Requirements for Primary Conduit and Duct Bank Installation

1. Table of Contents

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2. Scope

This standard provides the general requirements for the construction and installation of primary conduits and duct banks in the public right-of-way and on private property within the Seattle City Light (SCL) service territory. This includes system duct banks of more than two conduits, and primary service duct banks with only two conduits.

Job-specific requirements are not covered in this standard. Refer to the SCL Requirements Letter for job-specific requirements.

3. Application

This standard provides direction to SCL crews, engineers, customers, electrical service representatives, reviewers, inspectors, and contractors about where and how to properly install primary (601 – 50,000 V) conduits and all distribution duct banks in the public right-of-way and on private property.

For secondary (0 – 600 V) conduit installations, refer to SCL 0224.07.

For clearances between underground structures, refer to SCL 0214.00.

4. Requirements

4.1 General

Conduits and duct banks shall conform to Table 4.1 and Figures 4.3a and 4.3b.

Table 4.1. General Requirements

Function	System	Service
Voltage	601 – 50,000 V	601 – 50,000 V
Location	Right-of-way and private property	Right-of-way and private property
Area	Network and Looped Radial	Network and Looped Radial
Cover (minimum)	36 in	36 in
No. of Conduits (minimum)	2	2
Encasement	Yes	Yes
Marking Tape	Yes	Yes
Backfill	CDF	CDF

4.2 Depth

See Table 4.1 for minimum cover.

4.3 Alignment

Center line of the duct bank shall be located 15 feet from center line of street on either side of the street unless otherwise specified by the SCL engineer.

