

6 Underground Requirements

6.1 Basic Requirements

The Customer is responsible for the trenching, backfilling, compaction, conduit, transformer pads or vaults, and any other requirements to complete the construction for underground service. For a transformer installation, the Customer must provide space for the transformer on private property. For all trenching and transformer installations, the Customer must meet any requirements of governmental authorities—including excavation permits—and PGE.

All secondary services must be in conduit. To avoid damage to underground conductors and service equipment from soil settling, all service conduit riser elbows must be backfilled at least 4 inches deep with tamped, 3/4-inch minus crushed rock. Where a Customer's service conduit riser extends vertically through a paved or concrete surface adjacent to the service entrance, a sleeve is required around the conduit to prevent direct contact of the conduit with the pavement.

Where exposed to motor vehicles, the Customer must install and maintain a PGE-approved barrier to protect a pad-mounted transformer and other equipment. For more information, see Section 6.4.6, *Barrier Post*.

In most cases PGE will install, maintain, and own the underground service lateral from the PGE distribution line or transformer in the Customer's conduit to the point of delivery. For more information, see Section 6.3, *Conduit*.

6.2 Trenches Provided by the Customer

The Customer must be in compliance with the Occupational Safety and Health Administration (OSHA) rules and the Oregon Utility Coordinating Council (OUCC) standards. The location of the service entrance on the Customer's premises is an important consideration to both the Customer and PGE.

Customer responsibilities include:

- Consulting PGE to determine the route and the point of attachment for underground service laterals, meter locations, service outlet locations, current transformers, and terminal cabinet enclosures. Routing conduit under buildings or other permanent obstructions is not permitted; exceptions may be allowed with approval from PGE if alternative routes are not available.
- Locating the service entrance to make the meter and service easily accessible from PGE distribution lines and convenient for the installation, operation, and maintenance of PGE meters and equipment.
- Obtaining a permit from the local jurisdiction before any work in the right of way is performed. Only PGE-approved excavation contractors and contractors who have made special arrangements with PGE will be allowed to work under a PGE permit. The contractor must notify the local jurisdiction 48 hours before the work is to begin. A copy of the permit must be on site.

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- Placing spoil (excavated material) a minimum of 24 inches back from the edge of the trench as shown in **Figure 6-1** and **Figure 6-2**. If this is not possible, shoring may be required to comply with OSHA standards. Spoil may be placed in the street upon approval from the local jurisdiction.

