
	UNDERGROUND CONDUITS	062288
Asset Type: Electric Distribution	Function: Design and Construction	
Issued by: Lisseth Villareal (LDV2)		Date: 06-30-23
Rev. #21: This document replaces PG&E Document 062288, Rev. #20 For a description of the changes, see Page 21.		

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 may require concrete encasement.
 - C. Severe exposure to “dig-ins” and other hazards may require concrete encasement of conduit lines.
 - (1) Conduit separation for concrete encasement of conduit lines using spacers to avoid obstacles is illustrated on Page 16.
 - (2) Conduit separation for concrete encasement of conduit lines terminating into a manhole or vault, is illustrated on Page 17.
 - (3) Conduit separation for concrete encasement of conduit lines terminating into an enclosure is illustrated on Page 18.
2. For the minimum design requirements for trenches and conduits installed in PG&E electric distribution system see [Document 038193](#). Trench requirements previously listed in this document have been moved to [Document 038193](#).
3. For the design requirements of conduits installed specifically on bridges see [Utility Procedure TD-2310P-10](#).
4. In April of 2020, PG&E stopped purchasing rigid Polyvinyl Chloride (PVC) DB-120 for conduits, couplings, fittings, and bends for installation in its electric distribution system. PG&E now purchases rigid single wall or co-extruded cellular core wall PVC Schedule 40 conduits, couplings, fittings and bends as the standard conduit type for open trench installations.
5. Rigid single wall or co-extruded cellular core wall PVC Schedule 40 conduits, couplings, fittings, and bends are interchangeable with rigid PVC DB-120 conduits, couplings, fittings, and bends, respectively. This interchangeability is possible because DB-120 and rigid PVC Schedule 40 materials have the same outside diameters.

6. When conduit, including service conduit, is to be installed for PG&E by others, the conduits must meet the requirements listed in this document. The conduit listed below are also acceptable alternatives to the required Rigid single wall or co-extruded cellular core wall PVC Schedule 40.
 - A. Single wall and co-extruded cellular core wall PVC Schedule 80, UL 651 approved conduit that is so marked.
 - B. Hot-dip galvanized rigid steel conduit conforming to American National Standards Institute (ANSI) Specification C80.1.
 - C. PVC coated steel conduit and fittings conforming to UL 6 and ANSI Specification C80.1. Conduit and Fittings must be threaded.
 - (1) Nominal urethane coating on interior and threads must be 2 mil.
 - (2) Minimum PVC coating bonded to exterior must be 40 mil.
7. 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.
 - A. Chamfering must be performed at 45° around the conduit edge and inside the conduit wall for at least 1/2" or until there is no more ridge when joining the conduits at the couplings.
8. 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.
9. 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.
10. 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](#).
11. Install and attach to an end cap a non-detectable pulling tape with sequential footage markings (**Material Code M560154**) in all conduits that will be occupied after installation. The tape must be proven free and not glued or caught on joints.
12. Install and attach to an end cap a detectable pulling tape with sequential footage marking (**Material Code M602679**) conduits that will be vacant more than 30 days after their installation. Refer to [Document 038193](#) for further details.
13. All conduits must be capped. All conduits not terminating in a subsurface enclosure, pedestal, equipment pads, or vault are to be capped with unglued rigid caps (see Figure 12, Table 12 on Page 9). Conduits terminating in a subsurface enclosure, pedestal, equipment pads, or vault must be capped with temporary plugs (see Figure 13, Table 12 on Page 9).
14. Every effort should be made to obtain a straight, watertight conduit line.
15. 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 Rayplate 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](#).

Material Specifications

16. PVC conduits and fittings must comply with PG&E engineering material specification [EMS 64](#) which meet the following industry specifications:
 - A. Tensile modulus of 500,000 psi.
 - B. National Electric Manufacturers Association (NEMA): NEMA TC-2 for straight conduit, couplings and NEMA TC-3 for fittings and bends.
 - C. Underwriters Laboratory (UL): UL 651 or Electrical Testing Labs (ETL) that conforms to UL 651.
 - D. UL 651 or ETL conforms to UL 651 must be marked on the outside wall of the PVC schedule 40.
 - E. Rigid solid and single wall or co-extruded cellular core wall PVC Schedule 40 conduits, couplings, fittings, and bends must be gray in color.
 - F. Marking must conform to UL 651 requirements.

Underground Conduits

17. High density polyethylene (HDPE) conduits and fittings must comply with PG&E engineering material specification [EMS 63](#), and industry standards ASTM F2160, ASTM D3350, and UL 651A or ETL that conforms to UL 651A.
- A. HDPE conduit extruded over a cable (Cable-in-Conduit) must comply with UL 1990 or ETL that conforms to UL 1990.

Application

18. PVC conduit may be cut with a hacksaw or a fine-toothed wood saw. Clean off burrs. Bevel the inside to eliminate sharp edges.
19. For PVC conduit, 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 below shows the codes to order PG&E approved conduit cement.

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 and 30886V	12089	490157
	1 Pint	30885 and 30885V	12090	490151