Figure 4.3a. Primary Duct Bank, End View

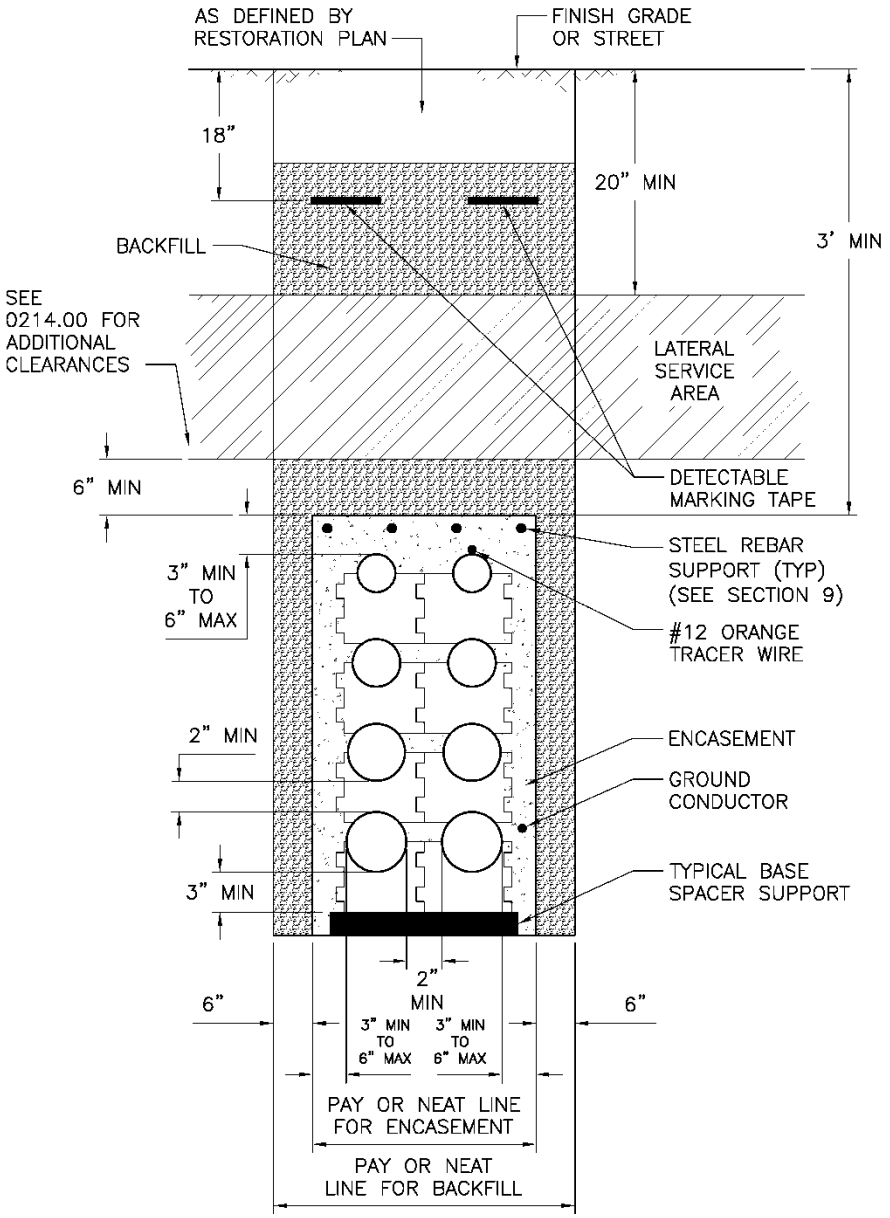
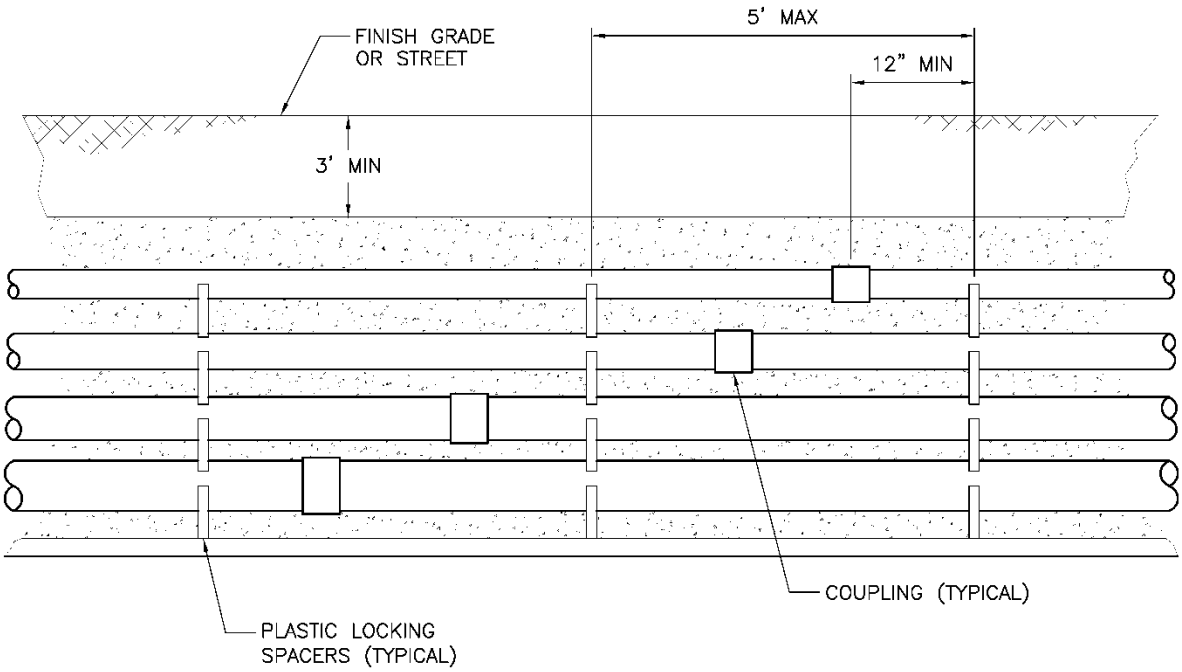


