

CITY OF LOS ANGELES
DEPARTMENT OF WATER AND POWER
POWER ENGINEERING DIVISION
DISTRIBUTION ENGINEERING SECTION



**UNDERGROUND CONDUIT AND SUBSTRUCTURES
SPECIFICATION NO. 104**

(REVISED 11/07/2025)

Questions regarding Specification No. 104 may be directed to the Underground Structures Utility Coordination Group via email at dwpps.coordination@ladwp.com

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SECTION 1 – TERMS, DEFINITIONS, AND ABBREVIATIONS

Brown Book – Latest edition, with amendments, of the Standard Specifications for Public Works Construction (Greenbook) adopted by the City of Los Angeles Board of Public Works (LABPW).

CalOSHA - California Division of Occupational Safety and Health Administration

Caltrans - California Department of Transportation

City – City of Los Angeles

Contractor – The individual or company that will perform the work as specified on the permit and design documents.

Department – Los Angeles Department of Water and Power.

Department Engineer – The engineer of record for any Department design.

Department Representative – Department personnel responsible for approving coordinating, reviewing, designing, approving design changes, and/or approving field changes.

Greenbook – Latest edition of the Standard Specifications for Public Works Construction (Greenbook) as adopted according to the Brown Book, latest edition.

Public Right-of-Way – Refers to any land, property, or interest therein owned by a city, town, or state, which is available for use by the general public. This includes but is not limited to public streets, alleys, sidewalks, bicycle lanes, and pedestrian pathways.

Substructure – Any underground structure providing easy access points for maintenance, inspection, and management of underground equipment and utility. This includes, but is not limited to, Hand Holes, Maintenance Holes, Switchpads, Transformer Pads, and Vaults.

Substructure Standards Engineer – The Department Engineer responsible for the creation and modification of Department Specifications and Standards.

Switchpad (SP) – Reinforced concrete pad used to support and anchor an above ground mounted switchgear.

Transformer Pad (TP) – Reinforced concrete pad used to support and anchor an above ground mounted transformer.

CL – Centerline
CSA – Canadian Standards Association
DE – Dead End
DWP – Department of Water and Power
DWPPS – Department of Water and Power, Power System
DWPWS – Department of Water and Power, Water System
F – Fiber
HH – Hand Hole
HW – Heavy Wall
MH – Maintenance Hole
NEMA – National Electrical Manufacturers Association
P – Plastic (PVC – Polyvinyl Chloride)
PB – Pull Box
PL – Property Line
PVC – Polyvinyl Chloride Pipe
RCB – Reinforced Concrete Box
RCP – Reinforced Concrete Pipe
RTRC – Reinforced Thermosetting Resin Conduit
SCG – Southern California Gas Company (SoCal Gas)
SD – Storm Drain
SL – Street Light
SP - Switchpad
SS – Sanitary Sewer
TP – Transformer Pad
TS – Traffic Signal
UL – Underwriter Laboratories
UG – Underground
VL - Vault

SECTION 2 – GENERAL PROVISIONS

- 2.1 The following underground substructure and conduit specifications are intended for underground circuits rated up to 34.5 kV. Underground circuits rated at higher voltages, are under the jurisdiction of the Underground Transmission Engineering Group.
- 2.2 **Order of Precedence of Documents.** In the event of conflicts, the documents shall govern in the following order of precedence:
- 1) Permits from other agencies as may be required by law.
 - 2) Applicable codes from other agencies as may be required by law, including but not limited to Los Angeles Municipal Code (LAMC) Chapter VI, Article 2, Sections 62.00-62.05; California Public Utilities Commission (CPUC) General Order No. 128; CalOSHA.
 - 3) Submittals approved by a Department Engineer or Department Representative.
 - 4) Design documents.
 - 5) Specification 104 as specified herein.
 - 6) Any applicable standards from the LADWP Common Service and Construction Standards (See [Subsection 2.3](#)).
 - 7) **For installation on Public Right-of-Way:** Latest edition adopted by the City of Los Angeles of the Standard Specifications for Public Works Construction (Greenbook) and as amended by the adopted Department of Public Works Brown Book.
 - 8) **For installation on private property:** Latest edition of the Department's Electric Service Requirements (See [Subsection 2.6](#)) and the Los Angeles Department of Building and Safety (LADBS) requirements, latest editions, where applicable.
 - 9) Field notes, checklists, or other items provided by the Department Representative.
- 2.3 **Standards and Codes.** All construction shall comply with the Department's Construction Standards and all the requirements specified herein. Department Standards and Codes can be found at the following website: www.ladwp.com/codes
- 2.4 **Inspection and Notification.** All underground structures and conduits shall be properly inspected by a Department Representative. Refer to [Section 3 – Inspection](#), for more details regarding inspection and notification requirements.

- 2.5 **Street Restoration.** For protection and restoration of existing improvements, all conduit and substructure installation in the public right-of-way shall meet the requirements of the Greenbook, Part 4, Section 400, Protection and Restoration of Existing Improvements, and applicable sections of the latest revision of the adopted Brown Book and any additional permit requirements.
- 2.6 **Private Property.** Additional requirements may be required within Private Property, contact LADWP Electric Service Representative "ESR" for installation requirements and refer to Electric Service Requirements Manual at: www.ladwp.com/codes

SECTION 3 – INSPECTION

- 3.1 **Contact Information.** Contact a Department Representative at the telephone number noted on the construction drawing(s) or as noted below:

For installation within Private Property:
Contact the assigned Electric Service Representative (ESR).
Visit: www.ladwp.com/find-right-person

For installations within Public Right-of-Way:
Contact the Underground Structures Utility Coordination Group.
Email: dwpps.uginspection@ladwp.com

- 3.2 **Pre-Construction Notification.** The Department shall be notified at least five (5) full business days prior to the start of construction activities. A Pre-Construction meeting shall be scheduled with a Department Representative. Contractor shall coordinate all other inspections with each governing agency, as required by permit(s).
- 3.3 **Inspection Hours.** On-site inspections performed by the Department Representative will be made between the hours of 9:00 am and 2:00 pm Monday through Friday. Inspections shall be requested at least two (2) full business days in advance.
- 3.3.1 **Special Inspection.** Special inspection, including nights and weekends, outside the normal business days and/or hours may be arranged by notifying the Department at least five (5) full business days in advance of the inspection date. The Contractor shall be required to pay any premium time charges that may be incurred by the Department Representative. A minimum of 4-hours shall be charged and travel time shall be included. Final acceptance of the project may be delayed if the Department does not receive reimbursement for the premium charged.
- 3.3.2 **Emergency Inspection.** In the event of an emergency, the Contractor may request special inspection, without advance notification. The Contractor may be required to sign a written agreement obligating them to pay for any premium time charges incurred due to the requested special inspection. Final acceptance of the project may be delayed until the Department receives reimbursement for the premium charges.
- 3.4 **Inspection Requirements.** At a minimum, the following must be inspected by the Department Representative prior to proceeding with construction. Additional inspections may be required by the Department Representative or requested by the Contractor.

- 3.4.1 **Material Inspection.** All materials shall be made available for inspection, upon request from the Department Representative. Product cut sheets and delivery tickets may also be requested and shall be provided by the Contractor.
- 3.4.2 **Conduit Inspection.** All conduits shall be inspected by a Department Representative prior to concrete encasement and/or backfill. If the conduit is encased or the trench is backfilled before the conduit has been inspected and approved, the Contractor shall be required remove and reconstruct, at the Contractor's expense.
- 3.4.3 **Precast Substructure Inspection.** When a substructure is specified, the structure shall not be installed until it has been inspected and approved by the Department Representative. Substructures may be rejected at any time prior to the final installation of cables or equipment.
- 3.4.3.1 Prior to installation of a structure the excavation and base material shall be made available for inspection.
- 3.4.3.2 All substructures shall be inspected prior to and during installation. If the structure is installed and backfilled prior to inspection from the Department Representative, the Contractor shall be required to remove and replace the structure, at the Contractor's expense.
- 3.4.4 **Mandrel Inspection.** Prior to final resurfacing over the installed conduit duct-bank a cylindrical mandrel as specified in Department's Standard Drawing No. 2-210 shall be drawn by hand through each duct (in both directions) without any mechanical assistance after conduit encasement. The Contractor shall be responsible for removing any obstacles found or replacing any duct section through which the mandrel will not pass. Replaced or repaired conduit shall be made available for inspection before encasement in concrete or backfilling. All conduits in that duct bank shall be re-mandrelled after encasement or backfilling.
- 3.5 **Permit Inspection Requirements.** The Contractor shall notify any relevant agencies prior to the start of construction and daily thereafter. This includes, but is not limited to, the City of Los Angeles Department of Public Works and the Bureau of Contract Administration for work conducted within the City of Los Angeles right-of-way (ROW), and Caltrans for construction activities within their respective ROW. The Contractor shall refer to the applicable permit for the appropriate contact information.