20. Use end bells fittings 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.
21. In applications where a conduit dead-ends, cap the end of the conduit and place a marker ball (material code **M374947**, Refer to [M-60](#) for more information) at the location. Identify the marker ball in construction drawings.
22. HDPE conduits shown in Table 10 and Table 11 (PVC, Bore-Gard schedule 40) on Page 8 are approved for horizontal directional drilling (HDD) trench-less applications. However, they can also be used in open trench applications.
- A. Only 2", 3" and 4" HDPE conduits are approved for vibrational plowing. Soil compaction after plowing is required. See Note 25A – 25C below.
- B. Coiled 4", 5" and 6" HDPE conduits must be re-rounded using an appropriate re-rounding tool as it comes out of the reel until 5% or less ovality is achieved. This requirement applies to all approved installation methods.
- C. During HDD installation, HDPE conduits are joined by butt-fusion. This method involves super-heating the conduit ends, pressing them together, and allowing them to cool, producing a continuous joint with a small bead at its interior and exterior. If the interior bead is not removed, the cables can snag during cable pulling. Therefore, de-beading is recommended between all conduit segments. De-bead individual joints, conduit sections completely before pullback starts.
- D. Mechanical couplings can be used for joining HDPE to HDPE conduits as well as HDPE to PVC conduits. See Figure 10 and Table 10 on Page 8 and Figure 31 and Table 24 on Page 15.
- (1) When using the mechanical couplings, it is extremely important to chamfer the HDPE conduit until the ridge inside the coupler resulting from difference between the inside diameter dimension of PVC and HDPE conduits is eliminated. The risk of ripping the cable jacket off as the cable is being pulled through the ridge is inevitable. The amount of chamfering varies depending on the size of the HDPE conduits being jointed.
23. **Caution:** When pulling conduit(s) in boring applications, be certain to cut the conduits to provide sufficient extra length for the conduit to relax. It may take as long as 72 hours for an excessively stretched conduit to fully relax.
24. **Caution:** Do not use Snap-N-Stack Combo Spacers in concrete encased application.

25. Conduit shown on Table 20 through Table 23 (flexible conduit) on Page 12 through Page 15 are for use in areas with minor soil settlement issues, and for large radius sweeps or re-routes.
26. 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. Soil compaction must meet PG&E's and any applicable federal, state, county, and local requirements. PG&E specific soil compaction requirements are as follows:
- A. Trenches/plowing that run across or along public roads and streets in the franchise areas must have soil compacted to a minimum of 95% density.
 - B. Trenches/plowing that run across private properties and in all other areas must have soil compacted to a minimum of 90% density.
 - C. A compaction test report may be required by PG&E. This report must include the testing company information: Name, Address, Contact information. For plowing installations a compaction test report is required.

References	Location	Document
Minimum Requirements for the Design and Installation of Conduit and Insulated Cable	UG-1: Cable/Greenbook	038193
Methods and Requirements for Installing Residential Underground Electric Services 0–600 V to Customer-Owned Facilities	UG-1: Services/Greenbook	063927
Methods and Requirements for Installing Commercial Underground Electric Services 0-600 Volts to Customer-Owned Facilities	UG-1: Services/Greenbook	063928
Selection of the Type of Underground Equipment	UG-1: General/Greenbook	072149
Engineering Material Specification 63, “High Density Polyethylene (HDPE) Conduits and Fittings”	TIL	EMS 63
Engineering Material Specification 64, “Polyvinyl Chloride (PVC) Conduits and Fittings”	TIL	EMS 64
Engineering Material Specification 4123, “Backfill Sand	TIL	EMS4123
Electric Distribution Conduits Installed on Bridges Request for Variance from	TIL	TD-2310P-10
Electric Distribution Standards	TIL	TD-2951P-01
Approved “Mark and Locate” Instruments, Equipment, Accessories, and Products	TIL	M60

Underground Conduits

Rigid Steel Conduit and Fittings

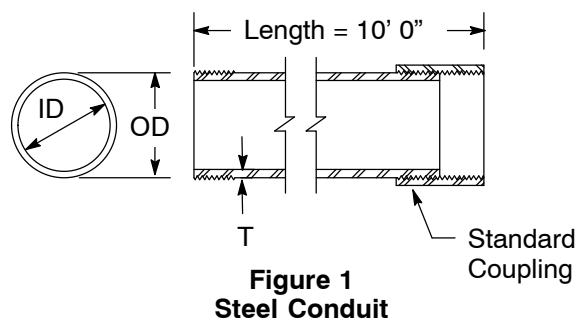


Table 2 Material Material Codes for Rigid Steel Conduit

Conduit Size (inches)	Dimensions (inches)			Weight (lbs.) ¹	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

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

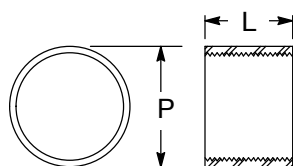


Table 3 Material Codes for Standard Steel Coupling

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

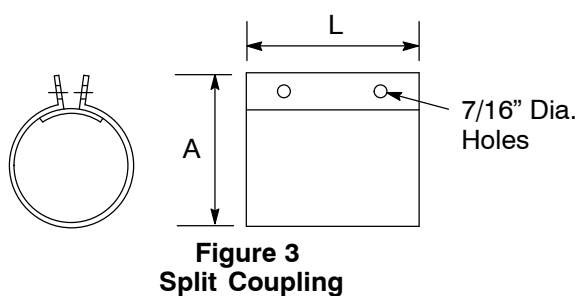
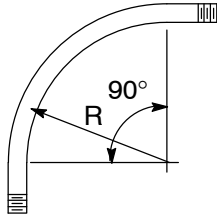


Table 4 Material Codes for Galvanized Steel Split Coupling

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 ¹	5.5	9	362107
6 ¹	6.5	9	362143

¹ These sizes are made of zinc-plated malleable iron. Can be installed on rigid steel 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

Underground Conduits

PVC and HDPE Conduit and Fittings

Notes

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



Figure 5
Rigid Plastic Conduit

Table 6 Data and Material Codes for Rigid Plastic Conduit Schedule 40¹

Conduit Size (inches)	Dimensions (inches)				Material Code
	Average Outside Diameter	Minimum Inside Diameter	Wall Thickness		
			Minimum	Maximum	
2	2.375	2.021	0.154	0.113	360153
3	3.500	3.008	0.216	0.148	016471
4	4.500	3.961	0.237	0.184	016472
5	5.563	4.975	0.258	0.221	016473
6	6.625	5.986	0.280	0.257	016474

¹ See Note 16 on Page 2 for material specifications.