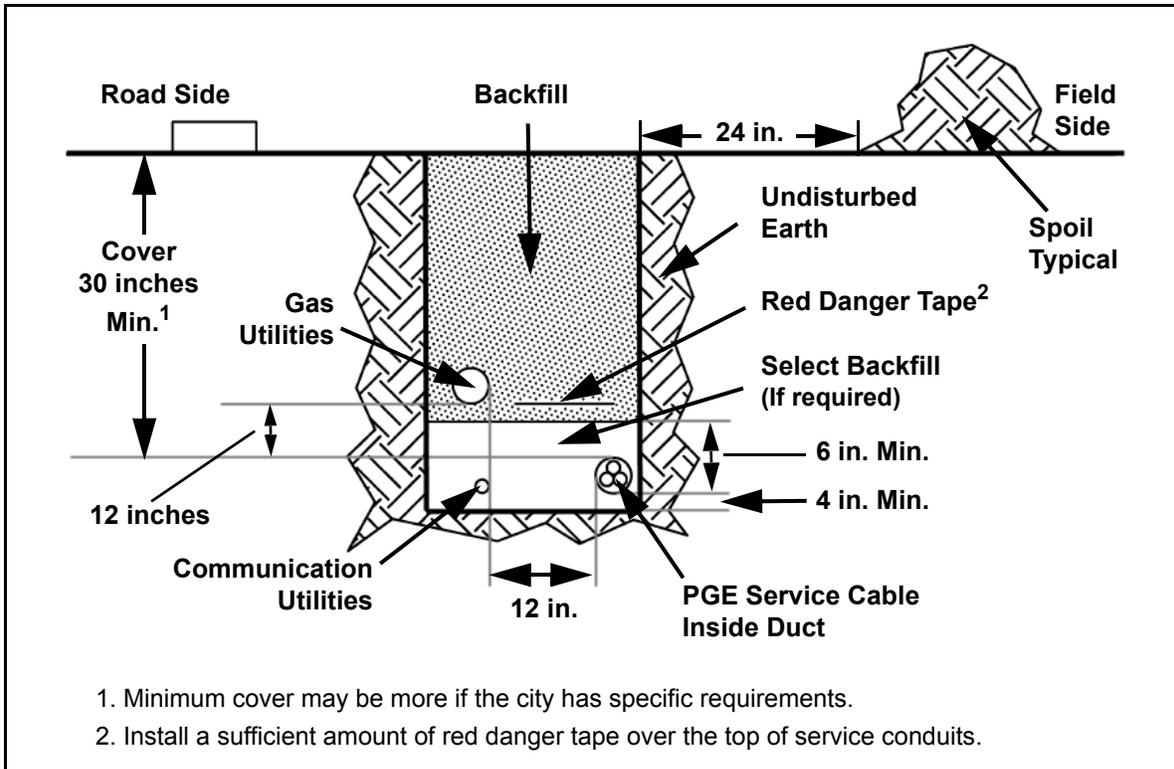


Figure 6-1: Service Cable Trench for Joint Use With Gas

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NOTE: For single-family and duplex residential subdivision, industrial, and commercial projects, finished grade must be established prior to trench excavation to ensure that minimum cover requirements for cables and conduits are attained. Minimum cover requirements for cables are measured from the trench surface to the top of the cable or conduit.

6.2.3 Select Backfill

When on-site backfill contains rocks larger than 4 inches or rocks with sharp corners, select backfill must be used. Select backfill must be placed a minimum of 4 inches below and 6 inches above the conduit or cable configuration.

Select backfill material is granular material that meets these standards:

- 100 percent of the material passes a 3/4-inch sieve.
- No more than 15 percent of the material passes a No. 200 mesh sieve.
- The material is reasonably free of organic and otherwise undesirable materials.

Backfill in the remainder of the trench must be free of rocks larger than 4 inches in diameter.

6.2.4 Mechanical Protection

For extreme, adverse ground conditions—such as solid rock formations or conflicts with other utilities—conduit may be installed at a minimum depth of 12 inches provided one of the following mechanical protection methods is used:

- Rigid steel.
- A layer of concrete directly above the conduit. This layer must be at least 2 inches thick and have a horizontal coverage of at least 6 inches beyond the end of the duct, high-density polyethylene (HDPE) duct, or PVC Schedule 40 duct.

6.2.5 Controlled Density Fill

Use a controlled density fill (CDF) where physical protection of the conduit system is necessary. CDF may be necessary for critical feeders or where the conduit system may be exposed to future excavation. CDF may also be used where the heat of the cable must be dispersed at a greater rate than the native soil backfill will allow. Install CDF 6 inches on all sides of the conduit.

CDF must have a maximum compressive strength between 200 and 500 psi in 28 days, have an allowable slump of 4 inches at the time of batching, and be dyed red.

6.2.6 Mitigating Potential Surface and Subgrade Water Flows

The Customer is responsible for recognizing and mitigating potential surface and subgrade water flows that may allow water to enter into the Customer's electrical equipment. Measures taken may include a second junction box for water mitigation.

6.3 Conduit

All conduit routes must be approved by PGE prior to installation by the Customer; Customer-installed conduit must be inspected by PGE before backfill.

PGE will not install a conductor if the conduit system is improperly constructed. The Customer is responsible for repairing—or for the costs associated with repairing—any conduit problems prior to installation of a PGE conductor. PGE will own and maintain the conduit system once a PGE conductor has been installed.

The Customer must install either rigid steel or electrical-grade Schedule 40 gray PVC conduit. Sweeps of PVC, rigid steel, and fiberglass are acceptable. All PVC joints must be glued. All factory- or field-cut conduits must be chamfered to prevent damage to PGE cables.