SECTION 4 – SURVEY

- 4.1 **Public Right-of-Way and Easement Areas.** Prior to construction, the Contractor shall have the entire construction area and the limits of excavation marked as specified in the construction drawings laid out by a land surveyor licensed in the State of California.
- 4.1.1 The Contractor shall maintain all survey marks required to complete the construction. The Contractor's surveyor shall be required to replace missing or damaged survey marks. For projects constructed under permit the Contractor shall also be responsible for the preservation of survey monuments and benchmarks.
 - 4.1.2 The Contractor shall obtain a copy of the surveyor's field notes and must provide to the Department Representative upon request.
 - 4.1.3 The Department Representative may request the construction be surveyed at the end of construction prior to final acceptance.
 - 4.1.4 **Easement Areas.** Extent of Easement Areas shall also be surveyed. The Department Representative may request a copy of the surveyor's field notes for any work performed within the easement.

SECTION 5 – EXCAVATION

5.1



DigAlert. The Contractor shall notify DigAlert (also known as Underground Service Alert or USA) at 811 or online at digalert.org prior to start of any excavation. Contractor shall comply with all California State Law as stated in CA Government Code 4216.

5.2 **Exploration.**

5.2.1 The Contractor shall explore for the location and depth of all existing underground infrastructure and utilities' mainlines such as sewers, storm drains, gas, telephone, water, other electric facilities, etc. If an unknown utility is found, the Contractor shall identify the utility, note its location on the as-built plan, and coordinate the relocation or removal of the utility, if needed.

5.2.2 Underground utility service connections are not shown on the Department's construction drawings. The Contractor shall assume that every property parcel is being served by a utility service connection for, but not limited to; telephone, water, gas, sewer, cable television, and electric power.

5.2.3 The Contractor, at the Contractor's expense, shall determine the location and actual depth of all utilities, including service connections and other substructures shown on the construction drawings far enough in advance of the actual conduit construction to facilitate decisions concerning the necessity for conduit to go either over or under these substructures in accordance with [Subsection 9](#).

5.2.4 The Contractor should expect abnormal substructure depths at all roadway intersections.

5.3 **Trench Excavation.** Trench excavation shall meet the requirements of the Greenbook, Part 3, Section 306-3 Trench Excavation, except as modified herein and excluding Sections 306-3.4, Minimum and Maximum Pipe Zone Trench Width, and 306-3.2, Removal of Surface Improvements.

5.3.1 **Trench Alignment.** The Contractor shall perform trench excavation to the lines and grades shown on the drawings and as specified herein. If deviations from the drawing alignment are found to be necessary, they must be approved by the Department Representative.

5.3.2 **Trench Bottom.** Trench bottom shall be smooth, level, and free from debris. Refer to [Subsection 5.8](#) for conditions with Unsuitable Soil.

- 5.3.3 **Trench Width.** The maximum trench width shall be determined by the number of columns of conduit in the duct bank (i.e., 24 inches for 1- or 2-wide and 30 inches for 3-wide) unless otherwise specified on the drawings or as approved by the Department Representative. Trenches exceeding the maximum width shall be formed to maintain the required concrete encasement.
- 5.4 **Supporting Existing Underground Utilities or Substructures.** Underground utilities or substructures encountered during the trench excavation shall be temporarily or permanently supported as required by the owner of the substructures or the governing agency. Damage to underground utilities or substructures shall be repaired at the Contractor's expense.
- 5.5 **Abandonment of Existing Utilities.** The Contractor shall confirm the abandonment of an existing utility with the appropriate utility owner. Interfering portions of abandoned pipes, culverts, and conduits that are four (4) feet diameter or less shall be cut, removed, and plugged in accordance with the applicable regulations (refer to Greenbook, Part 3, Section 306-3.3, Removal and Abandonment of Existing Conduits and Structures, and as modified by the Brown Book). For larger openings, details of the seal shall be shown on the plans.
- 5.6 **Removal of Surface Improvements.** Bituminous pavement, concrete pavement, curbs, sidewalks, or driveways removed in or adjacent to public right-of-way in connection with construction, shall be removed in accordance with Greenbook, Part 3, Section 306-3.2, Removal of Surface Improvements, except as modified herein.
- 5.6.1 Pavement shall first be saw cut before removing.
- 5.6.2 Sidewalk shall be cut at scoring lines.
- 5.6.3 The Contractor shall place and maintain temporary resurfacing and striping on all excavations in paved streets and sidewalks. The maintenance of temporary resurfacing shall continue until permanent resurfacing is placed.
- 5.7 **Classification.** All excavated materials shall be considered unclassified in accordance with Greenbook, Part 3, Section 300-2.
- 5.8 **Unsuitable Soil.** Where soft, spongy, unstable, or other similarly unsuitable sub-grade material is encountered upon trenching operations for installation of conduit or for placement of pre-cast concrete substructures, the contractor shall remove the unsuitable sub-grade material to a depth as ordered by the Department Representative. Any void thus created shall be refilled with crushed rock, meeting the gradation requirements of Greenbook, Part 2, Section 200- 1.2, for 3/4-inch crushed aggregate. After placement, the rock shall be tamped or vibrated as needed to achieve a minimum 90% compaction. The contractor may be required to provide compaction report(s)

prepared by a certified testing laboratory. The material compaction test(s) shall be in accordance with Sand-Cone Method, ASTM D1556, and Modified Proctor Compaction Test, ASTM D1557.

- 5.9 **Bracing Excavations (Trench Shoring).** Excavations shall be braced in accordance with the manufacturer's tabulated data, Greenbook, Part 3 Section 306-4, CalOSHA, and applicable permit requirements.

SECTION 6 – SUBSTRUCTURE INSTALLATION

- 6.1 **Inspection.** Pre-cast concrete substructures shall not be installed until they have been inspected and approved by the Department Representative. Poured-in-place substructures shall be inspected and approved during all stages of construction. Refer to [Section 3 – Inspection](#), for detailed inspection instructions.
- 6.2 **Specifications and Standards.** All pre-cast concrete substructures (hand holes, maintenance holes, transformer pads, and vaults) shall comply with the Department's standard drawings and shall be subject to inspection by the Department Representative prior to, during, and after installation.
- 6.3 **Existing Substructures.** Any existing substructure owned by the Department, or in which the Department maintains cables and/or equipment, shall not be opened unless specifically authorized by, and in the presence of, the Department Representative.
- 6.4 **Methane and Methane Buffer Zones.** All underground substructures and conduits placed in known methane gas areas (as identified by the Bureau of Engineering (BOE), Los Angeles Department of Building and Safety (LADBS), or the Developer), shall satisfy the requirements of the Department's Standard Drawing(s) H-242, 1-802.2, 1-804, and 1-806, latest revisions.
- 6.5 **Precast Substructures.** All pre-cast concrete substructures shall comply with the Department's latest revision of Specification P-178, Standard Specifications for Substructures: Precast Concrete.

Manufacturer Requirements

- 6.5.1 **QA Repair Report.** Each pre-cast concrete substructure delivered to a construction site shall have a quality assurance (QA) repair report from the manufacturer. This report shall be provided to the Department Representative at their request.
- 6.5.2 **Curing Time.** All pre-cast concrete structures shall be installed no earlier than seven (7) calendar days after the date the concrete, of which they are constructed, is poured.
- 6.5.3 **Markings.** All pre-cast concrete sections of substructures shall have paint markings stenciled on the inside and outside of each section. The stenciled markings shall indicate the manufacturer's name, identification number, Department standard number, date of pour, and the designation "DWP/FA-CN" (FA=Fly Ash, CN=Calcium Nitrate) or "DWP/F-CN-SC" (F=Fly Ash, CN=Calcium Nitrate, SC=Self-Consolidating Concrete). Also, the manufacturer's name, the

year, and the designation "FA-CN" or "F-CN-SC" shall be cast inside of each piece of the substructure. All markings shall be clear, legible, and durable.