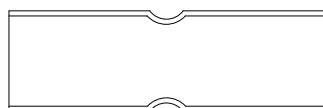


Figure 6
PVC Coupling

Table 7 Material Codes for PVC Swedge Couplings

Swedge Coupling		
Conduit Size (inches)	Minimum Socket Depth	Material Code
2	2.25	360321
3	2.75	360322
4	3.75	360323
5	4.25	360401
6	4.75	360482

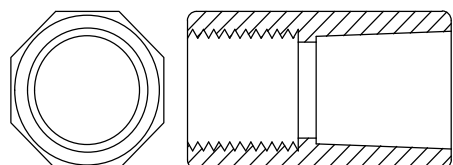


Figure 7
Plastic-to-Steel Adapter

Table 8 Material Codes for Plastic-to-Steel Adapters

Conduit Size (inches)	Minimum Socket Depth	Maximum Socket Depth	Material Code
2	1.125	2.00	360324
3	1.594	3.125	360325
4	1.750	3.375	360326
5	1.937	3.625	360402
6	2.125	3.750	360489

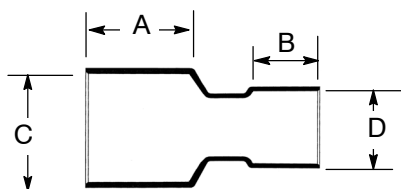


Figure 8
Swedge Reducer

Table 9 Data and Material Codes for PVC Swedge Reducers¹

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

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

Underground Conduits

PVC and HDPE Conduit and Fittings (continue)

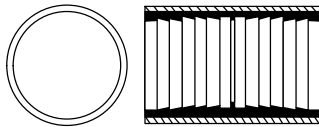
Table 10 High Density Polyethylene (HDPE) Conduit Directional Boring Conduit ^{1, 6}



**Figure 9
HDPE Conduit**



**Figure 10
PE Mechanical Coupling**



Conduit						Mechanical Couplings ^{2, 3}	
Size	Minimum Inside Diameter (Inches)	Min Wall Thickness (inch)	Length (feet)	Description	Material Code	Size (inches)	Material Code
2" Sch 80	1.913	0.238	500	Coil ⁴	360511	2	360690
2" Sch 80			40	Stick	360017		
3" Sch 80	2.864	0.300	500	Coil ⁴	360644	3	360691
3" Sch 80			40	Stick	360018		
4" Sch 80	3.786	0.377	625	Coil ⁵	360014	4	360692
4" Sch 80			40	Stick	360015		
5" SDR 13.5	4.689	0.412	450	Coil ⁵	360012	5	360694
5" SDR 13.5			40	Stick	360013		
6" SDR 13.5	5.585	0.491	450	Coil ⁵	360010	6	360695
6" SDR 13.5			40	Stick	360011		

- ¹ Color must be black with at least 3 red longitudinal strips.
- ² May be used to connect PE conduit to PVC conduit (except in directional drilling apps.)
- ³ Mechanical couplings are not designed for directional drilling. Fusion joints are required.
- ⁴ No reel.
- ⁵ With reel.
- ⁶ Average outside diameter is the same as PVC conduit shown in Table 6, Page 7.

Table 11 PVC (Bore-Gard) Directional Boring Conduit



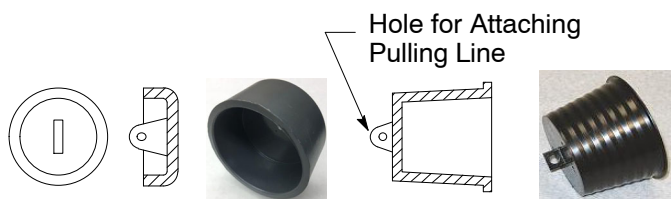
**Figure 11
PVC (Bore-Gard, Schedule 40)**

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 ¹	360031
4	Replacement Seal Gaskets ¹	360029
6	Conduit 10', Schedule 40	360027
6	Conduit 20', Schedule 40	360028
6	Replacement Locking Straps ¹	360032
6	Replacement Seal Gaskets ¹	360030

- ¹ Package of 10.

Underground Conduits

PVC Conduit and Fittings (continued)



Rigid Cap

Figure 12
Rigid Cap

Cap Plug

Figure 13
Plastic Conduit Cap

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

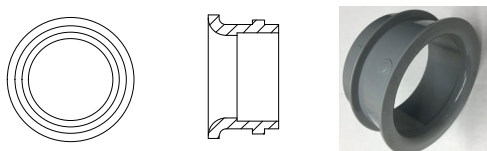


Figure 14
End Bell

Table 13 Material Codes for End Bells

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

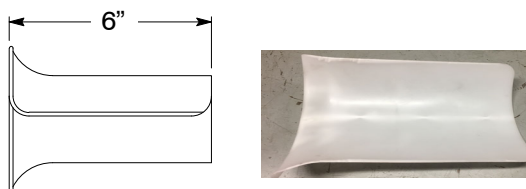


Figure 15
Cable Protector

Table 14 Material Codes for Cable Protectors ¹

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

¹ Not for new installations; for replacement only.

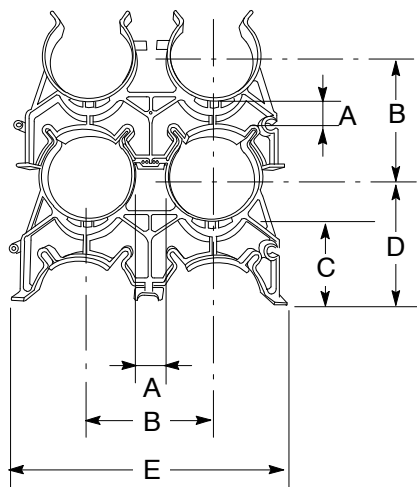


Figure 16
Snap-N-Stack Combo Spacers

Table 15 Material Codes for Snap-N-Stack Combo Spacers

Conduit Size (inches)	Duct OD (inches)	Horizontal Duct Positions	Dimensions (inches)					Material Material Codes
			A	B	C	D	E	
3	3.500	2	2	5.5	3.63	5.38	11	360459
4	4.500	2	2	6.5	3.88	6.06	13	360460
5	5.563	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

PVC Conduit and Fittings (continued)

