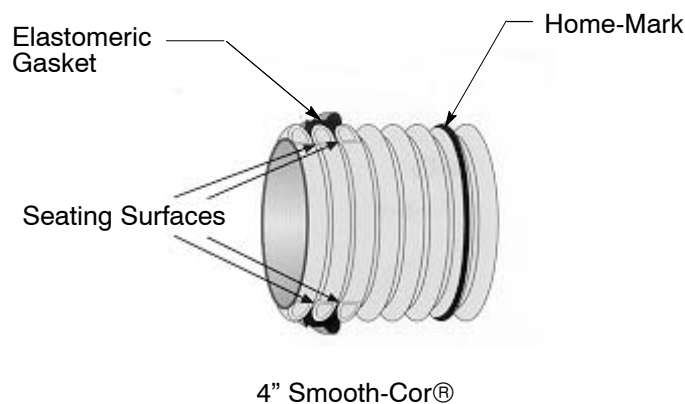
5. Insert the Key-Lock™ strip following the directional arrow into the pre-drilled hole in the coupler. Apply a small amount of lubricant to aid in the insertion. Push the Key-Lock™ strip (in the direction of the arrow on the label) around the entire circumference, locking the grooves in the conduit and coupler securely together. Trim the excess Key-Lock™ strip material from the coupler (optional). See Figure 25 below.



**Figure 25**  
**Key-Lock™ Couplers Strip Insertion**

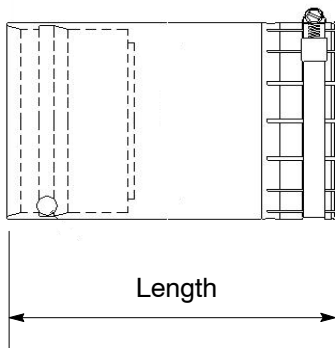
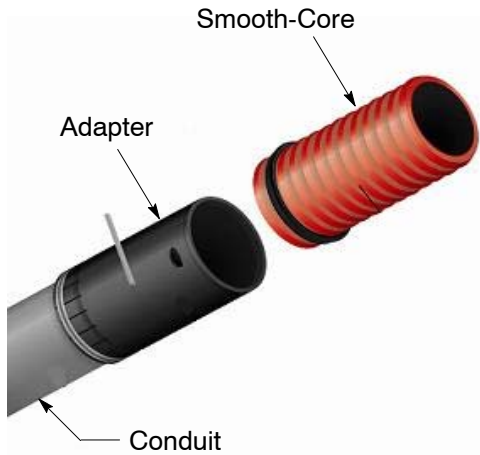
Note: When cutting the Smooth-Cor® conduit in the field to a custom length, it necessary to follow the steps below:

1. Cut the conduit at the selected corrugation valley.
2. Place the gasket over the newly cut and cleaned end, making certain to seat the gasket on the second corrugation for 4" conduit. The higher ridge of the elastomeric seal is positioned toward the body of the conduit and the lower ridge toward the end of the conduit. Using a felt marker, place a home-mark on the conduit to achieve proper coupling. When using 4" conduit, place the home-mark on the seventh corrugation. Repeat steps 2-5 as shown on Page 12 and 13 to complete coupling. See Figure 26 below.



**Figure 26**  
**Key-Lock™ Couplers Cut at Customized Length**

**Flexible (HDPE) Conduit and Fittings (continued)**



**Figure 27**  
**Key-Lock™ Adapter**

**Table 22 Data and Material Codes for Shurlock/Key-Lock™ (Adapter Smooth-Core-Shur-Lock Kit™ 1, 2)**

Conduit Size (inches)	Dimension (inches)	Material Code
	Length	
2	6.7	360106
3	6.63	360107
4	8.0	360108

- <sup>1</sup> Kit has adapter, one lock, and one gasket.
- <sup>2</sup> Adapter works connecting SC conduit to PVC and SC conduit to threaded steel conduit.

**Table 23 Required Rigid PVC stub out length <sup>1</sup>**

Conduit Size (inches)	PVC Stub Out (inches)
2	14.8
3	14.5
4	15
6	17.5

- <sup>1</sup> Stub out length needed to provide enough space for the adapter to connect rigid PVC to flexible conduit.

