SECTION 26 05 44 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Ducts in concrete-encased duct banks.
2. Handholds and handhole accessories.
3. Manholes and manhole accessories.

1.2 SYSTEM DESCRIPTION

A. Interconnected system of encased conduits, ducts, manholes and handholes to distribute power and telecommunications.

B. Conduit and duct routing, manhole, and handhole locations are shown in approximate locations unless dimensions are indicated. Route and locate to complete duct bank system.

C. Use concrete encased rigid steel or concrete encased rigid plastic conduits for all underground ducts.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Manholes.
2. Handholes.
3. Hardware.
4. Conduit and ducts, including elbows, bell ends, bends, fittings, and solvent cement.
5. Duct-bank materials, including spacers and miscellaneous components.
6. Warning tape. Detectable type.

B. Shop Drawings: Show fabrication and installation details for underground ducts and utility structures and include the following:

1. For manholes:
    a. Duct sizes and locations of duct entries.
    b. Reinforcement details.
    c. Manholes cover design and engraving.
    d. Step details.

e. Grounding details.

f. Dimensioned locations of cable rack inserts, pulling-in irons, and sumps.

C. Coordination Detailing Activity Drawings: Show duct profiles and coordination with other utilities and underground structures. Include plans and sections drawn to scale, and show all bends and location of expansion fittings.

D. Product Certificates: For concrete and steel used in underground precast manholes, according to ASTM C 858.

E. Product Test Reports: Indicate compliance of manholes with ASTM C857 and ASTM C858, based on factory inspection.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual routing and elevations of underground conduit and duct, and locations and sizes of manholes and handholes. Provide dimensions off of fixed elements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at Project site as recommended by manufacturer to prevent physical damage.

C. Arrange so identification markings are visible.

D. Lift and support precast concrete units only at designated lifting or supporting points.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving occupied facilities unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.

1. Comply with LAWA power shut-down procedures.

2. Do not proceed with utility interruptions without LAWA's Representative written permission.

1.7 COORDINATION

A. Coordinate layout and installation of ducts, manholes, and handholes with final arrangement of other utilities and site grading, as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes and handholes with

final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to manholes and handholes, and as approved by the LAWA Representative.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Manufacturers:

1. Underground Precast Concrete Utility Structures:
   - **a. Jensen Precast.**
   - **b. Utility Vault Co.**
   - **c. Brooks**
2. Frames and Covers:
   - **a. Alhambra Foundry**
   - **b. Campbell Foundry Co.**
   - **c. East Jordan Iron Works, Inc.**

2.2 DUCTS

A. Rigid Nonmetallic Conduit: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.3 HAND HOLES

A. Cast-Metal Boxes: Cast aluminum, with outside flanges and recessed, gasketed cover for flush mounting and with nonskid finish and legend on cover. Unit, when buried, shall be designed to support AASHTO H10 loading for sidewalk and landscaped areas and HS20 for roadways, parking lots and loading docks.

B. Precast Handholes: Reinforced concrete, monolithically poured walls and bottom, with steel frame and access door assembly as the top of handhole. Duct entrances and windows shall be located near corners to facilitate racking. Pulling-in irons and other built-in items shall be installed before pouring concrete. Cover shall have nonskid finish and legend. Unit, when buried, shall be designed to support AASHTO H10 loading for sidewalk and landscaped areas and HS20 for roadways, parking lots and loading docks. Cover Legend: All underground pull box covers shall have the following cast-in or bead welded and galvanized identification label permanently affixed to the exterior:

1. “ELEC-LV” for electrical power circuits 600 volts or less.
2. “ELEC-HV” for electrical power circuits over circuits over 600 volts.
3. “COMM” for communications circuits.

4. A custom 3-digit number shall be added to the cover. Contact the LAWA Engineer for number assignment. The minimum letter height shall be one (1) inch.

2.4 PRECAST MANHOLES

A. Precast Units: Interlocking mating sections, complete with accessories, hardware, and features as indicated. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Entry way diameter: 36 inches minimum.

C. Design and fabricate structure according to ASTM C858.

D. Structural Design Loading: ASTM C857, Class A-16 (AASHTO HS20).

E. Base section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

F. Riser Sections: 4-inch minimum thickness, and lengths to provide required depth.

G. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.

H. Steps: ASTM A615, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 36 inches. Adjust to custom manhole locations.

I. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.

J. Joint Sealant: ASTM C990, bitumen or butyl rubber.

K. Protective Coating: Plant-applied, coal-tar, epoxy-polyamide paint 15-mil minimum thickness applied to exterior and interior surfaces.

L. Source Quality Control: Inspect structures according to ASTM C1037.

M. Access Ladder: Provide permanent metal access ladder.

2.5 ACCESSORIES

A. Duct Spacers: Rigid PVC interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts.

B. Manhole Frames and Covers: Comply with AASHTO loading specified for manhole; Ferrous frame 36 inch clear ID by 6 inch minimum riser with 4-inch-minimum width flange

and 38-inch-diameter cover.