Table 16 Material Codes for Rigid PVC Schedule 40 Conduit Bends (sweeps)³

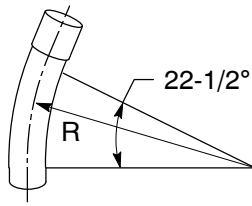


Figure 17
22-1/2° PVC Conduit Bend

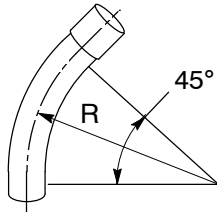


Figure 18
45° PVC Conduit Bend

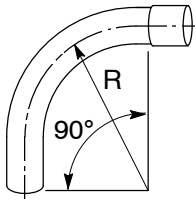


Figure 19
90° PVC Conduit Bend

Conduit Size (inches)	Sweep		Material Code
	Degree	Radius ¹ (inches)	
2 ²	11-1/4	24	360155
		36	360156
	22-1/2	24	360157
		36	360158
	45	24	360159
		36	360160
3 ²	11-1/4	24	360161
		36	360162
	22-1/2	36	360801
		36	360800
	45	36	360403
		24	360405
4 ³	11-1/4	36	360328
		60	360804
	22-1/2	36	360805
		60	360760
	45	36	360761
		60	360412
5	11-1/4	36	360413
		60	360414
	22-1/2	36	360415
		60	360416
	45	36	360417
		60	360418
6	11-1/4	36	360419
		60	360811
	22-1/2	60	360808
		60	360809
	45	36	360806
		60	360763
90	36	360416	
	60	360417	
	36	360418	
	60	360419	

¹ For each conduit bend; first row shows minimum vertical radius, second row shows minimum horizontal radius.
² For 2" and 3" primary conduits 90° degree bends, use 36" vertical radius. 24" vertical radius can be used with secondary and service conduits only.
³ See Notes 1 and 2 on Page 11.

Underground Conduits

PVC Conduit and Fittings (continued)

Notes in reference to Table 16 on Page 10

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

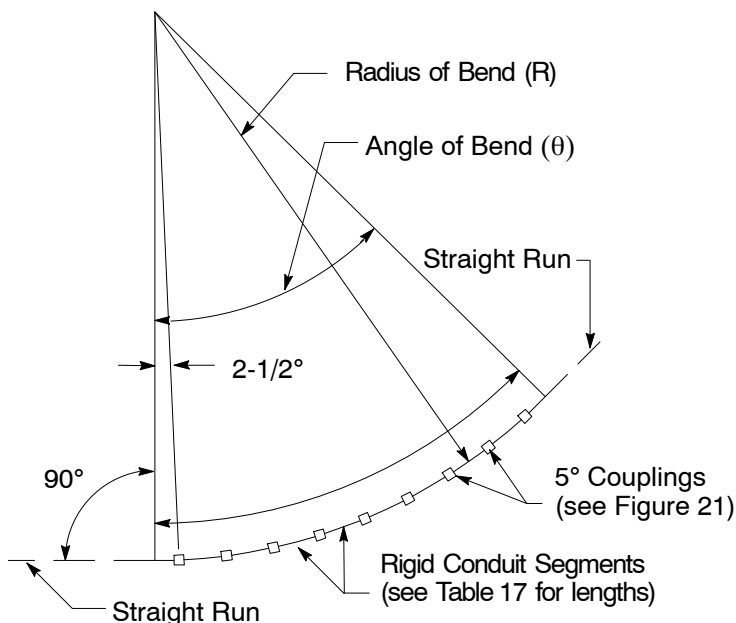


Figure 20
Typical Application of 5° Couplings

Example

Radius Bend (R) = 60 Feet

Angle of Bend (θ) = 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 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

Table 18 Number of Couplings and Conduit Segments Required

Angle of Bend (θ)	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

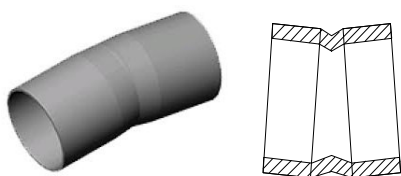


Figure 21
5° Coupling

Table 19 Material Codes for PVC Schedule 40, 5 Degree Coupling

Coupling Size (inches)	Material Code
2	360154
3	360399
4	360400
5	360407
6	360495

Flexible (HDPE) Conduit and Fittings

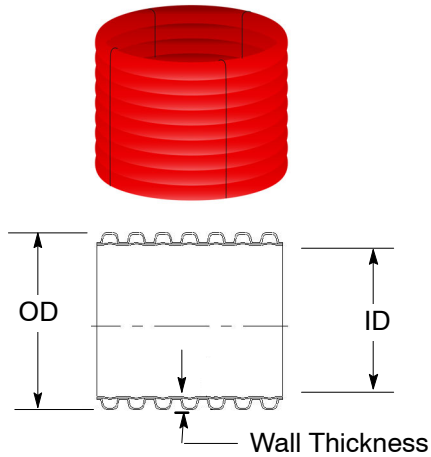


Figure 22
Corrugated Core Flex Conduit

Table 20 Data and Material Codes for Corrugated Core Flex Conduit With Couplers (250' coil) ^{1, 2, 3}

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

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

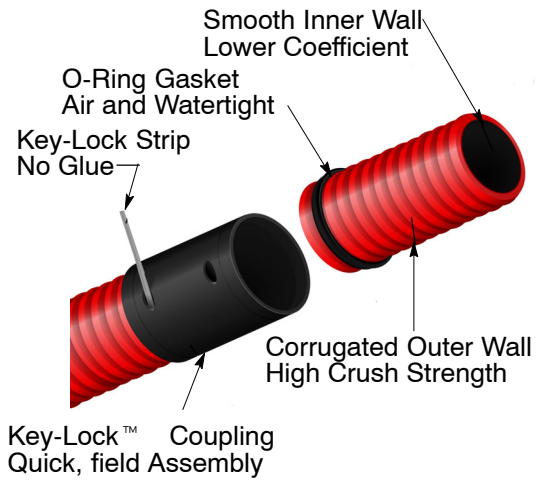


Table 21 Data and Material Codes for Key-Lock™ Couplers ¹

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

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

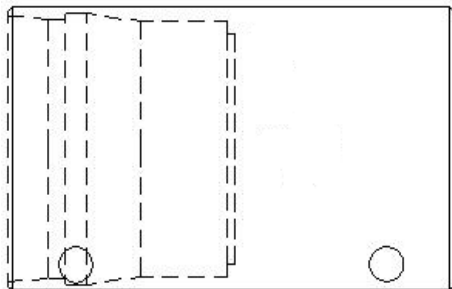


Figure 23
Key-Lock™ Couplers

Underground Conduits

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 24.