Figure 4.3b. Primary Duct Bank, Side View



5. Primary Conduit and Duct Bank Construction

Duct banks and conduit systems are electrical facilities for power distribution. In order for the electrical system to perform at its full capacity, the following requirements shall be met:

- Systems shall be constructed in a neat and workmanlike manner.
- All joints shall be tightly sealed against water intrusion. For transition joints (steel to PVC, steel to fiberglass) and set screw coupling joints, apply a layer of mastic tape (Stock No. 736470) and a layer of electrical tape (Stock No. 736656) on top.
- All coupling and adapter threads shall be sealed with Oatey Great White pipe joint compound or equal with approval prior to installation.
- All joints shall be properly aligned and square, and have adequate cure time.
- All edges shall be deburred and chamfered to prevent damage to cables. See SCL 7015.05.
- Conduit runs shall be adequately supported so they do not become distorted during encasement or backfill.
- Conduit bends shall be concentric and maintain consistent spacing.
- Set screw couplings shall be encased.

Installations that do not meet these criteria will be rejected.

5.1 Arrangement

5.1.1 Transposition

Conduits shall NOT be transposed between vaults.

5.1.2 Numbering

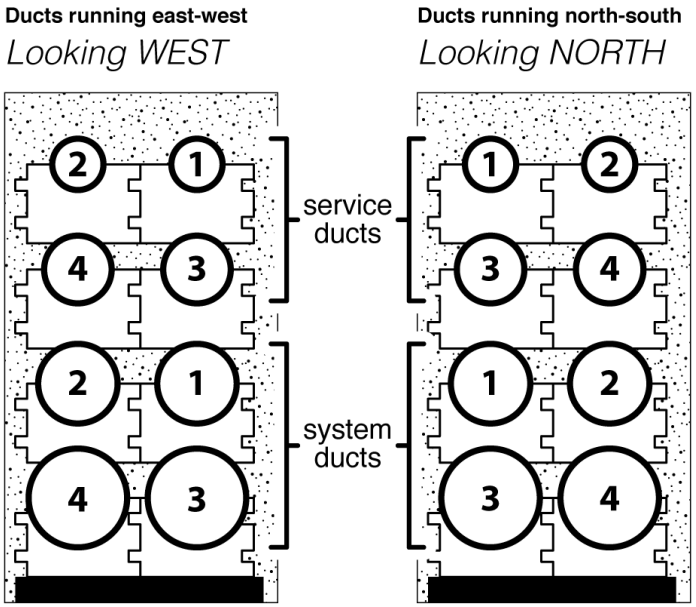
The ducts shall be numbered separately by type; service ducts together and system ducts together. The numbering method shall be as follows:

For ducts running east-west, count from north to south and from top to bottom.

For ducts running north-south, count from west to east and from top to bottom.

Example shown in Figure 5.1.2.

Figure 5.1.2. Duct Numbering Example



5.2 Termination

5.2.1 Permanent

The first two feet of all conduits exiting the vault shall be vertically and horizontally perpendicular to the vault face. Conduits shall enter the vault no more than 18 inches from the adjacent wall.

If there are multiple duct banks or direct-buried conduits entering horizontally and at right angles to each other in the same corner of a vault, manhole, or handhole, they shall enter at different elevations so they are vertically offset to the other.

All duct terminations into vaults, handholes, etc., shall be done by core drill. Core size shall be one trade size larger than conduit trade size.

Provide and install PVC-type DB-120 conduit end bells flush with the interior walls on all conduits entering the vault. The conduits shall be grouted both inside and outside of the vault. See SCL 7055.09 for approved manufacturers.

For terminating existing ducts in new vaults, see SCL 0222.06.