- 6.5.4 **Design and Drawings.** The design, calculations, and shop drawings of any pre-cast concrete substructure shall be approved by the Department prior to fabrication. All materials used for the fabrication of pre-cast concrete substructures shall be reviewed, tested, and approved by the Department.
- 6.5.5 **Inspection.** All pre-cast and poured-in-place substructures placed in public right-of-way shall be subject to approval by the City of Los Angeles Department of Public Works or governing agency such as Caltrans. All concrete substructures placed in private property shall be approved by the Electric Service Representative "ESR" and the Department of Building and Safety. Certificates of approval and/or a building permit may be required from the Contractor for any pre-cast or poured-in-place concrete substructure.

Installation Requirements.

- 6.5.6 Pre-cast concrete vaults, maintenance holes, and hand-holes shall be set on well compacted soil with 6-inch minimum depth of tamped/compacted crushed aggregate base, meeting the requirements of Greenbook, Part 2 Section 200-2.2 and all sumps and floor knockouts (other than those which facilitate the installation of ground rods) shall be left sealed.
- 6.5.7 Pre-cast transformer pad and switch pad shall be set on 6 inches of compacted 1" crushed rock, type A or concrete aggregate No.3, type B base, meeting the requirements of Greenbook, Part 2, Sections 200-1.2 and 200-1.4.
- 6.5.8 All vaults, maintenance holes, and handholes shall be placed in areas where the substructures are not subjected to surcharges other than backfill around the substructure. Adjacent retaining walls, foundations, or footings must be designed such that their loading does not affect the structural integrity of the Department's substructures. Designs likely to create additional surcharge must be approved by the Department of Building and Safety in private property and the Department of Public Works for structures in the public right-of-way and shall require acceptance by the Department.
- 6.5.9 Chipping or core drilling of any pre-cast concrete substructure, except at designated knockout locations, shall not be allowed unless the Contractor has the approval of the Department's Substructure Standards Engineer.
- 6.5.10 No foreign substructure or utility line shall enter any part of any Department substructure.

- 6.5.11 All vaults and maintenance holes shall have a minimum cover of 24 inches below finish surface. This minimum may be increased due to site specific requirements refer to [Appendix II, Table 2](#). Any variance from these limits will require the approval of the Department Substructure Standards Engineer unless otherwise noted on the construction drawings.
- 6.5.12 **Pre-cast Transformer Pads and Switch Pads.** Grade rings shall be used on all pre-cast transformer pads and switch pads on private property to achieve a minimum of 30 inches of cover measured from public right-of-way gutter grade to top of duct bank encasement at the property line.
- 6.5.13 **Hand Holes.** Grade rings shall be used on all pre-cast hand-holes to achieve a minimum of 30 inches of cover measured from public right-of-way gutter grade to top of duct bank encasement at the property line. Any variance from Standards Engineer. See the applicable standard (e.g., E-459, E-491, etc.) for additional information.

Water Proofing

- 6.5.14 When pre-cast concrete substructures are installed in high water table areas, the Department Representative may require that two layers of mastic tape be placed at all the joints and gaps between the pre-cast substructure panels or sections. If waterproofing of an entire substructure is required, an approved moisture barrier shall be applied to substructure prior to installation. Coating shall be applied by the coating manufacturer to the outside surface of the substructure at the precast manufacturer's plant and to the joints during field installation. All waterproofing shall be applied in accordance with the waterproofing manufacturer's recommendations for the field conditions present.
- 6.5.15 Substructures shall not be set in an area where excess surface or landscaping water accumulates. Use of electric sump pumps to drain the excess water is not allowed.
- 6.5.16 The grading around all substructures shall be configured in such a way that all surface water will be drained away from the substructures.
- 6.5.17 The landscaping and grading plans around the substructures shall be reviewed and approved by the Department Engineer for acceptable drainage and avoidance of potential water collection areas prior to the start of construction.
- 6.6 **Poured-in-place Substructures.** In the event a poured-in-place substructure is required, the request shall be reviewed and approved by the Department Representative and Substructures Standards Engineer. Poured-in-place substructures shall be subject to inspection by the Department Representative prior to and during construction.

6.7 Access Requirements.

- 6.7.1 There shall be a minimum clearance of 18 inches horizontally between the substructure (maintenance hole, vault, handhole) and other utilities. The required clearance for vaults, maintenance holes, and hand-holes away from any building, building projection, or overhang (such as a balcony), shall be a minimum of 2 feet from the vertical projection of the closest wall of the substructure. Adequate clearances shall remain in place to facilitate future maintenance, repairs, and the replacement of the substructure. For the clearance requirements around transformer pads see the Department's Standard Drawing No. C721-01.
- 6.7.2 All substructures located in private property shall be accessible to the Department's trucks by means of a clear and unobstructed path from the street to the structure with a minimum width of 12 feet, unless otherwise specified. Minimum vertical clearance above the path shall be 14 feet. The path paving must be capable of withstanding truck weights of 24 tons.
- 6.7.3 If the path requires any turns by the Department trucks, the minimum required clearances might be increased to allow for adequate curve radiuses and clear areas for the trucks to make the turn. Consult the Department Engineer when such a situation is anticipated.
- 6.7.4 Trees, plants, and shrubs on or around the Department substructures shall not restrict access to the substructure for maintenance. Trees shall be planted at least 7 feet clear to all sides of the substructure. Trees and plants shall be planted so that their growth does not apply unintended pressure causing possible damage to the Department substructure. Any planting area that is not in compliance with these requirements may be removed without notice at the owner's expense.

6.8 Grading Requirements.

- 6.8.1 Head castings, hand hole covers, and transformer pads shall be set to final or required finish grade, by the Contractor, prior to completing the final grading of adjacent unpaved areas.
- 6.8.2 **Roadway Areas.** All substructure frames and covers located in roadway areas shall be adjusted to match required finish grade. The grade shall be set to match the crown and grade of the surrounding roadway. Vault and maintenance hole castings shall be adjusted to grade in accordance with the Department's Standard Drawings 1-802 and 1-802.1, latest revision.

6.8.3 **Parking Areas.** All substructure frames and covers located in parking areas shall be adjusted to match required grade. The grade shall be set such that the surrounding surface, immediately adjacent to the structure and for a distance of 3 feet minimum (measured perpendicular to the edge of the structure), can be sloped away at a rate of 1/2 inch per 10 feet of run. The contractor shall set the structure to the required grade prior to completing the final paving.

6.8.4 **Sidewalk and Parkway Areas.** All substructure frames and covers located in sidewalk or parkway areas shall be adjusted to meet grade from top of curb to edge of sidewalk.

6.8.5 **Planter and Unimproved Areas.** All substructure frames and covers located in planter areas (not accessible to pedestrian traffic) shall be adjusted such that their top surface is two (2) inches above final grade of the surrounding ground.

6.8.5.1 Substructures installed in unpaved and planter areas shall have a concrete collar constructed as shown on the Department's Standard Drawing H-168, latest revision.

6.9 **Final Requirements.**

6.9.1 All water and debris must be removed from newly installed vaults, maintenance holes, handholes, and transformer pad handholes prior to final acceptance.

6.9.2 **Terminators.** All gaps exceeding 1/8 inch between ends of conduits, which have been glued into place, and the abutment step in plastic terminators cast into substructure end-walls and side-walls, shall be filled with red body putty (Bondo) or equivalent, and made smooth to the satisfaction of the Department Representative. Construction grout is not an acceptable substitute for Bondo.

6.9.3 **Grounding.**

Vaults, Maintenance Holes, and Hand Holes. The Contractor shall install 5/8-inch diameter by 8-foot long, 304 Stainless Steel ground rods in each substructure. The number and location of ground rods shall be as shown on the Department standard drawing or as required by the Department Representative.

Transformer Pads and Switch Pads. The number and location of ground rods and ground wire shall be as shown on the Department standard drawings or as required by the Department Representative.

6.9.4 Ladder Installation. The substructure ladder and hanging hardware assembly shall be installed to face oncoming vehicular traffic unless otherwise instructed by the Department Representative. In the event that the direction of oncoming traffic is not immediately apparent, or more than one traffic direction is possible, the Department Representative will determine which side the ladder and hanging hardware assembly shall be installed.