1. All manhole and underground pullbox covers shall have the following cast-in or bead welded and galvanized identification label permanently affixed to the exterior:
    a. "ELEC-LV" for electrical power circuits 600 volts or less.
    b. "ELEC-HV" for electrical power circuits over circuits over 600 volts.
    c. "COMM" for communications circuits.
    d. A custom 3-digit number shall be added to the cover. Contact the LAWA Engineer for number assignment. The minimum letter height shall be one (1) inch.
2. Cast iron with cast-in legend as indicated above subsection 1: Milled cover-to-frame bearing surfaces.
3. Manhole Frames and Covers: ASTM A48; Class 30B gray iron, 36-inch size, machine-finished with flat bearing surfaces.

C. Sump Frame and Grate: ASTM A48, Class 30B gray cast iron.

D. Pulling Eyes in Walls: Eyebolt with reinforcing-bar fastening insert 2-inch- diameter eye and 1-by-4¬inch bolt.
1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.

E. Pulling and Lifting Irons in Floor: 7/8-inch- diameter, hot-dip-galvanized, bent steel rod; stress relieved after forming; and fastened to reinforced rod. Exposed triangular opening.
1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

F. Bolting Inserts for Cable Stanchions: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

G. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

H. Cable Stanchions: Hot-rolled, hot-dip-galvanized, T-section steel; 2-1/4-inch size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.

I. Cable Arms: 3/16-inch- thick, hot-rolled, hot-dip-galvanized, steel sheet pressed to channel shape; 12 inches wide by 14 inches long and arranged for secure mounting in horizontal position at any location on cable stanchions.

J. Cable-Support Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

K. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of

withstanding temperature of 300 deg F without slump and of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

L. Warning Tape: Provide underground-line detectable warning tape specified under section "Identification for Electrical Systems."

2.6 CONSTRUCTION MATERIALS

A. Seal manhole section joints with sealing compound recommended by the manhole manufacturer.

B. Damp proofing: Comply with "Bituminous Damp proofing."

C. Mortar: Comply with ASTM C270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C387, Type M, may be used.

D. Brick for Manhole Chimney: Sewer and manhole brick, ASTM C32, Grade MS.

E. Concrete: Use 3000-psi- minimum, 28-day compressive strength and 1-inch maximum aggregate size.

F. Provide red dye added to concrete during batching.

PART 3 - EXECUTION

3.1 APPLICATION

A. Underground Ducts for Electrical Cables Higher than 600V: Type EPC-40-PVC, concrete-encased duct bank.

B. Manholes: Underground precast concrete utility structures.

C. Manholes: Cast-in-place concrete.

3.2 EARTHWORK

A. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Soil compaction at all locations shall be as specified by civil and structural specifications.

B. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

C. Restore disturbed pavement.

3.3 CONDUIT AND DUCT INSTALLATION

A. Exercise care in excavating, trenching, and working near existing utilities. Locate any existing buried utilities before excavating.

B. Duct bank trench shall be shored, framed and braced for installing ducts. Frames, forms, and braces shall be either wood or steel. Variations in outside dimensions of the installed duct bank shall not exceed 2 inches on the vertical or the horizontal from the design. Remove forms and bracing after 24 hours and before backfilling.

C. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions. Duct banks shall be laid to a minimum grade slope of 4 inches per 100 feet. This slope may be from one manhole to the next or both ways from a high point between manholes, depending upon the contour of the finished grade.

D. Duct banks shall be installed so that the top of the concrete encasement shall be no less than 36 inches below grade or pavement for primary power. As a general rule, depths shall be a minimum of three feet, but not more than six feet.

E. Curves and Bends: Use manufactured 48 inches minimum elbows for stub-ups at equipment, and enclosures, and at building entrances. Use manufactured long sweep bends with a minimum radius of 4 feet minimum, both horizontally and vertically, at other locations. Manufactured long radius bends may be used in runs of 100 feet or less on approval from the LAWA's representative. Vertical feeder sweep into buildings shall be coated steel. Multiple conduit sweeps shall be concentric and maintain spacing throughout. Medium-voltage conduit sweeps shall be 12' minimum radius sweeps.

F. Use solvent-cement joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

G. Duct Entrances to Manholes and Handholes: Space end bells approximately 10 inches o.c. for 5-inch ducts and vary proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances. Where connection to bulkhead of duct bank is made to vaults or existing duct banks, the concrete encasement shall be doweled with on No. 4 reinforcement rod 36 inches long per conduit to the existing encasement.