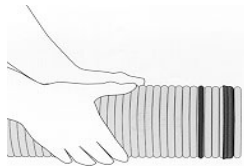


Figure 24
Key-Lock™ Couplers Gasket Position

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 25.



Figure 25
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 26.



Figure 26
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 27.

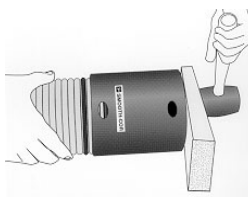


Figure 27
Key-Lock™ Couplers Locked in Place

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 28 below.

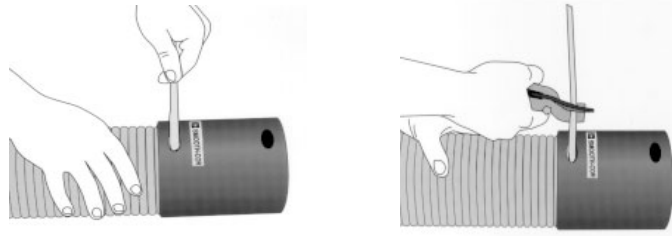


Figure 28
Key-Lock™ Couplers Strip Insertion

Note: When cutting the Smooth-Cor® conduit in the field to a custom length, it is 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 13 and 14 to complete coupling. See Figure 29 below.

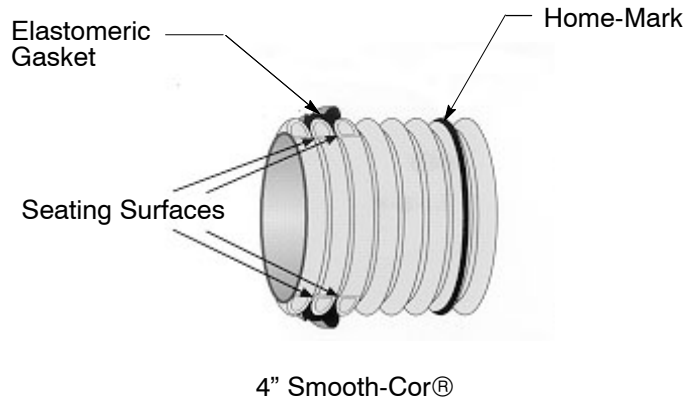


Figure 29
Key-Lock™ Couplers Cut at Customized Length

Underground Conduits

Flexible (HDPE) Conduit and Fittings (continued)

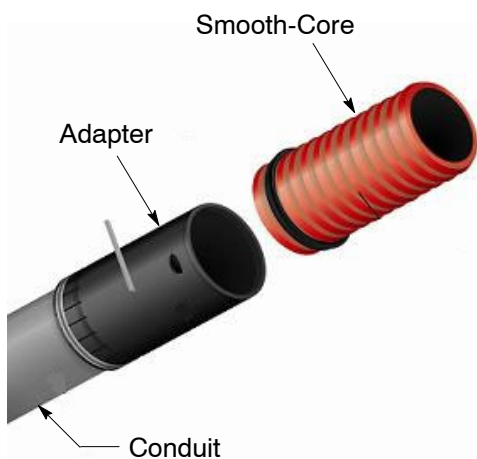


Table 22 Data and Material Codes for Shurlock/Key-Lock™ (Adapter Smooth-Core-Shur-Lock Kit™ 1, 2)

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

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

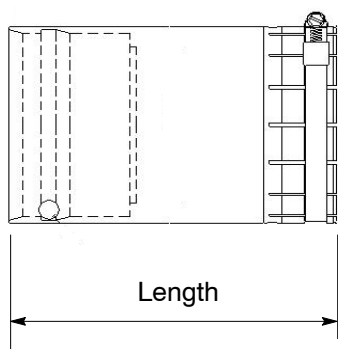


Figure 30
Key-Lock™ Adapter

Table 23 Required Rigid PVC stub out length ¹

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

- ¹ 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 7.
 - C. Use appropriate size end bell for PVC conduit listed in Table 13 on Page 9.



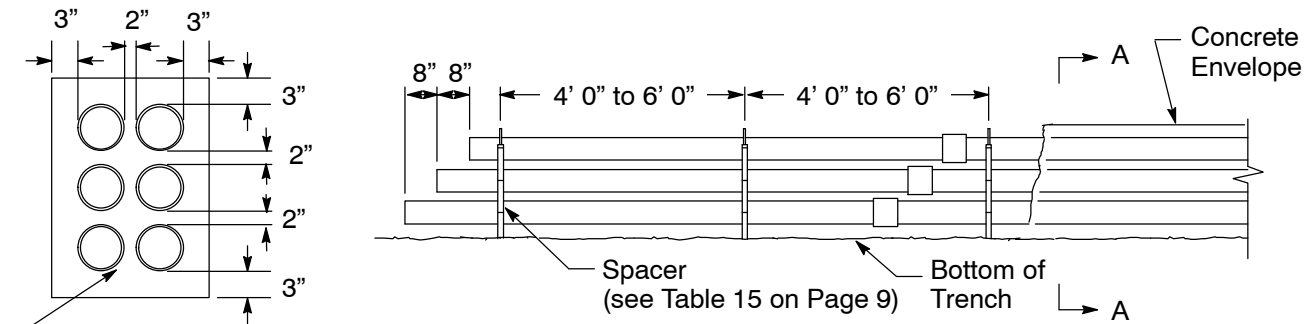
Figure 31
Shur-Lock II Coupler

Table 24 Data and Material Codes for Shur-Lock II Coupler ¹

Conduit Size (inches)	Dimension (inches)	Material Code
	Length	
2	5.70	027241
3	10.75	027242
4	12.00	027243
5	14.25	027244
6	14.25	027256

- ¹ For use to join HDPE–HDPE and HDPE–PVC conduit, threaded or non-threaded steel conduit.