**Note**

1. The key-lock bell end adapters smooth-core bell are no longer commercially available. Before the end of the flexible conduit run, it is necessary to transition from the flexible conduit to PVC conduit by following the steps below.
  - A. Use appropriate size Shurlock/Key-Lock™ coupler listed in Table 22.
  - B. Use a straight section of at least 18 inches of appropriate size PVC conduit listed in Table 6 on Page 6.
  - C. Use appropriate size end bell for PVC conduit listed in Table 13 on Page 8.

## Underground Conduits

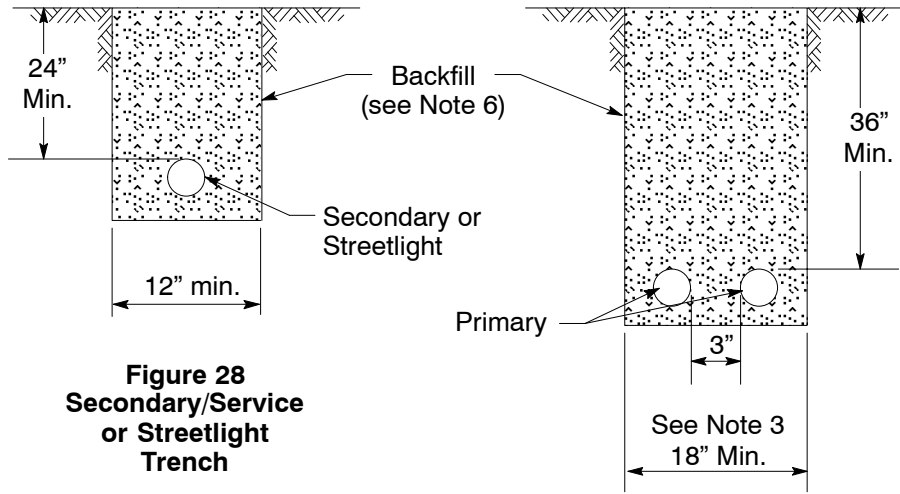
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### Trench Requirements

#### Notes

1. Field conditions may require a minimum depth greater than shown in Figure 28 and Figure 29.
  - Preferred maximum depth from final grade to the bottom of the trench is 60 inches.
  - When needed to avoid obstacles, maximum depth from final grade to the bottom of the trench is 120 inches.
  - Trenches deeper than 120 inches require a variance. Follow the instructions found in [Utility Procedure TD-2951P-01](#) to submit a variance request.
2. Maintain maintain minimum of 3-inch separation between:
  - Primary to primary conduits
  - Primary to secondary, service, and streetlight conduits.
3. Maintain minimum of 1.5-inch separation between:
  - Secondary to secondary, service, and streetlight conduits
  - Service to service, and streetlight conduits
4. Clearances in Note 2 and Note 3 may be reduced when conduits are entering enclosures, panels, pads, vaults, or structures. Allowance must be made for the installation of the conduit end bells.
5. Sharp turns, bends, or other irregularities in the conduit must be avoided.
6. If the bottom of a trench which will contain plastic conduit is rocky, use backfill material conforming to the requirements of [Engineering Material Specification 4123](#). Before tamping in the area of plastic conduit, apply at least 6 inches of backfill over the top of the conduit to avoid breakage. Final backfill may then be placed in the trench and tamping employed to finish grade. In order to reduce costs, the soil originally removed from the trench should be used as backfill wherever possible (see Note 14 on Page 2).
7. Do not use salt-water sand backfill with steel conduit.
8. Other utility practices may require a greater minimum conduit separation.
9. Refer to state of California, [Department of Industrial Relations; Trench Construction Safety Orders](#) for trench construction requirements. These orders are issued by the Department of Occupational Safety and Health.
10. When crossing obstructions, such as shown in Figure 31 and Figure 32 on Page 17, maintain 6-inch minimum separation.