SECTION 7 – SUBSTRUCTURE VENT INSTALLATION

- 7.1 **Inspection.** Substructure vents shall not be backfilled until they have been inspected and approved by the Department Representative. Refer to [Section 3 – Inspection](#), for detailed inspection instructions.
- 7.2 **Materials.** All vent pipes and accessories shall be 12-inch diameter PVC sewer pipe in accordance with ASTM D3034, Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, latest revision.
- 7.3 **Maximum Bends.** There shall not be more than two 90-degree bends, including the vertical bend, in any vent pipe installation, unless approved by the Department Representative.
- 7.4 **Maximum Distance.** Vent outlets shall be located in the closest sidewalk or planter area to the substructure. Piping for single vent should not exceed 30 feet in length, unless approved by the Department Representative.
- 7.5 **Minimum Space.** Vent outlet covers shall be installed with a minimum separation of 5'-0" from center to center.
- 7.6 **Slope Requirements.** All pipe installed shall maintain a minimum grade such that any water intrusion flows into the substructure to avoid ponding in the pipe.
- 7.7 **Standpipe Vent.** All vent outlet covers located in pedestrian sidewalks, planter areas, or unimproved areas shall be the architectural standpipe type in accordance with the Department's Standard Drawing No. C730-10, latest revision.
- 7.8 **Flush Mount Vents.** In the event stand pipe vents cannot be installed within the public right-of-way, flush mount vents may be required. Flush mount vent installation is subject to the sole discretion and approval of the Standards Engineer. All flush mount vents shall be installed in accordance with the Department's Standard Drawing No. C730-09, latest revision. All flush mount type vent outlet covers, shall be placed away from any water runoff. If they are located in planter or unimproved areas, they shall be placed two (2) inches above the surrounding finished grade. Flush mount vents shall not be installed within private property.
- 7.9 **Number of Vents.** Vents shall be installed in pairs unless otherwise specified on the approved Department drawing. Vent knockouts shall have the same number of high elevation knockouts and low elevation knockouts, unless otherwise approved by the Department Representative.
- 7.9.1 **Methane Zones.** All structures shall meet vent requirements as specified in H-242.

SECTION 8 – SUBSTRUCTURE AND VENT BACKFILL

- 8.1 **General.** Backfill around new and existing structures shall be considered structure backfill in accordance with the requirements of Greenbook, Part 3, Section 300-3, Structure Excavation and Backfill (Excluding Sections 300-3.2 and 300-3.6), except as modified herein:
- 8.2 **Inspection.** Substructures and vents shall not be backfilled until they have been inspected and approved by the Department Representative. A minimum of 2 hours is required after encasement is poured before the backfill or as required by the Department Representative. Refer to [Section 3 – Inspection](#), for detailed inspection requirements.
- 8.3 **Public Right-of-Way**
- 8.3.1 **City Property.** When a structure is to be located in dedicated City property, structure backfill shall be 100-E-100 (See [Appendix II, Table 1](#)), in accordance with Greenbook, Part 2, Section 201-1, Table 201-1.3.3 for Trench Backfill.
- 8.3.2 **Public Right-of-Way.** When a structure is to be located in dedicated public right-of-way, but is not within the City limits, structure backfill shall follow the standards and requirements of the governing agency, unless otherwise specified in the permit.
- 8.3.3 **State of California Property.** When a structure is to be located in the State of California Right-of-Way, whether it is subject to vehicular traffic or not, structure backfill shall be a Caltrans approved mix for 2-sack cement slurry (See [Appendix II, Table 1](#)), unless otherwise specified in the Caltrans permit.
- 8.3.4 **Parkways and Planter Areas.** When a structure is to be located within public right-of-way and is within a planter or parkway area, structure backfill shall be as specified in [Subsection 8.3.1](#), except the upper 24 inches of backfill within the planter area, which shall meet the requirements of Greenbook, Part 8, Section 800-1, Landscape Materials.
- 8.4 **Private Property**
- 8.4.1 **Developed Areas.** When a structure is to be located within Private property and located under a paved roadway, parking lot, driveway, or in an easement area, the structure backfill shall be 100-E-100 (See [Appendix II, Table 1](#)), in accordance with Greenbook, Part 2, Section 201-1, Table 201-1.3.3 for Trench Backfill.
- 8.4.2 **Areas Subject to Vehicular Traffic.** When a structure is to be located within Private property in an area subject to vehicular traffic, the structure backfill shall

be 100-E-100 (See [Appendix II, Table 1](#)), in accordance with Greenbook, Part 2, Section 201-1 for Trench Backfill.

- 8.4.3 Unimproved Areas not Subject to Vehicular Traffic.** When a structure is located in an unimproved area within Private property and not subjected to vehicular traffic, structure backfill shall meet the requirements of Greenbook, Part 3, Section 306-12, for Backfill, and also:
- 8.4.3.1 Sand meeting the requirements of Greenbook, Part 2, Section 200-1.5.5, Sand Gradations, for Mortar, shall be used to backfill the excavated area.
 - 8.4.3.2 Sand shall be placed evenly in 2 foot maximum thick horizontal layer or lifts.
 - 8.4.3.3 Backfill densified through jetting shall meet the minimum relative compaction requirements outlined in Greenbook, Part 3, Section 306-12.4, Jetted Bedding and Backfill Compaction Requirements, or as otherwise noted by the permitting agency.
 - 8.4.3.4 Contractor shall provide compaction report(s) providing results of the test taken at every other compacted layer, or as directed by the Department representative. The report shall be prepared by a certified testing laboratory. The soil compaction test(s) shall be in accordance with Sand-Cone Method, ASTM D1556, and Modified Proctor Compaction Test, ASTM D1557.
 - 8.4.3.5 Where jetting is not allowed, backfill shall meet the requirements of [Subsection 8.4.1](#).

SECTION 9 – CONDUIT INSTALLATION

9.1 Inspection.

Prior to Installation. All PVC conduits shall be made available for visual inspection and approval by the Department representative prior to installation. Manufacturer catalog and/or Technical Data Sheets may be required by the Department Representative.

Prior to Encasement. Conduits shall not be encased until they have been inspected and approved by the Department Representative. Refer to [Section 3 – Inspection](#), for detailed inspection requirements.

Testing. The Department representative may also request laboratory testing of any PVC conduit in addition to the visual inspection. In such a case, the Contractor shall submit one 7 foot long or two 4 foot long PVC conduit samples with the same run numbers and one coupling or bell end attached to:

Los Angeles Dept. of Water and Power
Electrical Conduit and Material Testing
1630 North Main St. Bldg. #7
Los Angeles, CA 90012

Please allow five (5) business days for test results. Where the conduit fails to meet the visual requirements or the American Society of Testing and Materials (ASTM) F512, Standard Specification for Smooth-Wall PVC Conduits and Fittings for Underground Installation, the Contractor shall be responsible for the replacement of the substandard conduit with acceptable conduit.

9.2 **Excavations and Backfill.** All excavations and backfill shall be done in accordance with Sections [5](#), [8](#), and [10](#) of this Specification and:

9.2.1 **For installation on private property.** The Department of Water and Power Underground Construction Standard Drawing H-168, latest revision.

9.2.2 **For installation in Public Right-of-Way:** The Los Angeles Municipal Code, Chapter VI, Article 2, Section 62.00-62.05 and Greenbook, Part 3, Section 306, Open Trench Conduit Construction, as modified herein.

9.3 **Size and Type.** Electric conduits shall be of the size and type (or approved equivalent) noted on construction drawings.

9.4 Clearance Requirements.

9.4.1 When crossing other existing utilities, provide a minimum clearance of 6 inches between the conduits in direct buried, or the conduit concrete encasement in encased buried construction. The respective utilities may have additional clearance, inspection, or protection requirements.

9.4.2 Crossing Existing Utilities.

When crossing existing utilities, the following conditions shall be met:

The conduit section(s) as shown on the construction drawings may be constructed over the existing utilities if the minimum cover (See [Appendix II, Table 2](#)) and clearance requirements (see Subsection 9.4) are met. Otherwise, conduit(s) shall be constructed under existing underground utilities, or as otherwise noted on the construction drawings.

All conduit sections crossing under, or over existing underground utilities shall be constructed without the aid of segments or bends unless their use is approved by the Department Representative prior to construction.

9.4.3 When paralleling other existing utilities there shall be a minimum clearance of 12 inches between the conduit and the existing utility in direct buried, or the conduit concrete encasement and the existing utility in encased buried construction. The respective utilities may require additional clearance.

9.4.4 When paralleling a high-pressure gas line (HPGL) there shall be a minimum clearance of 5 feet between the conduit and the existing HPGL in direct buried, or the conduit concrete encasement and the existing HPGL in encased buried construction.

9.4.5 All trees, plants, and shrubs near the Department conduit(s) shall be at a minimum clearance of 7 feet. These plants shall be placed so that their growth does not create pressure or cause potential damage to the Department conduit(s). Any planting area that is not in compliance with these requirements may be removed without notice.