If rock or other obstructions are encountered, consult PGE. When the conduit terminates at a PGE pole, consult PGE for exact conduit location. See **Table 6-1** for conduit requirements for secondary voltage conductors.

Additional conduit requirements for secondary voltage conductors include:

- Four-inch conduit may be substituted for 3-inch conduit.
- Large conduit size, additional conduits, or a larger bend radius may be required for longer runs, four-wire full neutral, or direct connection to utility conduit. The Customer must consult PGE for specific requirements.
- Conduit spacers are required for any multiple-conduit installations where a horizontal configuration in the trench cannot be obtained. Contact PGE for approved conduit spacers.

HDPE duct may be used for horizontal directional boring applications. The duct must meet the requirements of PGE specification L22501 (available upon request of your PGE project manager).

For safety reasons, the duct must be black with three equally spaced extruded red stripes, which is a specification requirement. Aluminum couplings with barbed threads on both ends must be used to join HDPE duct sections, and straight couplings with barbed threads on one end and NPT on the other end must be used for connecting to PVC duct.

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NOTE: The conduit requirements listed in **Table 6-1** are for reference only. Requirements for a specific situation depend on the design and requirements of the service.

Table 6-1: Conduit Requirements for Secondary Voltage Conductors

Service Entrance Ampacity	Single-Phase, Three Wire		Three-Phase, Four Wire ¹	
	Conduit Size	# of Conduits	Conduit Size	# of Conduits
200 A or lower	3-inch	1	3-inch (minimum)	1
320 A continuous	3-inch	1	—	—
400 to 600 A	3-inch	2	3-inch (minimum)	2
800 A	3-inch	3	3-inch (minimum)	3
1000 A	—	—	3-inch (minimum)	4
1200 A	—	—	3-inch (minimum)	5
1201 to 1300 A	—	—	3-inch	6
	—	—	5-inch	4
1301 to 1500 A	—	—	3-inch	7
	—	—	5-inch	4
1501 to 1600 A	—	—	3-inch	8
	—	—	5-inch	5
1601 to 1800 A	—	—	3-inch	9
	—	—	5-inch	5
1801 to 2000 A	—	—	3-inch	11
	—	—	5-inch	6
2001 to 2100 A	—	—	3-inch	12
	—	—	5-inch	6
2101 to 2300 A	—	—	3-inch	13
	—	—	5-inch	7
2301 to 2500 A	—	—	3-inch	14
	—	—	5-inch	8
2501 to 2700 A	—	—	3-inch	15
	—	—	5-inch	9
2701 to 3000 A	—	—	3-inch	16
	—	—	5-inch	11

1. Consult PGE for conduit sizes for all three-phase services. These values are provided for reference only and may not align with the actual requirements for a specific situation.

6.3.1 Customer-Owned Conductors

The Customer’s service conductors must be in a separate conduit system from PGE conductors.

6.3.2 Conduit Sweeps and Pull Lines

Bends must have a minimum 36-inch formed sweep radius for a 2- to 4-inch conduit, and a minimum 60-inch formed sweep radius for a 5- to 6-inch conduit.

IMPORTANT: All bends must be factory made. Field bends or field heat bends are not acceptable.

Rigid steel or PGE-approved fiberglass bends are required for runs of 151 feet or longer, or for any length run with more than 180 degrees in bends. PVC Schedule 40 bends are acceptable for runs of 150 feet or shorter. The maximum total number of bends in any conduit is 270 degrees.

Sweeps must be separated by a minimum 5-foot straight section. There must be a 3-foot minimum straight section from a vault. See **Table 6-2** for fiberglass sweep specifications.

Where a Customer’s conduit extends to a PGE pole, the Customer must provide the sweep. Consult PGE for the exact location on the pole.

Cap all conduits at **both** ends during installation to keep them free of dirt and debris.

IMPORTANT: All conduits must have a 500 pound-rated nonconductive pull line with 6 feet of line extending from each end of the conduit.