5.2.2 Temporary

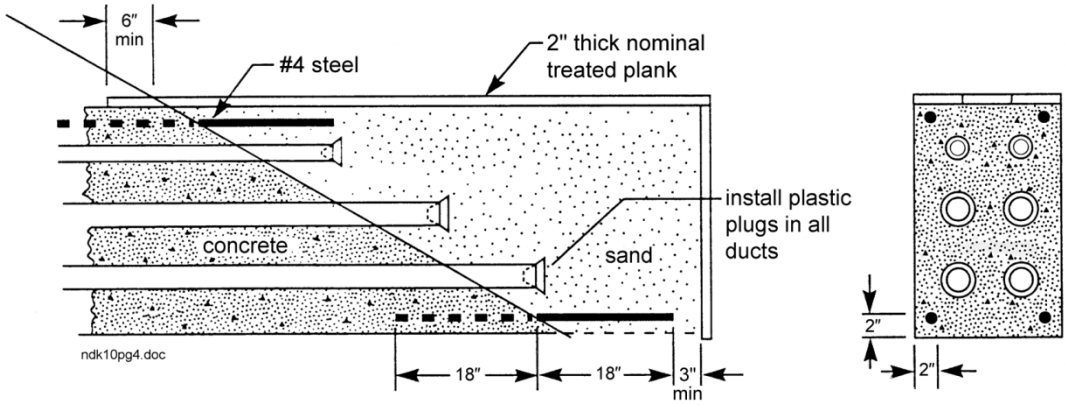
Install reinforcement steel dowels whenever placing of encasement is to be delayed beyond initial set.

Spacers shall be placed as close to the temporary termination as possible in order to maintain proper conduit spacing.

Lower conduit shall be flush or protrude beyond the conduit above it to ease reattachment.

See Figure 5.2.2 for details.

Figure 5.2.2. Temporary Termination



5.3 Changes in Direction

Any changes in direction must consist of only one type of conduit material and all bends must have the radius of the largest conduit. See Table 5.3 for minimum bend radius requirements.

For a change in direction, the PVC conduit may be cold-formed, provided the deflection does not exceed 1 ft per 10-ft section.

For standard wall fiberglass conduit, lateral deflection shall not exceed 1 ft per 20-ft section.

Each conduit bend shall be mandreled prior to placement and encasement. See SCL U2-11.40/NDK-40.

Conduits installed on private property must include a proper transition on the private property when meeting up with conduit in the right-of-way that requires a minimum 36-in cover.

Table 5.3. Minimum Bend Radius

Conduit (in)	System[1, 3] (in)	Service[2, 3] (in)	Communication (in)
2.5	–	24	–
3	144	36	–
4	144	48	48
5	150	60	–
6	144	60	–

Notes:
[1] PVC conduit is not allowed for system conduit bends.
[2] Bending PVC conduits with heat is not allowed.
[3] Typical unless otherwise specified by SCL engineer.

6. Conduits

Schedule 40 PVC, rigid steel or fiberglass conduits can be used in conduits and duct banks as specified in Table 6.

Table 6. Allowed Conduit Materials

	Schedule 40 PVC (SCL 7015.05)	Rigid Steel (RGS) (SCL 7050.05)	Fiberglass (SCL 7025.05)
System – Straight	Yes	Yes	Yes
System – Bend	No	Yes	No[1]
Primary Service – Straight	Yes	Yes	Yes[2]
Primary Service – Bend	No	Yes	No[1]
Communication – Straight End Bend	Yes	Yes	No

[1] Typical unless otherwise specified by SCL engineer.

[2] Only for 5-inch conduits.

Conduits entering an in-building vault or within a building footprint shall be steel.

Conduits exposed under aerial structures (bridges, etc.) shall be steel and effectively grounded.

Conduits installed under, or through, wall or structural sections shall be steel.

Factory and field straight-cut ends shall be chamfered throughout the duct run. See SCL 7015.05.

The conduit shall be RGS if there is 10 ft or less between bends (except communication conduits).

Allow two hours minimum to cure conduit adhesive prior to encasement.

A spare conduit shall be provided. Conduit shall be run in pairs.