9.5 Materials.

9.5.1 **Uniform Conduit.** All the conduit types used in any continuous run shall be of uniform type and size. Exceptions to this provision will be made for PVC bends which require type DB-120, and when a run crosses steeply sloping terrain or non-compacted fill areas. Exceptions will also be made if indicated on the construction drawings, or if requested by the Department Representative. See

[Subsection 9.13.4](#) for non-compacted fill and [Subsection 9.13.3](#) for sloping terrain conduit type requirements.

9.5.2 PVC.

- 9.5.2.1 All PVC conduits shall be direct burial (DB) type DB-120. Encased burial type EB-35 may be used for encased duct banks only if approved by the Department Representative.
- 9.5.2.2 All conduit used for above ground construction shall be PVC schedule 80, or metallic conduit as specified on the construction drawing(s) and applicable standard drawing.
- 9.5.2.3 All PVC encased buried (EB), or direct buried (DB) conduit used for underground construction shall be manufactured in accordance with ASTM F 512, Standard Specification for Smooth Wall PVC Conduit and Fittings for Underground Installation.
- 9.5.2.4 All PVC Schedule 40 or 80 conduit used in the construction shall be manufactured in accordance with UL- 651, UL Standard for Safety PVC Conduit and Fittings, and/or NEMA TC 2, Electrical PVC Conduit.
- 9.5.2.5 All PVC fittings and accessories (reducers, adapters, caps, etc.) shall be manufactured in accordance with ASTM F 512.
- 9.5.2.6 All PVC bends shall be DB-120 and encased whenever they are used in conjunction with type EB-35 conduits. Any other materials must be approved by the Department Representative.

9.5.3 **Metallic Conduit.** All metallic conduits shall be hot-dipped galvanized rigid steel conduit (GRC). GRC may be used for all low-voltage service conditions. GRC shall be used where low-voltage service conduit will remain exposed or may be subject to damage. Use of GRC conduit will also be required if requested by the Department Representative or if such use is called out on the construction drawings. Hot-dipped galvanized intermediate metallic conduit (IMC) may be

used as an alternate to GRC, except where exposed to traffic. Running-thread type connections are not permitted. All metallic conduits shall be grounded.

9.5.4 **Fiberglass Conduit.** Fiberglass conduit may be used for mainline or service conduit only if specified in the construction drawings or if requested by the Department Representative. All fiberglass conduits shall be heavy wall with ultraviolet (UV) protection and shall use gasket or epoxy sealed joints. Refer to [Appendix I – Section 6.0](#) for additional information.

9.5.5 **PVC Cement and Primers.**

9.5.5.1 **Primer.** Use a primer from the approved list or an equivalent product. The primer shall be purple in color and must meet ASTM F656, Standard Specification for Primers for Use in Solvent Cement Joints of PVC and Fittings requirements. Refer to [Appendix I – Table 2](#). Approved DWP Primer List.

9.5.5.2 **Cement.** Use PVC pipe cement from the approved list or an equivalent cement (Heavy body, medium set, clear) meeting ASTM D2564, Standard Specification for Solvent Cements for PVC Systems requirements. Only clear cement shall be used unless otherwise specified by the Department Standards Engineer. Refer to [Appendix I – Table 3](#). Approved DWP Cement List.

9.6 **Conduit Installation.**

9.6.1 All conduits shall be as specified on the construction drawings. Refer to [Appendix I – Subsection 3.0](#) for additional installation instructions.

9.6.2 All conduit used for above ground construction shall be PVC schedule 40, PVC schedule 80, or metallic conduit as specified on the construction drawing(s) or marked plot plan(s).

Residential Property Installations. Service conduits shall be extended one foot inside of the front property line and three (3) feet inside from the side property line. The open end of the conduit shall be closed with a plug or cap in accordance with [Subsection 9.10](#) unless otherwise specified.

9.6.3 **Preparation.**

9.6.3.1 The spigot ends of all factory-made bends and straight conduit shall be chamfered in accordance with [Appendix I – Diagram “A”](#).

- 9.6.3.2 The contractor must make certain that all foreign matter has been wiped clean from the joining portions of both pieces to be joined before joints are primed, cemented, and assembled.
- 9.6.4 **Pipe Cuts.** All cut or damaged ends of duct shall be cut, chamfered, and de-burred in accordance with [Appendix I, Subsection 3.1](#), PVC Conduit Installation.
- 9.6.4.1 The conduit must be cut square and any burrs incurred must be removed (Use of a miter box, or other means to ensure square cutting of the conduit is recommended).
- 9.6.4.2 All the conduit cut in the field shall be chamfered and de-burred in accordance with [Appendix I – Diagram “A”](#).
- 9.6.5 **Cementing Conduit.**
- 9.6.5.1 Cementing of conduit shall be in accordance with ASTM D2855, Standard Practice for the Two-Step Method of Joining PVC Pipe and Piping Components with Tapered Socket, except as modified herein.
- 9.6.5.2 Cement and primer shall be applied using a manufacturer’s approved roller or swab.
- 9.6.5.3 All PVC pipes shall be wiped clean of dirt or water and cut pipe ends shall be chamfered and de-burred, prior to primer application.
- 9.6.5.4 PVC primer and cement are fast drying products. They shall be applied as quickly as is consistent with the manufacturers’ recommendations.
- 9.6.6 **Direct Buried.** Any conduit or conduit duct bank (a group of two or more conduits) that will only house cables intended to carry loads of less than 600 volts shall not be encased in concrete, unless requested by the Department Representative or as otherwise noted on the construction drawing(s).
- 9.6.6.1 **Conduit Spacing.** There shall be a minimum of two (2) inch spacing maintained between all adjacent conduits. Duct spacers or two (2) inch sand layers shall be used if conduits are placed on the top of each other.
- 9.6.6.2 **Trench Bottom.** The trench must be uniformly graded and the bottom shall be smooth and rock free. In the event of a rocky bottom, a four (4) inch bed of sand or sand slurry will be required.

- 9.6.6.3 **Span Between Spacers.** The use of spacers is required to maintain uniformity in the duct bank section. Refer to [Appendix I, Table 4](#) for requirements relating to duct spacers.
- 9.6.6.4 **Minimum Cover.** Minimum cover over conduit in Direct Buried conduit shall be in accordance with [Appendix II, Table 2](#), Minimum Depth Specification for conduit and substructure Installations.
- 9.6.6.5 **Direct buried conduit tie-ins.** All types of direct buried conduit tie-ins entering substructure walls shall be grouted into the walls and concrete encased for a minimum distance of 18 inches outside of the substructure walls.
- 9.6.7 **Encased Buried.** Any conduit or conduit duct-bank that will house at least one (1) 600 volts or higher voltage cable(s) shall be encased in concrete (330-C-1700 or equal). For residential tracts and private properties only, any conduit or group of conduits belonging to another utility and sharing the same trench (Joint Trench) with LADWP conduit(s) shall not be encased in concrete and shall comply with [Subsection 9.12](#), Joint Trenches.
- 9.6.7.1 **Conduit Spacing.** There shall be a minimum of two (2) inch spacing maintained between all adjacent conduits.
- 9.6.7.2 **Trench Bottom.** The trench must be uniformly graded and the bottom shall be smooth and rock free. In the event of a rocky bottom, a four (4) inch bed of sand or sand slurry will be required.
- 9.6.7.3 **Span Between Spacers.** The use of spacers is required to maintain uniformity in the duct bank section. Refer to [Appendix I, Table 4](#) for requirements relating to duct spacers.
- 9.6.7.4 **Minimum Concrete Cover.** Maintain a minimum of three (3) inch and a maximum of six (6) inch concrete envelope on top, bottom, and sides of a single conduit or around a group of conduits in a duct-bank.
- 9.6.7.5 **Minimum Cover.** Minimum cover for Encased Buried conduit shall be in accordance with [Appendix II, Table 2](#), Depth Specifications for Conduit and Substructure Installations.
- 9.6.7.6 **Conduit Fastening.** Tie and fasten all conduits in a multi conduit run with cable ties or equivalent to prevent floating. Whenever smaller diameter conduits are placed in spacers intended for larger size conduits, all such conduits shall be securely tied to the spacers with cable ties or equivalent.

9.7 Conduit Bends.

9.7.1 **Bend Radius.** Minimum conduit bend radius shall be in accordance with [Appendix II, Table 3](#), Conduit Bend Radius Specifications.