A pull line must be installed after the conduit is joined and the glue is dry. When a new conduit and/or pull line will be entering an existing PGE secondary vault or transformer, the installer is required to contact PGE prior to installation. A PGE crew will be scheduled to meet the installer at the site to assist with the installation.

Additional sweep requirements include:

- Each sweep must have two extra-deep, fabricated PVC couplings.
- The sweep must meet NEMA TC14, *Reinforced Thermosetting Resin Conduit and Fittings*, for iron pipe size (IPS) design.

Table 6-2: Fiberglass Sweep Specifications

Diameter (inches)	Sweep Radius (inches)	Minimum Wall Thickness (inches)
2–4	36	0.095
5–6	60	0.110

6.3.3 Duct Proofing

Duct proofing is a process used to ensure that the duct is clear of obstructions and grit; it also ensures that no portion of the duct is collapsed or out of round. The Customer is responsible for duct proofing all ducts installed for PGE jobs before the job is completed and before the installation of PGE conductors.

To test for obstructions and out-of-round ducts, a wood test mandrel (or equivalent plastic and/or hard rubber mandrel) configured for the duct ID installed must be pulled through the ducts.

The Customer is responsible for furnishing the appropriate duct-proofing tool, such as a duct brush or steel or polyurethane duct checker.

6.3.4 Conduit Locations

During construction, the Customer must mark conduit locations with white paint or other marker, such as a plastic strip, per Oregon Administrative Rules (OAR) 952-001-0070.

6.4 Concrete Pads and Vaults for a Pad-Mounted Transformer

6.4.1 Pad

A precast concrete pad is required for a pad-mounted transformer. Consult PGE for transformer dimensions and installation requirements. Pads must be flush with the finished grade within 12 inches of a sidewalk or other paved area.

The Customer must install a 5/8-inch OD x 8-foot ground rod inside the transformer. (PGE will provide this ground rod.) The ground rod must be a maximum of 4 inches above final grade and a minimum of 4 inches on the field side of the primary source.

6.4.2 Vault

PGE requires a vault under a cable compartment. Consult PGE for transformer vault dimensions. The vault lid must be installed 2 inches above the finished grade in landscaped areas and flush with the finished grade within 12 inches of a sidewalk or other paved area.

6.4.3 Clearances

See **Figure 5-13** in Section 5.10, *Working Clearances Around PGE Submersible Equipment* for the required clearances from a pad-mounted transformer.

6.4.4 Excavation and Backfill

Excavate the entire area beneath the pad or vault to a depth of 18 inches below final grade. All soil beneath the pad site must be compacted and level prior to setting or pouring the pad or vault to prevent settling. Backfill with compacted 3/4-inch minus gravel within 5 feet of the pad or vault.

6.4.5 Temporary Cover on All Openings

Where the Customer provides openings for PGE equipment, such as a pad-mounted transformer, the Customer must provide and install a temporary cover. The cover must be 3/4-inch marine grade or exterior grade plywood that is 6 inches larger than the opening and secured without damaging the concrete. PGE will remove the temporary cover during installation of the electrical equipment.

6.4.6 Barrier Post

Install a barrier post, or posts, around all electrical equipment (such as a transformer, switchgear, or sectionalizing cabinet) in areas where the equipment is exposed to vehicle traffic. The barrier post design and location must be approved by PGE.

Follow these requirements when installing a barrier post.

- Install a 6-inch diameter, Schedule 40 galvanized steel post filled with concrete on all sides of the equipment that are exposed to vehicles.
- The barrier posts must be no more than six feet apart. See **Figure 6-3** for a top view of the barrier post locations around electrical equipment.
- Install the barrier post off-center of the equipment to allow the door to open.
- Do not install a barrier post closer than 4 feet to the front edge of the concrete pad or vault where the equipment door is located or will be located. See **Figure 6-3** for barrier post locations, and see **Table 6-3** for barrier post dimensions.
- Do not install a barrier post closer than 3 feet to the sides or back of the concrete pad or vault when the side or back of the equipment does *not* have a door. (See **Figure 6-3**.)