7. Trench

The bottom of the trench shall be free of debris and fine-graded by hand to remove sharp, embedded rocks and loose stones over 1/2 inches in size. Or, the trench shall be over-excavated and replaced with bedding material to cover protruding rocks and stones by a minimum of 2 in. The bottom shall be graded even. Bedding material shall be crushed rock.

There shall be no standing water in the trench and the trench shall not be saturated.

8. Spacers

Spacers for conduit separation shall be plastic lock-type (see SCL 7015.80) of such configuration to give the required separation between conduit and earth, as shown in Figure 4.1.

Horizontally, spacers shall be placed a maximum of 5 ft apart in both straight and bending sections of duct banks and a minimum of one foot away from any coupling, fitting, or end bell, as shown in Figure 4.2.

Base spacers shall be used to obtain clearance to subgrade material under the conduit for the placement of the 3-in minimum of encasement.

Base spacers may also be used to obtain 3-in side cover of conduit in bends.

Two-inch nominal concrete blocking, 16-in by 8-in by 1.75-in minimum, shall be provided under the base spacers.

Secure conduit to spacers in order to prevent floatation and deflection during encasing.

9. Encasement

Conduit encasement is required if the conduits used are for cable rated 601 V or higher.

The encasement shall be red HSFTB. HSFTB is a concrete mix and is the only allowed material for encasement:

- Refer to Material Standard 7150.00 for HSFTB requirements.
- Refer to Construction Standard 0226.06 for HSFTB installation.
- Allow 48 hours to cure prior to pulling cable.

Steel rebar support may be required. See SCL 0222.04.

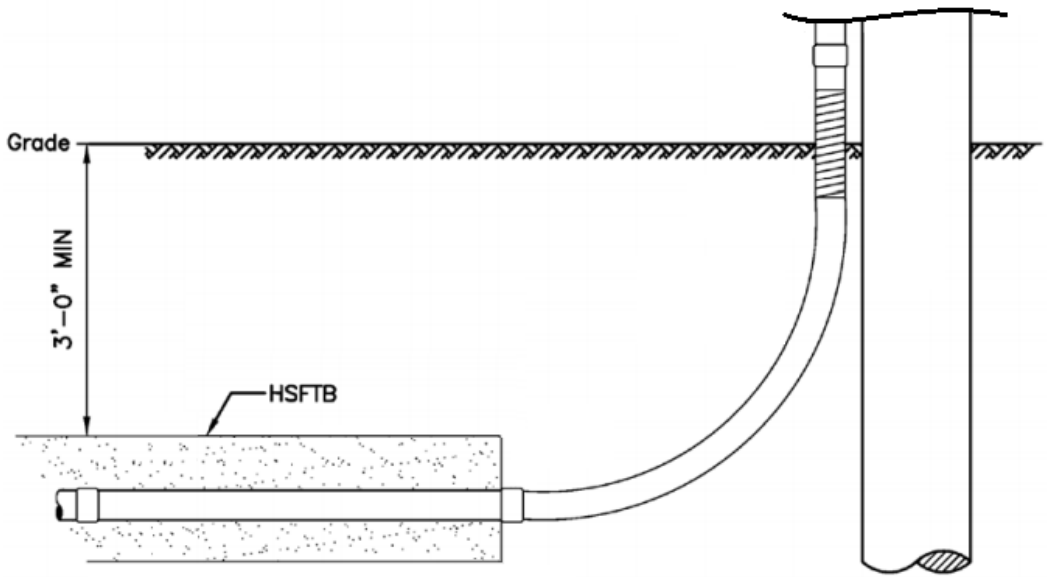
Forming is required for encasement:

- No forming or shoring structures shall be left in the trench after encasement.
- Metallic leave-in-place type forms may be allowed with permission of an SCL engineer. After curing, all forms and staking shall be cut flush with the top of the duct bank.

The encasement shall be a minimum of 3 in and a maximum of 6 in around all conduits in a duct bank.

The encasement shall end before the elbow of the conduit riser.