Conduit Construction, Built-up Method



Plastic Conduit
(see Table 6 on Page 7)
Separation between conduits
when using spacer. See
Figure 16 on Page 9.

Section A-A

Figure 32
Typical Straight Run Installation
(6" conduit, 6-way shown)

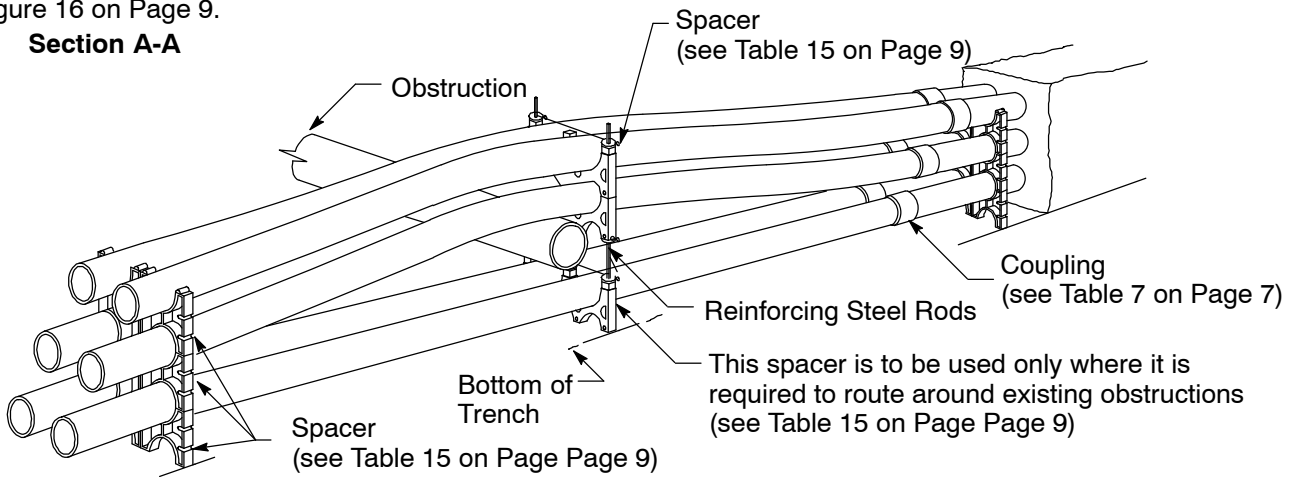


Figure 33
Typical Perspective View of
Installation Around Obstruction

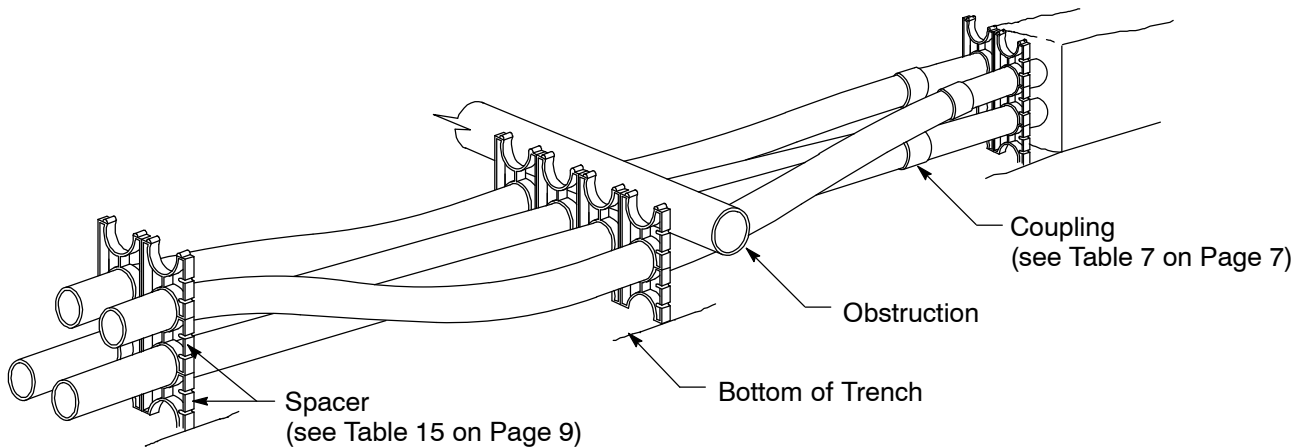


Figure 34
Typical Perspective View of
Installation Under Obstruction

Underground Conduits

Construction and Termination of Conduit Line into a Manhole or Vault

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.