### Underground Conduits



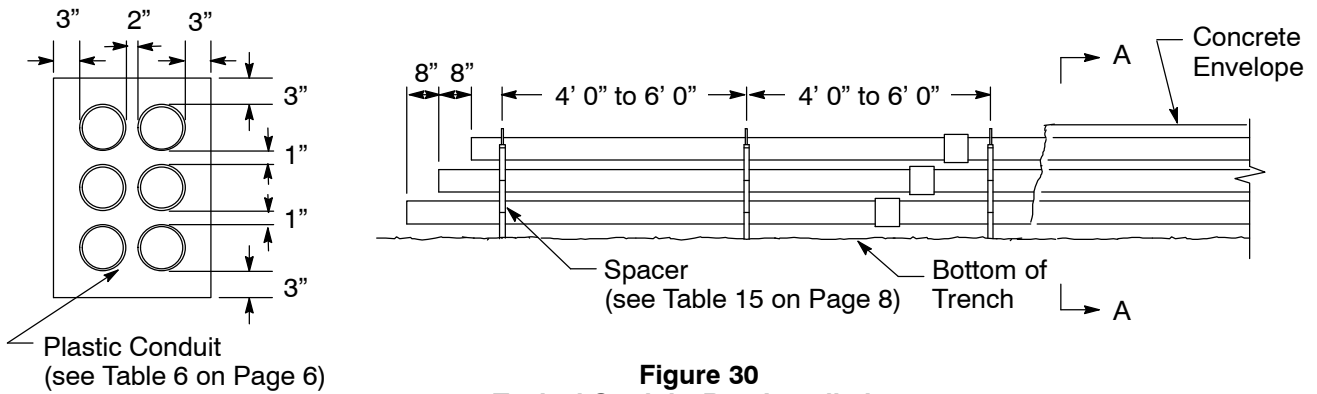
**Figure 28**  
Secondary/Service  
or Streetlight  
Trench