9.7.2 **Unplanned Offsets.** Conduit Line Offsets shall be approved the Department representative in accordance to the Standards specified below:

4.8kV and below: Refer to Standard Drawing No. 1-161

34.5kV and below: Refer to Standard Drawing No. 1-166

9.7.3 **Field Bends.** No field bends shall be made without the approval of the Department Representative unless shown on the construction drawings. All field bends shall be made in accordance with [Appendix I, Table 1](#).

9.7.3.1 **Hot Bending.** Hot bending of PVC conduit is not allowed in the field.

9.8 Conduit Fittings.

9.8.1 Reducer couplings shall be used when changes in conduit sizes are required.

9.8.2 Adapter couplings shall be used to convert between different types of conduits.

9.8.3 Slip couplings shall be used to join conduits of the same diameter coming from opposite directions to the same point. Insertion of conduit (when dry) should not be over 3/4 of the way into the fitting.

9.9 Conduit Spacers.

9.9.1 Duct spacers should be of a type recommended by conduit manufacturers and approved by the Department of Water and Power. Refer to [Appendix I, Table 4](#) for the maximum span between duct spacers for each duct size.

9.9.2 All conduit spacers shall be self-supporting and shall not transmit a vertical load to any conduit.

9.10 Conduit Termination.

9.10.1 Termination at Substructure Walls.

9.10.1.1 All DB and EB conduits shall enter vaults, maintenance holes, and handholes perpendicular to the wall and shall terminate with end bells or duct terminators (end bells or duct terminators are not required for 1-, 2- and 3-inch conduits). The end bells or duct terminators shall be flush with the inside

face of the knockout, and shall be rounded and smooth. No rough edges will be accepted.

9.10.1.2 Cap all free conduit ends, inside precast concrete pad-mount hand-holes, with plastic duct plugs with a nipple.

9.10.1.3 Cap all end bells or duct terminators, inside pre-cast concrete vaults, maintenance holes and regular hand-hole substructures with Cal Am expandable duct plug or equivalent.

9.10.2 **New Dead-Ends.** All conduits that are required to be dead ended for future connections shall be constructed in accordance with Department's Standard Drawing No. 1-120.1, latest revision.

9.10.2.1 All dead-end pipes shall be the bell end or a coupling and must be capped using a tapered polyethylene plugs with a nipple. The tapered polyethylene plugs shall be securely taped to the PVC conduit with reinforced tape. Use expandable duct plug with nipple or equivalent in place of the tapered polyethylene plugs in high water table areas, clayey soil, or as directed by the Department Representative.

9.10.3 **Joining to Existing Dead-End Conduits.**

9.10.3.1 The dimensions shown on the construction drawings for the locations and depths of existing dead-end conduits, which are to be joined, are approximate.

9.10.3.2 Where new conduit is required to be joined to an existing dead end conduit, the Contractor shall determine in advance of construction, the actual location and depth of the joining ends of all conduits. The Contractor, at the Contractor's expense, shall attempt to locate the existing dead-ends within a search area delineated by a circle of six (6) foot radius centered on the dead-end location indicated on the plans. If the indicated dead ends cannot be located within the prescribed search area, the Department Representative should be consulted for further direction.

9.10.3.3 The Contractor shall chamfer and de-burr the existing conduit dead-ends. Prior to the joining of the conduits, the Contractor shall clean and swab that portion of the existing conduits located between the joining end and the closest existing substructure. All cleaning, swabbing, and joining operations shall be performed in presence of the Department Representative, unless otherwise approved by the representative. See [Subsection 9.11](#), Completed Spans, herein for pulling tape requirements.

9.11 Completed Spans.

A completed conduit run from a structure to another structure, from a structure to a pole, from a structure to a dead-end, from dead-end to dead-end.

9.11.1 Mule Tape.

9.11.1.1 Install flat, woven multi-fiber polyester ribbon, minimum 3/8-inch nominal width and 1250-pound minimum tensile strength pulling tape in all ducts. The pulling tape shall be printed with the rated tensile strength and sequential footage markings with legible and stable print (no rub off). Fasten each tape to the expandable duct plugs on each end with 5-foot minimum slack.

The tape shall be in one continuous length through each duct with no cuts, splices, or ties allowed.

Where the conduit is required to be joined to an existing duct-bank, the Contractor shall install a continuous span of tape from both terminating ends of the duct-bank. **A Department Representative must be present prior to opening or entering any energized substructure. The Contractor shall follow all federal, state, and local safety regulations.**

9.11.2 **Clear Water.** All conduits shall be free of water. The Contractor, to the satisfaction of the Department Representative, shall repair any leakage through conduit. Replaced or repaired conduit shall be made available for inspection before encasement in concrete, shading with sand, or backfilling.

9.11.3 **Swab Debris.** All completed ducts shall be swabbed to remove all foreign material.

9.11.4 **Mandrel.** Prior to final resurfacing over the conduit duct-bank a cylindrical mandrel as specified in the latest Department Standard Drawing No. 2-210 shall be drawn by hand through each completed duct **(in both directions) without any mechanical assistance.** The Contractor shall be responsible for removing any obstacles found or replacing any duct section through which the mandrel will not pass. Replaced or repaired conduit shall be made available for inspection before encasement in concrete, shading with sand, or backfilling. All conduits in that duct bank shall be re-mandrelled after encasement or backfilling.

9.11.5 **Cap.** All ducts shall be capped or plugged at both ends with duct plugs immediately after the completion of installation and again after swabbing and mandrelling, in accordance with [Subsection 9.10](#), Conduit Termination.

9.12 **Joint Trenches.** Joint trenches are defined as any trench in which a foreign utility is to be located vertically in the same trench. When minimum vertical (perpendicular) and horizontal (parallel) clearances are maintained, it is not considered a joint trench by the Department, regardless of the time of installation.

9.12.1 Joint trenches with telephone, communication, and cable TV companies shall be allowed only in new residential tracts and on private properties and must be approved by the Department Engineer. A joint trench is not to be allowed whenever a Department conduit or conduit duct-bank is intended to carry at least one (1) 34,500 volts cable.

9.12.2 Joint trench shall be constructed in accordance with the Department's Standard Drawing H-168, latest revision.

9.12.3 There shall be a minimum clearance of 12 inches vertically and/or horizontally between the Department conduit in direct buried or the Department conduit concrete encasement in encased buried construction and other joint utilities. Other users of a joint trench may require additional depth for cover and/or separation. **Joint utilities cannot be in the same Department conduit(s) concrete encasement.**

9.13 **Special Cases.**

9.13.1 **Jack and Bore.** When Jack and Bore is specified on the construction drawings, the contractor shall prepare and submit a work plan, including but not limited, to shoring, de-watering, traffic control plan, casing data sheet, and any other submittals needed to obtain the permits. Contractor shall follow all LAMC and CalOSHA Tunneling and Mining Permits. Additionally, when working within public right-of-way, the Contractor shall be responsible for obtaining approval from all permitting agencies.

- 1) Refer to Specification C778-07 for Department Requirements.
- 2) Contractor shall be responsible for pulling all additional permits.

9.13.2 **Horizontal Directional Drilling (HDD).**

When Horizontal Directional Drilling (HDD) is specified on the construction drawings or, under special conditions, is approved by the Department representative, the HDD shall be completed in accordance with the City of Los Angeles HDD policy Special Order No. 015-1102. The contractor shall obtain approval from all permitting agencies for HDD installations made in public right-of-way (Special City permit may be required).

Material Requirements. Smooth wall coilable high-density schedule 40 or 80 PVC conduit shall be used for Horizontal Directional Drilling (HDD) if such use is approved by the Department Representative.

9.13.3 **Sloping Terrain.** Conduit installation in sloping terrain where any 40-foot section of the conduit run exceeds 30-degrees from horizontal:

Direct Buried. The conduit shall be metallic for the entire sloped portion and a minimum of 10 feet beyond the top of the slope. Baffle boards are required to retain backfill in accordance with Department's Standard No. 1-225, latest revision.

Encased Buried. The conduit shall be concrete encased and rebar reinforced for the entire sloped portion and a minimum of 10 feet beyond the top of the slope (Contractor to submit reinforcement detail to standards engineer for approval). Baffle boards are required to place the concrete in sloped trenches in accordance with Department's Standard No. 1-225, latest revision.