If a smaller clearance is required, PGE approval is necessary.

- All concrete must have a minimum compressive strength of 3000 psi after 28 days, and be domed at the top of the steel post. The concrete must have a 2-inch dome above the final grade to prevent water pooling.
- Install the barrier post in undisturbed earth. However, the area between the vault wall and the barrier hole may be filled with 3/4-inch minus compacted gravel if three feet of undisturbed area is not available after the vault is set.

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- Provide 3 inches of concrete below the bottom of the post.
- Use steel reinforcement when the barrier post is at a loading dock. Steel reinforcement must be 6 x 6 W2.9/2.9 welded wire fabric (WWF) placed around the outside of the galvanized steel post. Steel reinforcement is not required in an area that has only car traffic. See **Figure 6-4**.
- Overlap the welded wire fabric 6 inches and use a wire tie to secure the fabric.
- Paint all barrier posts safety yellow and apply two 3-inch-wide reflective bands near the top of all barrier posts. See **Figure 6-4**.
- Where a barrier post interferes with opening the equipment door or inhibits the workspace, a removable barrier post must be installed with prior approval of PGE.
- A barrier post must be installed prior to energizing the service.

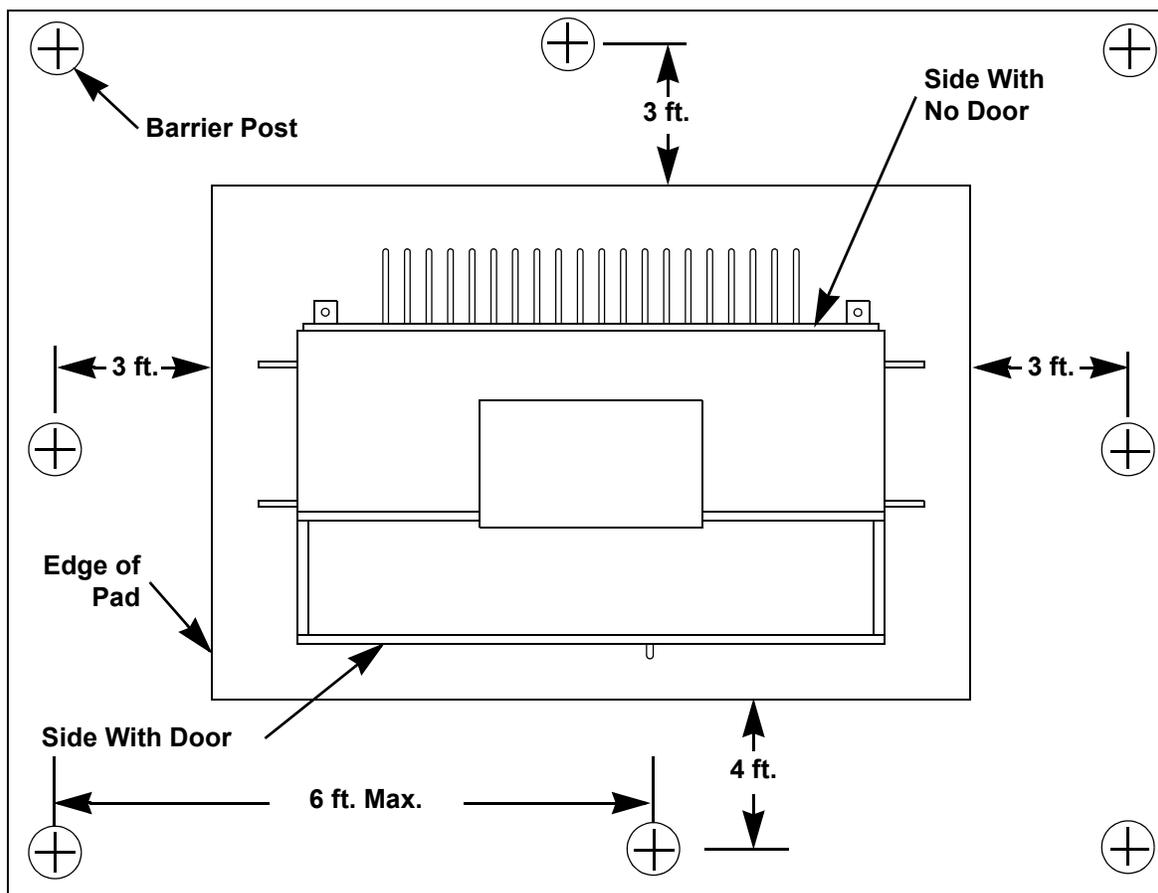


Figure 6-3: Top View of Barrier Post Locations at a Pad-Mounted Installation

The dimensions shown for A and B in the table below refer to the drawing in **Figure 6-4**.

Table 6-3: Barrier Post Dimensions For Specific Locations

Location	Dimension (inches)		
	Length of Galvanized Steel Post	A Hole Diameter	B Height Above Final Grade
Loading dock	108	30	54
Car traffic area	96	24	42

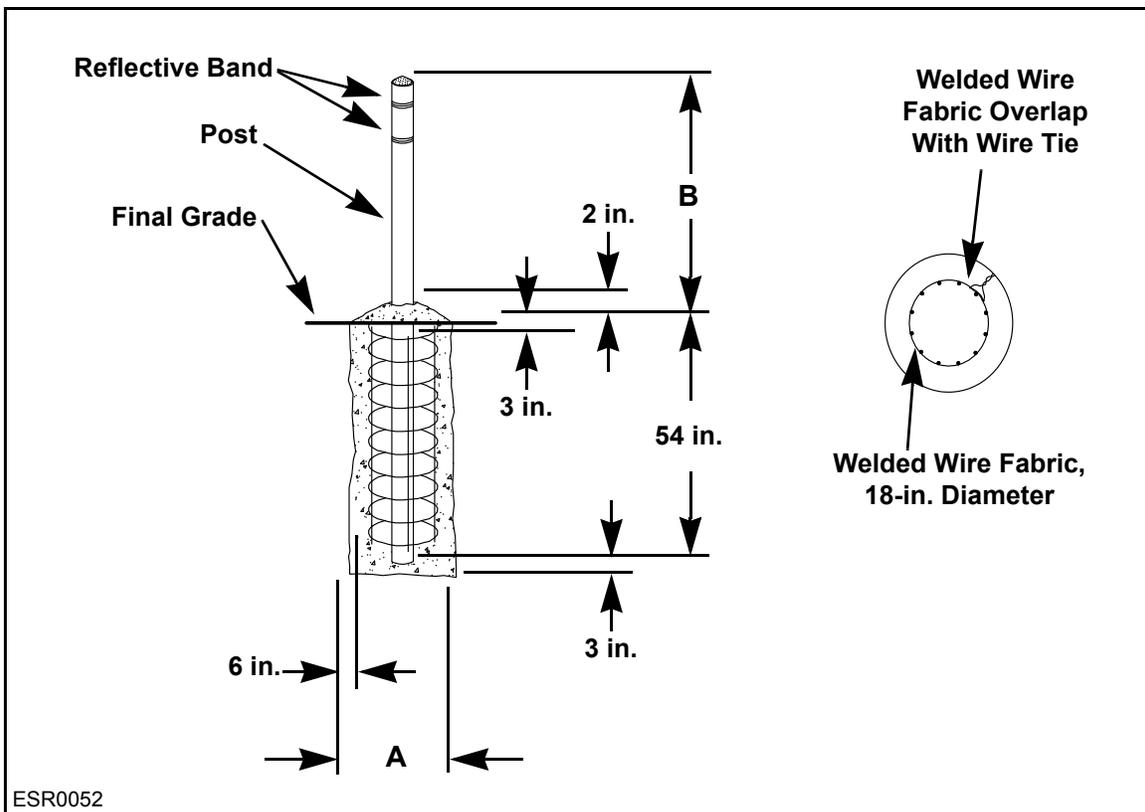


Figure 6-4: Barrier Post Dimensions

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