**Figure 29**  
Primary Trench

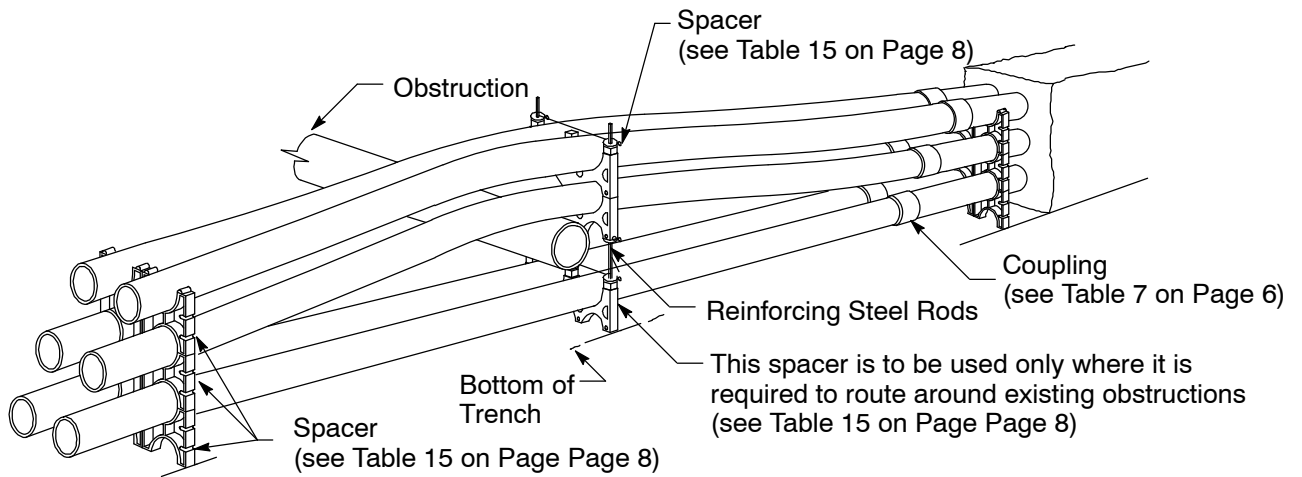


Underground Conduits

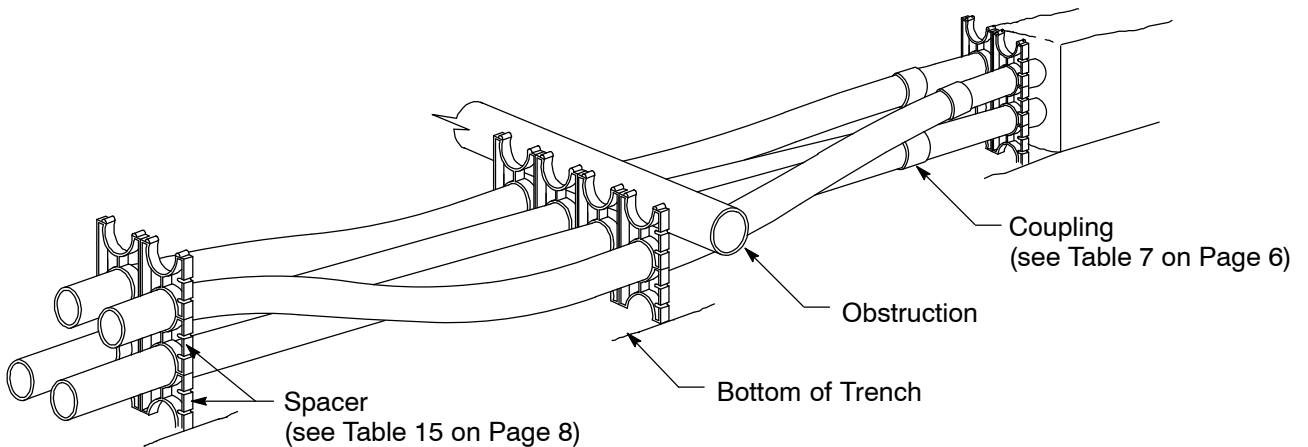
Conduit Construction, Built-up Method



**Figure 30**  
Typical Straight Run Installation  
(5" conduit, 6-way shown)



**Figure 31**  
Typical Perspective View of  
Installation Around Obstruction

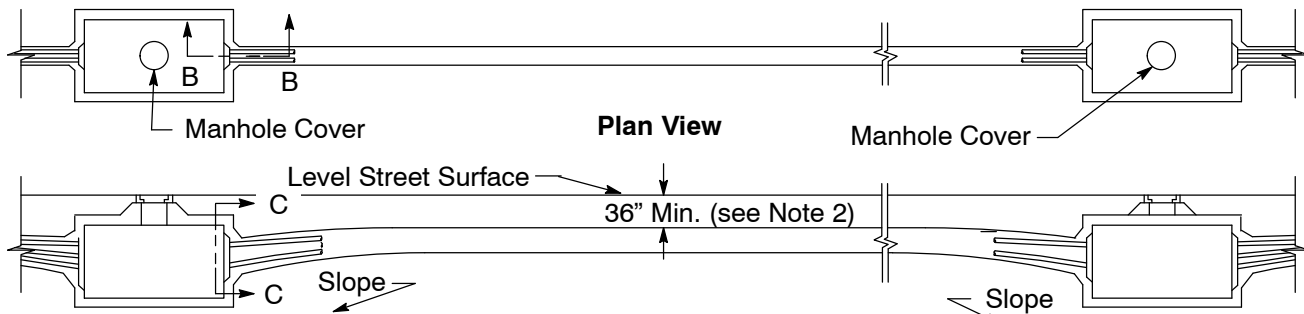


**Figure 32**  
Typical Perspective View of  
Installation Under Obstruction

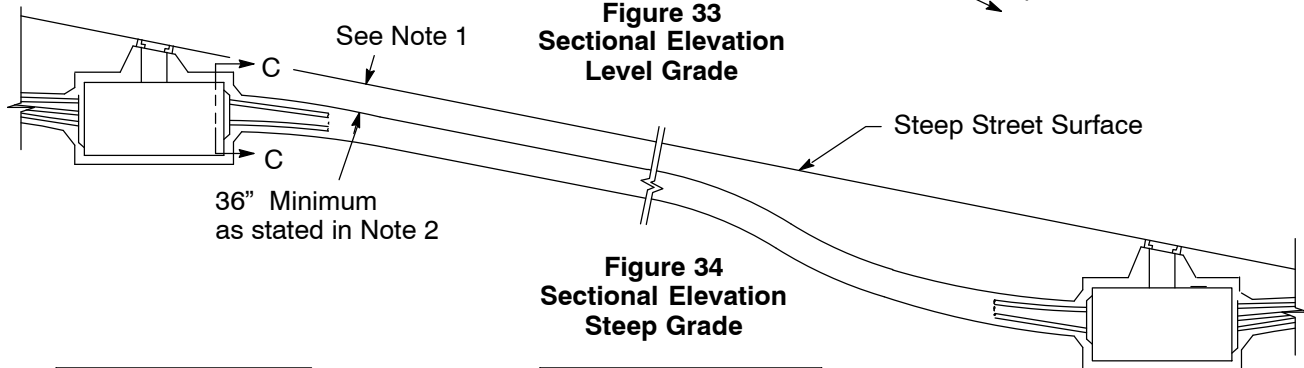
**Construction and Termination of Conduit Line**

**Notes**

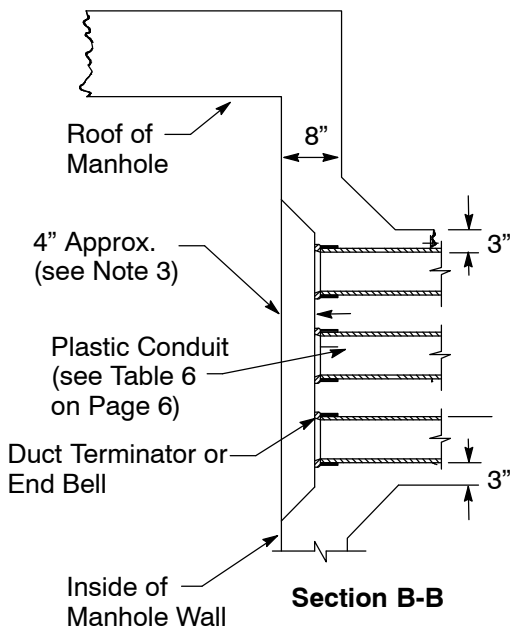
1. Slope the conduit sufficiently to provide adequate drainage. On level ground, slope the duct line from the center to each manhole.