9.13.4 **Non-Compacted Fill Areas.** PVC conduit shall not be placed in a non-compacted fill area unless encased in concrete with rebar reinforcement. Four No.4 continuous rebar, grade 60 ksi, shall be placed, one in each corner of the concrete envelope, parallel to the conduit run with a minimum concrete cover over rebar of 1.5 inches.

9.13.5 **Bridges.** Conduits, installed inside a bridge cell or suspended under a bridge shall be supported by Reinforced Plastic Mortar (RPM) spacers or hangers. The dimensions and the spacing of the supports shall be in accordance with the applicable Department Standard drawing(s) G-356, H-223 or H- 247, latest revisions.

9.14 Street Light Conduit.

9.14.1 Contractor shall confirm the street light service points with the Bureau of Street Lighting Inspector before street light conduit is installed.

9.14.2 Street light service conduits (not including mainline street light) shall be placed in the same trench with other electric conduits where practical.

9.14.3 When street light conduit is in a separate trench, cover over conduit shall be in accordance with [Appendix II, Table 2](#), Depth Specifications for Conduit and Substructure Installations, as applicable.

9.14.4 **Non-Residential Areas.** Street light conduit shall be dead ended 12 inches behind curb face.

9.14.5 **Residential Areas.** Street light service conduit should be located under proposed sidewalks and will normally be placed 2 feet from the front property lines.

SECTION 10 – CONDUIT ENCASEMENT AND TRENCH BACKFILL

Conduit Encasement

- 10.1 **Inspection.** When concrete encased or direct buried conduit is specified, concrete encasement and/or backfill shall not be made until the conduit has been inspected and approved by the Department representative. Refer to [Section 3, Inspection](#), for detailed inspection instructions.
- 10.2 **Material.** All conduits shall be encased using a DWP approved mix, as specified in [Appendix II, Table 1](#).
- 10.3 **Conduit Spacing.** Maintain a minimum of two (2) inch spacing between adjacent conduits, in accordance with [Appendix I, Section 8](#).
- 10.4 **Conduit Cover.** Maintain a minimum of three (3) inch and a maximum of six (6) inch concrete envelope on top, bottom, and sides of a single conduit or around a group of conduits in a duct-bank, in accordance with [Appendix I, Section 8](#). Formwork shall be installed as required by Department Representative to prevent overpour of encasement. **Overpour beyond 6 inches will be rejected and removed at the Contractor's expense.**
- 10.5 **Trench Requirements.** Trench bottom shall be smooth, level, compacted, and free from debris.
- 10.6 **Time.** The total elapsed time between the initial addition of water to concrete at the batch plant and placement of concrete at the job site shall not exceed 90 minutes, unless approved by the engineer. If multiple batches of concrete are required, they shall be poured sequentially. Under conditions contributing to quick setting of the concrete, the engineer may reduce the total elapsed time permitted.
- 10.7 **Tremie.** To reduce segregation, metal, or rubber tremie chutes shall be used to deposit concrete, 330-C-1700 (See [Appendix II, Table 1](#)), for conduit encasement where the free fall to the bottom of the trench exceeds 8 feet.
- 10.8 **Residential Property Installations.** The edge of all main line conduit encasement shall be placed a minimum of two (2) feet outside the property line(s), unless otherwise specified.

Trench Backfill

10.9 **Inspection.** Trenches shall not be backfilled until they have been inspected and approved by the Department Representative. A minimum of two (2) hours is required after encasement is poured before the backfill or as required by the Department Representative. Refer to [Section 3 – Inspection](#), for detailed inspection instructions.

10.10 Public Right-of-Way

10.10.1 **City Property.** When conduit is to be located in dedicated City property, structure backfill shall be 100-E-100 (See [Appendix II, Table 1](#)), in accordance with Greenbook, Part 2, Section 201-1, Table 201-1.3.3 for Trench Backfill.

10.10.2 **Public Right-of-Way.** When conduit is to be located in dedicated public right-of-way, but is not within the City limits, structure backfill shall follow the standards and requirements of the governing agency, unless otherwise specified in the permit.

10.10.3 **State of California Property.** When conduit is to be located in the State of California Right-of-Way, whether it is subject to vehicular traffic or not, structure backfill shall be a Caltrans approved mix for two (2) sack cement slurry (See [Appendix II, Table 1](#)), unless otherwise specified in the Caltrans permit.

10.10.4 **Parkways and Planter Areas.** When a portion of conduit is located in public right-of-way and is within a planter or parkway area, trench backfill shall be as specified in [Subsection 10.10.1](#), except the upper 24 inches of backfill within the planter area, which shall meet the requirements of Greenbook, Part 2, Section 800-1, Landscape Materials.

10.11 Private Property

10.11.1 **Developed Areas.** When conduit is to be located within Private property and located under a paved roadway, parking lot, driveway, or in an easement area, the structure backfill shall be 100-E-100 (See [Appendix II, Table 1](#)), in accordance with Greenbook, Section 201-1, Table 201-1.3.3 for Trench Backfill.

10.11.2 **Areas Subject to Vehicular Traffic.** When conduit is to be located within Private property in an area subject to vehicular traffic, the structure backfill shall be 100-E-100 (See [Appendix II, Table 1](#)), in accordance with Greenbook, Part 2, Section 201-1 for Trench Backfill.

- 10.12 **Unimproved Areas not Subject to Vehicular Traffic.** When conduit is located in an unimproved area within Private property and not subjected to vehicular traffic, structure backfill shall meet the requirements of Greenbook, Part 3, Section 306-1.3, for Backfill and Densification, and also:
- 10.12.1 Sand meeting the requirements of Greenbook, Part 2, Section 200-1.5.5, Sand Gradations, for Mortar, shall be used to backfill the excavated area.
 - 10.12.2 Sand shall be placed evenly in two (2) foot maximum thick horizontal layer or lifts.
 - 10.12.3 Backfill densified through jetting shall meet the minimum relative compaction requirements outlined in Greenbook, Part 3, Section 306-1.3.5, Jetted Bedding and Backfill Compaction Requirements, or as otherwise noted by the permitting agency.
 - 10.12.4 Contractor shall provide compaction report(s) providing results of the test taken at every other compacted layer, or as directed by the Department Representative. The report shall be prepared by a certified testing laboratory. The soil compaction test(s) shall be in accordance with Sand-Cone Method, ASTM D1556, and Modified Proctor Compaction Test, ASTM D1557.
 - 10.12.5 Where jetting is not allowed by governing agencies, backfill shall meet the requirements of [Subsection 10.10](#).

SECTION 11 – CONTRACTOR RESPONSIBILITIES

- 11.1 **Contractor’s License.** For projects within Public Right-of-Way, a valid Class “A” License shall be maintained throughout the entirety of the project by the Contractor.
- 11.2 **Pre-Construction Meeting.** Contractor shall set up a pre-construction meeting with a Department Representative prior to commencing any work. Refer to [Subsection 3.1 – 3.3](#) for detailed requirements.
- 11.3 **Inspection Requirements.** Contractor shall have conduit and trench inspected and approved by the Department representative prior to concrete encasement and/or backfill. Refer to [Section 3 – Inspection](#), for detailed requirements.
- 11.4 **Conduit Installation and Approval Requirements.**
 - 11.4.1 The Contractor shall be responsible for the construction of the conduit system and installation of the substructures in accordance with the direction of the Department Representative and the latest revisions of the following: Specification 104 and the Commercial Service Construction Standards.
 - 11.4.2 No underground cable or equipment will be installed until after all construction and inspections have been passed by the Department Representative, all permit requirements have been met (Refer to [Subsection 11.9](#)), and the Contractor’s as-built drawings have been submitted and approved.
 - 11.4.3 No underground conduit system and substructure installation is considered approved by the Department until the installation of all cables and equipment as designed by the Department engineer and installed by the Department crews are successfully completed.
- 11.5 **Cable and Equipment Installation Requirements.** Due to extenuating circumstances, the Department may install cable or equipment before final approval, subject to all of the following:
 - 11.5.1 The circumstances warrant this sequence of work in the opinion of the Department.
 - 11.5.2 The Contractor agrees in writing to pay the Department for any costs incurred to make the installation acceptable after all final paving, sidewalks, and retaining walls are completed.
 - 11.5.3 Adequate precautions are taken to protect the facilities. Examples include, but are not limited to, sidewalks around substructures and post barricades.