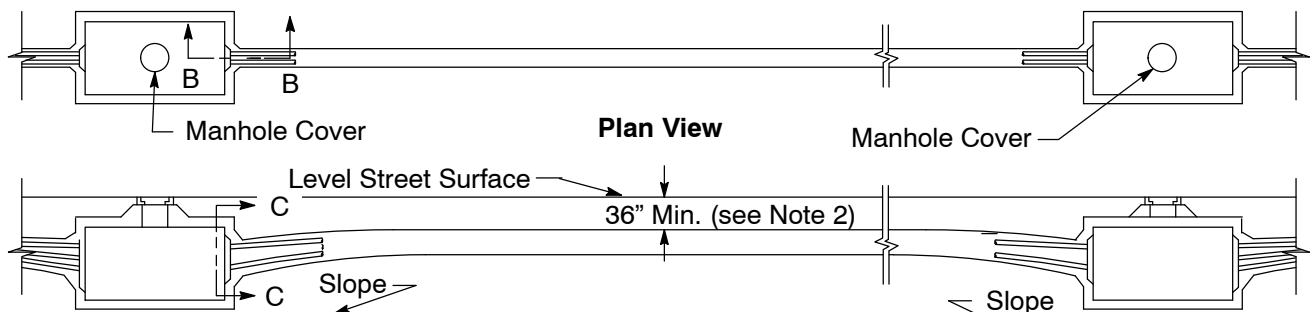


Figure 35
Sectional Elevation
Level Grade

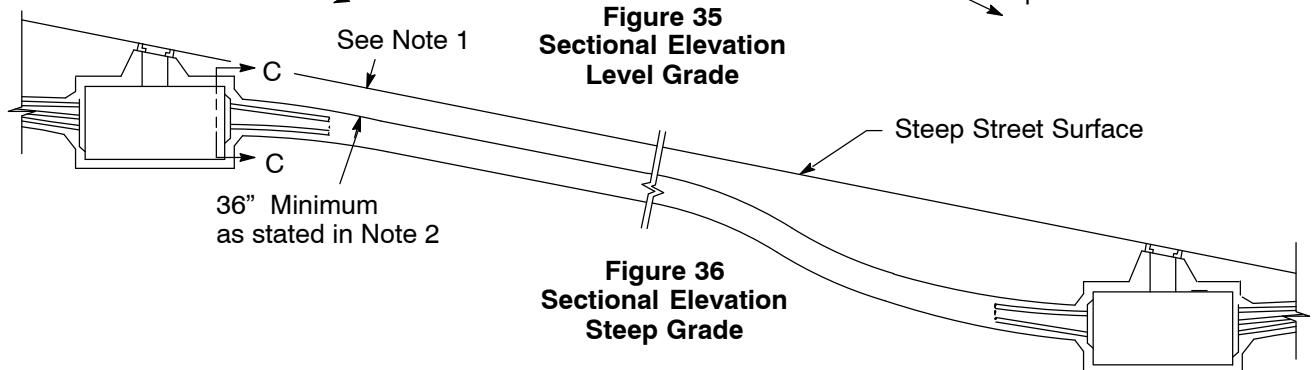
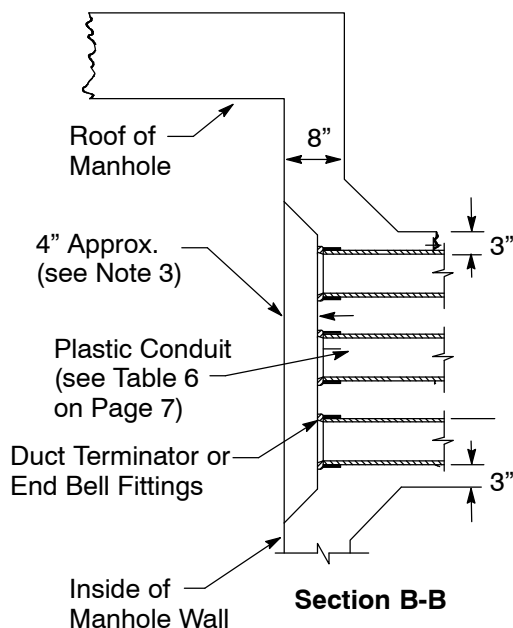
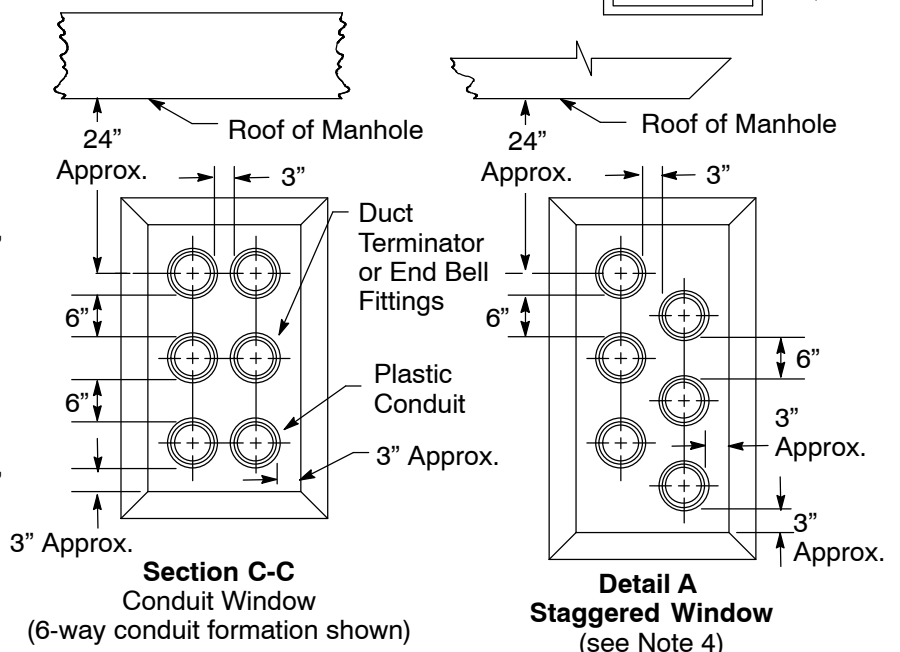


Figure 36
Sectional Elevation
Steep Grade



Section B-B



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

Detail A
Staggered Window
(see Note 4)

Concrete Encasement Conduit Configuration Tables

Notes

1. 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.
2. 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.
3. Separation for conduits installed in concrete encasement will remain 3" to facilitate safe concrete removal and conduit access.
4. Concrete: Normal Weight
Aggregate, ASTM, C33 Uniformly Graded
Maximum Aggregate Size 3/4 inch type
Minimum Compressive Strength: $f'c = 3,000$ pound-force per square inch (psi).

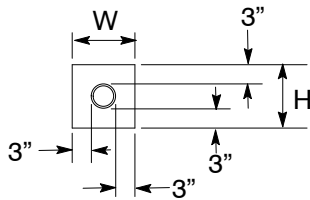


Figure 37
Single Conduit Configuration

Table 25 Dimensions for Single Conduit Configurations

Conduit		Envelope Dim.		Concrete Req. Cubic Yards per 100 ft. ¹
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

¹ Quantities may vary due to variations encountered in construction.