2. Local city ordinances may require a minimum cover greater than PG&E's requirements of 24" for conduits containing circuits energized at 750 volts or less, and 36" for conduits containing circuits energized in excess of 750 volts. Depth may be reduced in either case if adequate mechanical protection – as defined in [Section 3.3.6 of the Greenbook](#)– is provided.
3. Where required, the depth of the conduit window may be increased. Where this is necessary, tie the conduit envelope concrete into the manhole reinforcing steel.
4. Vertical staggering of conduits at entrance shown in Detail A will assist in arranging for cable crossover if required.



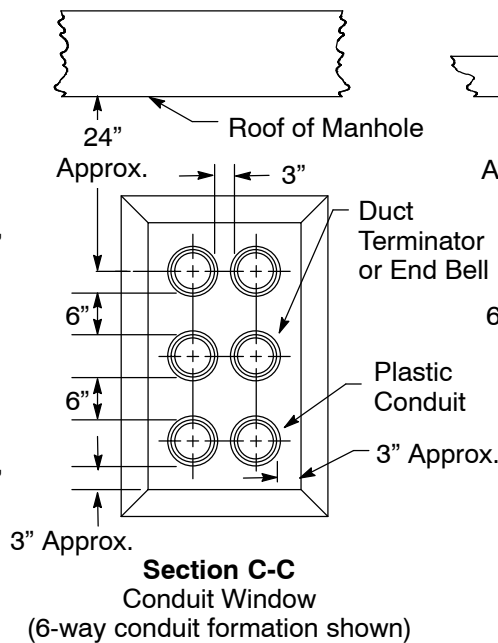
**Figure 33**  
Sectional Elevation  
Level Grade