H. Building Entrances: Make a transition from underground duct to rigid steel conduit 5 feet outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:

1. Concrete-Encased Ducts: Install reinforcement in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall. Expand duct bank at building entry to provide 6" spacing between sealing system sleeves. Coordinate sleeve placement with structural reinforcement bar placement.

2. Provide methane penetration EYS sealing fitting at each conduit penetration into

building – both vertical and horizontal. Arrange so that sealant parts remain accessible.

3. Waterproofed Wall and Floor Penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight. Seals shall be Link Seal Assembly with precast 'CS" model – non-metallic sleeve by Link Seal or equal.

I. Concrete-Encased, Nonmetallic Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators 6'-0" O.C. to prevent sagging and deforming of ducts and secure separators to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Duct joints in concrete may be placed side by side horizontally, but shall be staggered at least 6 inches vertically. Joints shall be made in accordance with manufacturer's recommendations for the particular type of duct and coupling selected. In the absence of specific recommendations, plastic duct connections shall be made by brushing a plastic solvent cement on the inside of a plastic coupling fitting and on the outside of duct's ends. The duct and fitting shall then be slipped together with a quick one-quarter turn to set the joint.

3. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application. Pour each run of envelope between manholes or other terminations in one continuous operation. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope. At connection to manholes, dowel concrete encasement with on No. 4 reinforcing bar 36 inches long per duct.

4. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.

5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.

6. Minimum Clearances between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.

7. Depth: Install top of duct bank at least 24 inches below finished grade in no traffic areas and at least 30 inches below finished grade in vehicular traffic areas, unless otherwise indicated.

J. Direct-Buried Ducts: Direct-Buried Ducts are for temporary construction only and only as determined and approved by LAWA. Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators not more than 4 feet center-to-center along entire length of duct bank including top pipes.
2. Install expansion fittings as required.
3. Trench Bottom: Continuous, firm, and uniform support for duct bank. Prepare trench bottoms for pipes less than 6 inches in nominal diameter.
4. Backfill: Install backfill. After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, complete backfilling normally. Do not place backfill for a period of at least 24 hours after pouring of concrete.
5. Minimum Clearances between Ducts: 3 inches between ducts for like services and 6 inches between power and signal ducts.
6. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.

K. Warning Tape: Bury metal backed detectable warning tape approximately 12 inches above all concrete-encased duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank.

L. Stub-ups: Use rigid steel conduit for stub-ups to equipment. For equipment mounted on outdoor concrete bases, extend steel conduit a minimum of 5 feet from edge of base. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete. Galvanized steel conduits installed below grade shall be painted with two coats of Koppers Bitumastic paint before installing in ground.

M. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

N. Pulling Cord: Install 100-lbf- test nylon cord in all ducts, including spares. Identify opposite terminal points of duct.

3.4 MANHOLE AND HANDHOLE INSTALLATION

A. Elevation: Install manholes with rooftop at least 15 inches below finished grade. Install

handholes with depth as required. Place and align precast manholes to provide horizontal tolerance of 2 inches in any direction and vertical alignment with not greater than 1/8 inch maximum tolerance for 6 foot of depth. Completed manhole shall be rigid, true to dimensions and alignment, and shall be watertight.

B. Drainage: Install drains in bottom of units where indicated. Coordinate with drainage provisions indicated. Sumps shall be knocked out at time of installation.

C. Access: Install cast-iron frame and cover.

1. Install precast collars and rings to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

2. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch above finished grade.

D. Waterproofing: Apply waterproofing to exterior surfaces of units after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole and hand hole chimneys after brick mortar has cured at least three days. Seal manhole section joints with sealing compound recommended by the manhole manufacturer. Penetration into manholes and/or boxes shall be sealed. Provide conduit duct plugs for unused terminator openings of spare conduits in manhole. Do not water seal top removable cover until cable pulling has been completed.

E. Damp proofing: Apply damp proofing to exterior surfaces of units after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, damp proof joints and connections and touch up abrasions and scars. Damp proof exterior of manhole and hand hole chimneys after brick mortar has cured at least three days.

F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

G. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

H. Grounding: Install ground rod through floor in each structure with top protruding 6 inches above floor.

1. Seal floor opening against water penetration with waterproof nonshrink grout. Ground exposed metal components and hardware with bare-copper ground conductors. Train conductors neatly around corners. Use cable clamps secured with expansion anchors to attach ground conductors.

I. Precast Concrete Manhole Installation: comply with ASTM C 891.

1. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.

2. Unless otherwise indicated, support units on a 12” level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth. Provide a minimum 6-inch level base of ¾ inch crushed rock under manhole to ensure uniform distribution of soil pressure on floor.

3. Manholes below building floor shall have all earth work compacted to match compaction required by structural specifications.

3.5 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

B. Grounding: Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance .

C. Duct Integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of the duct. If obstructions are indicated, remove obstructions and retest.

D. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

END OF SECTION 26 05 44