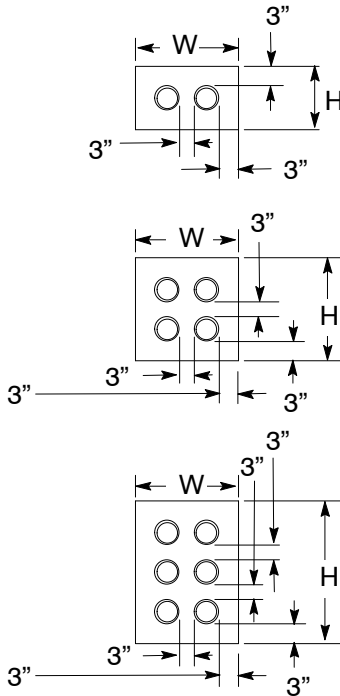


Figure 38
Two, Four, and Six-Way Conduit Configuration

Table 26 Dimensions for Multiple Conduit Configurations

Conduit		Envelope Dim.		Concrete Req. Cubic Yards per 100 ft. ¹
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

¹ Quantities may vary due to variations encountered in construction.

Underground Conduits

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.

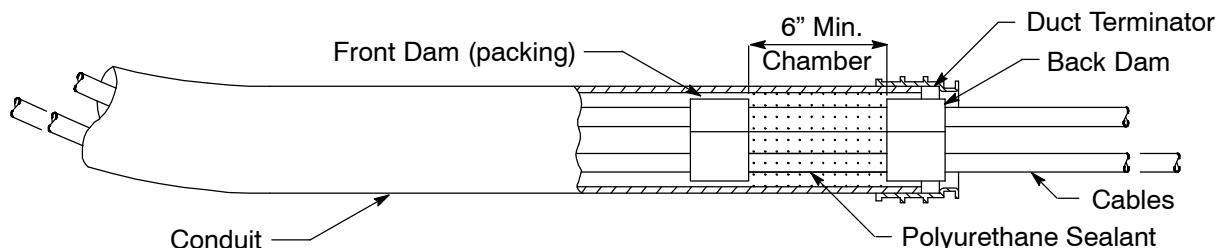


Figure 39
Details of a Polyurethane Seal

- 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.

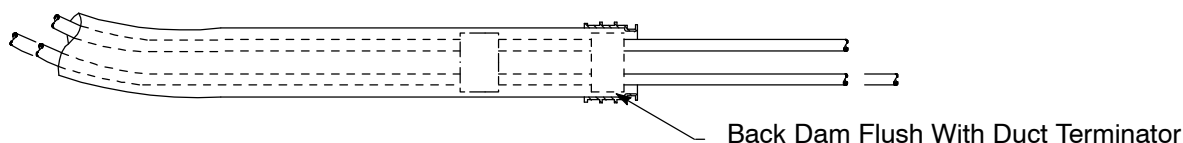


Figure 40
Front Dam Installation

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

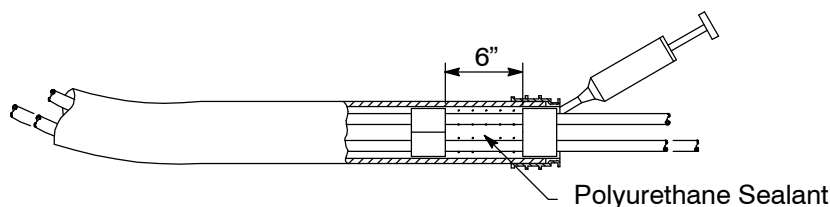


Figure 41
Nozzle Application

Table 27 Material Codes for Polyurethane Conduit Seal Kits ¹

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

¹ Kits have a 12 month shelf-life.

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 CO₂ cartridges. Both of these materials need to be ordered separately. See Figure 45 on Page 21 .
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 21.
6. For additional reference, the link below 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. The video titled “RDSS – Rayflate Duct Seal System Installation and Removal” is posted in Microsoft Stream. Access Microsoft Stream at <https://web.microsoftstream.com/> from PG&E intranet.

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 ²					0-2.75-4.5	2.50-4.24
6 ²						2.50-5.50
RDSS Clip Size	N/A	75	75	100	125	150

¹ One RDSS clip per RDSS seal is included in the kit.
² 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 45 on Page 21.



**Figure 42
RDSS Seal and Clip**



**Figure 43
AT/AP-150 Device**

Underground Conduits

Instructions for Sealing Conduit Using RDSS (continued)



Figure 45
IT-16 Installation Tool and CO₂ Cartridges

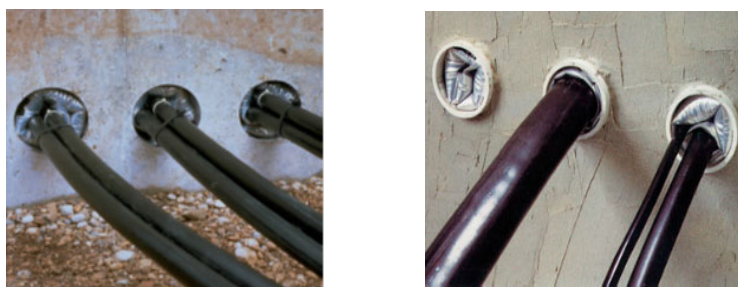


Figure 44
RDSS Installed

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 ₂ Gas Cylinders	360221

¹ Installation tool re-usable. Unless damaged, only need to order once.

² Only these types of cylinders are compatible with this tool.

Revision Notes

Revision 21 has the following changes:

1. Added new note 6C under General Information section on Page 1.
2. Made last paragraph of note 6 stand alone as new note 7. Added verbiage about chamfering under note new Note 7 on Page 2.
3. Revised Note 11, and added new Notes 12 on Page 2 and 17 on Page 3.
4. Added Oatey new part number to Table 1 on Page 3.
5. Added new Notes 22A–22D on Page 3.
6. Replaced left image of Figure 6 on Page 7.
7. Expanded Table 10, added Table Footnote #6 on Page 8.
8. Added Table footnote 1 to Table 24 on Page 15.
9. Fixed typo in Note 3 on Page 18.