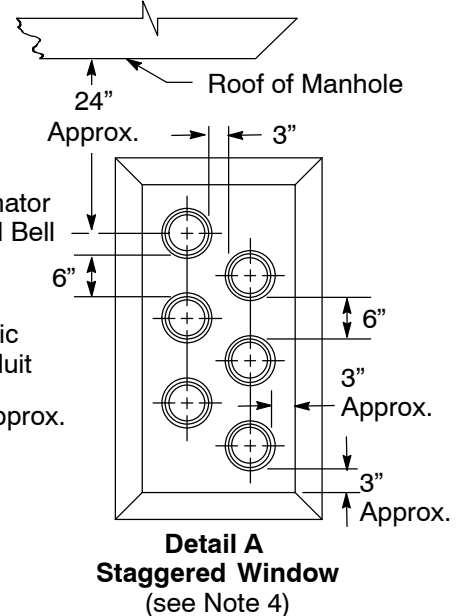
**Figure 34**  
Sectional Elevation  
Steep Grade



**Section B-B**



**Section C-C**  
Conduit Window  
(6-way conduit formation shown)



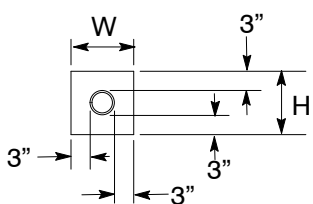
**Detail A**  
Staggered Window  
(see Note 4)

## Underground Conduits

### Conduit Configuration Tables

#### Notes

- For conduit lines two-way and larger, install #4 reinforcing bars in all four corners of the conduit envelope. Overlap bars 15 inches and install a minimum of 3 inches from the top or bottom and 1 inch from the side of the envelope.
- Where the width of the trench is greater than the required width of the envelope, the horizontal spacing between conduits may be increased as long as 3-inch spacing between the conduit and the outside edge of the envelope is maintained.
- Concrete: Normal Weight  
Aggregate, ASM, C33 Uniformly Graded  
Maximum Aggregate Size 3/4 inch type  
Minimum Compressive Strength:  $f'_c = 3,000$  pound-force per square inch (psi).

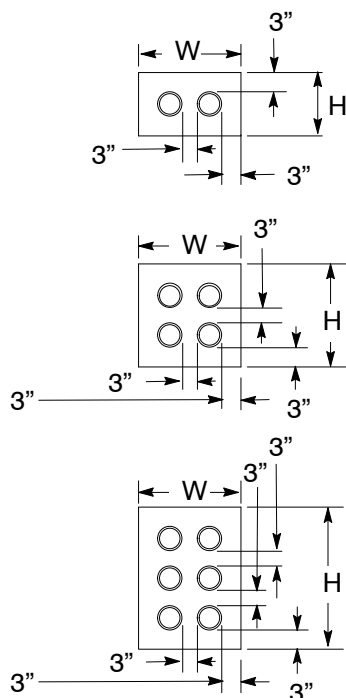


**Figure 35**  
Single Conduit Configuration

**Table 24 Dimensions for Single Conduit Configurations**

Conduit		Envelope Dim.		Concrete Reqd. Cubic Yards per 100 ft. <sup>1</sup>
Description	Size	W	H	
Single	2"	8-1/2"	8-1/2"	1.9
	3"	9-1/2"	9-1/2"	2.3
	4"	10-1/2"	10-1/2"	2.8
	5"	11-1/2"	11-1/2"	3.4
	6"	12-1/2"	12-1/2"	4.0

<sup>1</sup> Quantities may vary due to variations encountered in construction.