Figure 9. Encasement at the Conduit Riser



10. Backfill

Controlled Density Fill (CDF) – A self-compacting material used for backfill. Refer to SCL 7150.30 for CDF specification.

11. Identification

Install two 3-in-wide red detectable underground marking tapes over the corners of the duct bank at 18 in below the finished grade.

12. Inspection

Inspections shall be done by Seattle City Light. Conduit and duct bank installations require that the inspection be done when laying conduit, prior to, and during, encasement pour; and prior to, and during, backfill pour. Additional inspections may be done for more complex installations. Inspection approvals are required prior to moving on to the next stage of conduit and duct bank construction. An inspection may include verification of proper construction, adherence to engineer design and SCL standards, and conduit mandreling and cleaning. See SCL U2-11.40/NDK-40 for mandreling and cleaning details.

13. Communications

On all new underground installations of system conduits and duct banks, two 4-in PVC conduits shall be installed for communication uses. The two communication conduits shall be placed above the power conduits in looped radial duct banks and above the 2-in conduits in network duct banks. A 4 ft x 4 ft x 4 ft handhole is required for splicing when specified by the SCL engineer. Provide each communication duct bank with a continuous orange jacketed #12 stranded copper tracer wire installed above the conduits, submerged in the conduit encasement material. Leave 10 feet of each tracer wire coiled at each vault or handhole. If a conduit is terminated outside a vault or handhole, leave 4 feet of each tracer wire coiled in the end of the conduit. If the communication conduits leave the duct bank, they shall be encased in red HSFTB. See U2-11.40/NDK-40 for cleaning, mandreling, and pull tape requirements.

14. Additional Network Conduits

On all new underground network installations of conduits and duct banks, two 2-in PVC conduits shall be installed. The two conduits shall be placed below the communication conduits in network duct banks. The 2-in conduits are typically used for system grounds, vault lighting and vault discharge. If the bend radius is greater than 10 ft, the 2-in PVC conduit may be cold-formed to match the rest of the duct run. If the bend radius is less than 10 ft, RGS elbows are required.

15. References

SCL Construction Standard 0214.00; “Clearances between SCL Underground Structures and Other Utility Structures in the Public Right-Of-Way”

SCL Construction Standard 0222.04; “Duct Bank Reinforcement”

SCL Construction Standard 0222.06; “Duct Bank Terminations”

SCL Construction Standard 0224.07; “Requirements for Secondary Conduit Installation”

SCL Construction Standard 0226.06; “Installation of Fluidized Thermal Backfill”

SCL Construction Standard U2-11.40/NDK-40; “Mandreling and Cleaning of Ducts and Conduits”

SCL Material Standard 7015.05; “Schedule 40 PVC Conduit and Fittings”

SCL Material Standard 7015.80; "Conduit Spacers for PVC and FG Conduit"

SCL Material Standard 7025.05; "Fiberglass Conduit and Fittings, Standard-Wall, Five-Inch IPS"

SCL Material Standard 7050.05; "Zinc-Coated Steel Conduit and Fittings"

SCL Material Standard 7055.09; "DB120, PVC Conduit Fittings"

SCL Material Standard 7150.00; "Fluidized Thermal Backfill"

SCL Material Standard 7150.30; "Controlled Density Fill"

16. Sources

City of Seattle Plans for Municipal Construction; City of Seattle, 2011 edition

Edwards, Tommy; SCL Inspector and subject matter expert for 0222.02

Lu, Curtis; SCL Engineer and originator of 0222.02

Perander, Eivind; SCL North Distribution Engineer and subject matter expert for 0222.02

SCL Construction Standard NDK-10 (canceled) "Installation of Nonmetallic Conduit with FTB Concrete Encasement"

SCL Construction Standard U2-11 (canceled) "Installation of Nonmetallic Conduit with Concrete or FTB Encasement"

Stewart, Bob; SCL Inspector and subject matter expert for 0222.02

Youngs, Rob; SCL Inspector and subject matter expert for 0222.02