**Figure 36**  
Two, Four, and Six-Way Conduit Configuration

**Table 25 Dimensions for Multiple Conduit Configurations**

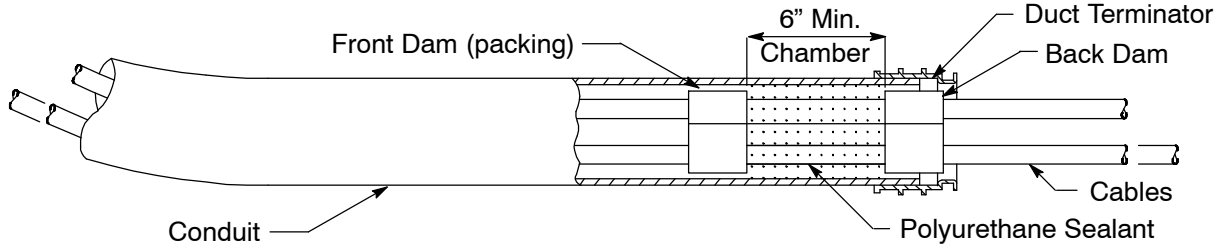
Conduit		Envelope Dim.		Concrete Reqd. Cubic Yards per 100 ft. <sup>1</sup>
Description	Size	W	H	
2-way	3"	16"	9-1/2"	3.9
	4"	18"	10-1/2"	4.9
	5"	20"	11-1/2"	5.9
	6"	22-1/2"	12-1/2"	7.2
4-way	4"	18"	18"	8.3
	5"	20"	20"	10.3
	6"	22-1/2"	22-1/2"	13.0
6-way	4"	18"	25-1/2"	11.8
	5"	20"	29"	15.0
	6"	22-1/2"	32"	18.5
8-way	4"	18"	33"	15.3
	5"	20"	37-1/2"	19.0
	6"	22-1/2"	41-1/2"	24.0

<sup>1</sup> Quantities may vary due to variations encountered in construction.

**Instructions for Sealing Conduit Using Foam**

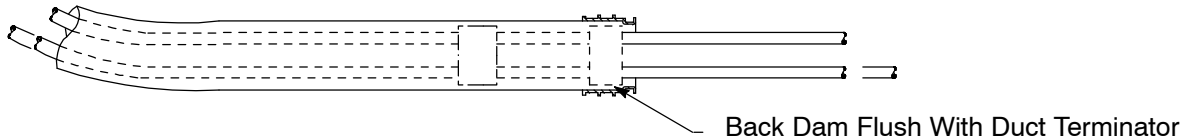
**Notes**

1. Within minutes, polyurethane foam expands to form a water and gas barrier that can be easily removed in the future.
2. Consult the manufacturer’s instructions included in each kit.



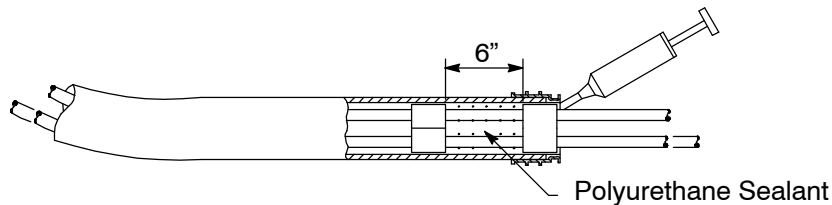
**Figure 37**  
**Details of a Polyurethane Seal**

- Step 1 Wipe off loose dirt and grime from cables.
- Step 2 Install front dam (packing). Wind a strip of packing around each cable. Push the dam approximately 6 inches to 8 inches into the conduit. Install the back dam in the same manner as the front dam, and push it into the conduit until the dam is flush with the duct terminator.



**Figure 38**  
**Front Dam Installation**

- Step 3 Insert the nozzle into the chamber between the dams and inject polyurethane.



**Figure 39**  
**Nozzle Application**

**Table 26 Material Codes for Polyurethane Conduit Seal Kits <sup>1</sup>**

Conduit Size	Material Code	Manufacturer	Catalog Number
2" Through 6"	019178	Dura-Line (Arnco) Hydro Seal	S-60-C6P
	490813	Polywater	FST-250KIT-PGE

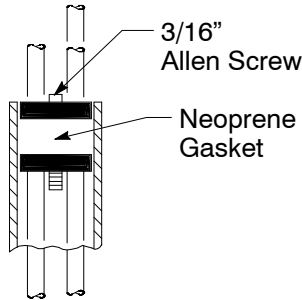
<sup>1</sup> Kits have a 12 month shelf-life.

Underground Conduits

**Instructions for Sealing Conduit Using Foam (continued)**

**Termination Enclosure Riser Seal Method**

- Step 1 Place the residential riser seal on the cable and slowly push it into the mouth of the riser conduit. Turn the Allen screw until the neoprene gasket expands to form a tight seal.
- Step 2 This riser seal is to be used to seal the riser conduit at the customer’s service termination enclosure only. The top of the service riser is the preferred location. Belowground use is approved if an alternative to foam is needed.



**Table 27 Material Codes for Termination Enclosure Riser Seals**

Conduit Size	Cable Size	Material Code	Manufacturer and Catalog No. Environmental Solutions Cat.
2"	1/0 Triplex	019179	ESC – 103
	4/0 Triplex	019180	ESC – 403

**Figure 40**  
**Termination Enclosure Riser Seal**

**Instructions for Sealing Conduit Using RDSS**

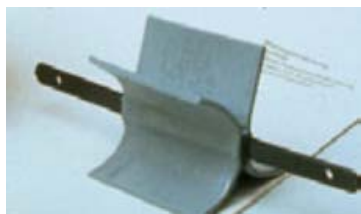
**Notes**

1. Consult the manufacturer’s instructions included in each kit.
2. Installation tool IT-16 is needed to install RDSS. This tool uses CO<sub>2</sub> cartridges. Both of these materials need to be ordered separately. See Figure 43 on Page 23 .
3. Select the appropriate RDSS size per Table 28.
4. When sealing three or more cables, the RDSS sealing clip listed on Table 34 must be used with the DRSS duct deal. One clip seals up to four cables.
5. Order RDSS as indicated in Table 29 on Page 23.
6. For additional reference, the attached link provides an installation video. This video was developed by the manufacturer and may not reflect the use of the company required PPE. When performing this work, please be sure to use the appropriate PPE (i.e. long sleeves, hard hat, etc.) as required by PG&E.  
<https://www.knowledgekeeper.com/libraries/video/4c9bdcb11d19e4c5c4>. After signing into Knowledge Keeper:  
a.) click on the library b.) Scroll down c.) Click on field : Equipment Underground d.) Scroll down until finding RDSS Video.

**Table 28 RDSS Size Selection**

Normal Duct (Conduit) Size (Inches)	RDSS-45 Cable/Cable Bundle Diameter (Inches)	RDSS-60 Cable/Cable Bundle Diameter (Inches)	RDSS-75 Cable/Cable Bundle Diameter (Inches)	RDSS-100 Cable/Cable Bundle Diameter (Inches)	RDSS-125 Cable/Cable Bundle Diameter (Inches)	RDSS-150 Cable/Cable Bundle Diameter (Inches)
1-1/2	0-1.25					
2		0-1.50	0-1.00			
3				0-2.00		
4				0-3.25	0-2.75	
5 <sup>2</sup>					0-2.75-4.5	2.50-4.24
6 <sup>2</sup>						2.50-5.50
RDSS Clip Size	N/A	75	75	100	125	150

<sup>1</sup> One RDSS clip per RDSS seal is included in the kit.  
<sup>2</sup> For 5” and 6” ducts with cable bundle diameters less than listed on this table or empty; an RDSS-AT/AP-150 device must be used along with RDSS. RDSS-AT/AP-150 must be ordered separately. See Figure 43 on Page 23.



**Figure 41  
RDSS Seal and Clip**



**Figure 42  
AT/AP-150 Device**

## Underground Conduits

### Instructions for Sealing Conduit Using RDSS (continued)



**Figure 43**  
IT-16 Installation Tool and CO<sub>2</sub> Cartridges



**Figure 44**  
RDSS Installed

**Table 29 Material Material Codes for RDSS Kits and Installation Tool**

Item	Material Description	Material Code
1	RDSS-45-PG&E	360213
2	RDSS-60-PG&E	360214
3	RDSS-75-PG&E	360215
4	RDSS-100-PG&E	360216
5	RDSS-125-PG&E	360217
6	RDSS-150-PG&E	360218
7	RDSS-AT/AP-150 Device	360219
8	RDSS-IT-16 Tool	360220
9	Compressed CO <sub>2</sub> Gas Cylinders	360221

<sup>1</sup> Installation tool re-usable. Unless damaged, only need to order once.

<sup>2</sup> Only these types of cylinders are compatible with this tool.

### Revision Notes

Revision 18 has the following changes:

1. Added photos of various materials.
2. Deleted obsolete materials no longer commercially available.
3. Added maximum depth trench requirement.
4. Revised Title of Table 28 on Page 22.