- 11.5.4 Final street restoration shall be inspected and approved by the City of Los Angeles and/or the State of California (as jurisdiction applies) and shall be acceptable to the Department.
- 11.5.5 Contractor shall not enter any structures where cable or equipment has been installed.
- 11.6 The Contractor shall obtain a second permit from the State of California Department of Transportation, if so required, for construction of an electrical underground distribution system within the State's right-of-way.
- 11.7 The Contractor shall be responsible for the preservation of Survey Monuments and Bench Marks in accordance with Greenbook, Part 1, Section 3-11, Surveying, as modified by the City of Los Angeles "Brown Book" and as specified in [Section 4](#).
- 11.8 **As-built Requirements.** Prior to final acceptance, the Contractor shall submit as-built drawings to the Department Representative via email in PDF format, unless otherwise approved by the Department Representative. The Department Representative will review and notify the Contractor if they have been accepted.

All as-built drawings must include:

- 11.8.1 Cover over the duct bank at a maximum of 20' intervals and whenever there is a sudden change in the conduit depth.
 - 11.8.2 Any use of vertical offsets must be indicated, including the location, offset angle, and radius.
 - 11.8.3 Cover over all substructures installed.
 - 11.8.4 Any changes to the design including, but not limited to, conduit alignment, substructure location, or duct bank sections.
 - 11.8.5 All dimensions shall be verified by either circling the dimension shown or writing the correct dimension.
- 11.9 **Closing Permits.**

No Work by DWP. Contractor is responsible for closing all permits when no work is required by the Department.

Work Required by DWP. Contractor shall keep permit open when additional work is required to be completed by the Department. All street restoration work shall be completed by the Contractor. Any issues that arise from Contractor's scope of work must be resolved at Contractor's expense.

APPENDIX I
Installation Instructions for
Underground Conduit
(Revised 11-07-2025)

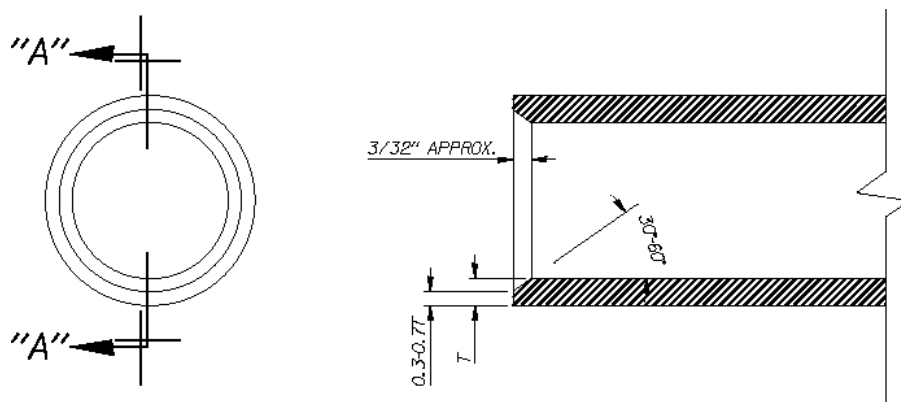
1.0 **Scope.** This standard provides detailed installation instructions for polyvinyl chloride (PVC) and fiberglass conduit and fittings.

2.0 **General Specifications.**

- 2.1 All PVC expansion joints shall be Schedule 40 with tapered joints which are sealed with either gaskets or O-rings, and must have 12-inch minimum expansion potential. Expansion joints must be belled at both ends.
- 2.2 All fiberglass conduits shall be heavy wall (HW) type, reinforced thermosetting resin conduit (RTRC), manufactured in accordance with the latest applicable UL/CSA/NEMA standards, unless otherwise noted or approved by the Department Representative. Conduit joints will be either gasket or epoxy sealed.
- 2.3 All fiberglass expansion joints shall be HW type, manufactured in accordance with the latest applicable UL/CSA/NEMA standards, with gasket or O-ring sealed tapered joints, unless otherwise approved by the Department Representative.

3.0 **PVC Conduit Installation.**

3.1 **Pipe Cuts.** All the conduit cut in the field shall be chamfered and de-burred as shown in DIAGRAM A below:



SECTION "A-A"

DIAGRAM "A"

3.2 Cementing Conduit.

- 3.2.1 Apply primer with the applicator once to the inside of the socket, and once to the outside of the spigot end over a length equal to the depth of the socket.
- 3.2.2 While the primer on the spigot and socket is still wet, apply the cement with the applicator once to the inside of the socket and once to the outside of the spigot end over a length equal to the depth of the socket. The quantity of glue applied should be sufficient to wet the pipe. Excess cement on the socket should be avoided as it is wiped into the joint and tends to weaken the pipe.
- 3.2.3 If the primer has dried prior to applying the cement or if the cement has dried prior to joining the two pipes, both primer and the cement must be reapplied. The joint must be assembled immediately after the last cement application.
- 3.2.4 Slip conduit straight into the socket until it bottoms, twist approximately $\frac{1}{4}$ turn then hold the joint for 15 seconds (One (1) minute in extreme cold weather), so that the conduit does not push out of the fitting.
- 3.2.5 Do not twist or drive pipe after insertion is completed. No blows by hammer or by any other means shall be used to aid the assembly of the PVC conduit joints.
- 3.2.6 Another fitting or duct section can be added to the free end of the conduit, within two or three minutes if care is exercised in handling so that strain is not placed on the previously joined assembly.
- 3.2.7 Under normal circumstances, the newly joined members shall remain undisturbed for at least five minutes before they are handled. In cold or damp weather, this interval should be increased to allow for the slower evaporation of the solvent.
- 3.2.8 After initial set, care must be exercised in handling the conduit to prevent twisting or pulling the joint.
- 3.2.9 Wipe off the excess solvent that is left on the outer shoulder of the fitting after the joint is assembled. Plastic bristle brushes should not be used for this purpose.

- 3.2.10 Keep cement cans covered when not in use and always keep them away from excess heat and flames.
- 3.2.11 Solvent cement thinner may not be used for thinning cement that has thickened.
- 3.2.12 All discarded cement and primer cans are to be removed from the open trench and properly disposed of prior to conduit encasement and trench backfilling.
- 3.2.13 All cut bends of PVC conduit shall be assembled in the presence of the Department of Water and Power (Department) representative or otherwise approved by said representative.

3.3 Conduit Bend Radius.

- 3.3.1 Minimum bend radius for straight conduit that is to be cold bent in the trench is as follows:

Table 1. Minimum Bend Radius	
Conduit Size (inches)	Minimum Radius (feet)
3	12-1/2
3 to 6	65

3.4 Mechanical Damage Prevention Recommendations.

- 3.4.1 Conduit should not be left exposed in open trench for longer than eight hours.
- 3.4.2 Provide support for the full length of conduit when transporting long conduit lengths.
- 3.4.3 Do not permit unsupported overhangs.

4.0 PVC Temperature Effect Precautions. Due to the expansion and contraction of plastic duct (1-1/2 inches per 100 feet for every 20 degrees Fahrenheit (F) change in temperature), the following precautions should be taken:

4.1 Temperature Precautions.

- 4.1.1 All plastic conduit and fittings to be joined should be exposed to the same temperature conditions for a reasonable length of time before assembly.
- 4.1.2 Allow extra conduit footage at each tie-in for contraction when duct temperature is higher than that of the surrounding soil; or extra room for expansion if the reverse condition exists.
- 4.1.3 When pouring concrete over conduit in encased buried or placing backfill in direct buried, the contractor shall allow for temperature-induced movement at the free end of the conduit. This can be accomplished by pouring the concrete or placing the backfill from the center of the run (if both ends of the run are open) or starting from the tie-in point and working towards the free end. This is extremely important for concrete encasement since conduit is subject to temperature rise as concrete cures.

5.0 Approved PVC Cement and Primers.

Table 2. Approved DWP Primer List	
1	Christy's Purple Primer
2	LSP 670P Primer
3	RectorSeal Jim PR-1L Primer
4	Weld-On P-70 Purple Primer
5	Plasti-Weld 903 Series Purple Primer for PVC

Table 3. Approved DWP Cement List	
1	Christy's Clear PVC Pipe Cement
2	LSP Solvent Cements 617C PVC Cement
3	RectorSeal Gold 844L Clear PVC Solvent Cement
4	Weld-On 717 Clear PVC Cement
5	Plasti-Weld 1500 Series Heavy Duty Clear PVC Solvent Cement

6.0 **Fiberglass Conduit with Epoxy Connection.**

6.1 **Fiberglass.**

- 6.1.1 **Fiberglass Adhesive.** All fiberglass conduits that do not use gasket sealed joints shall be installed with epoxy resin adhesive used as the binding medium in the joints.
- 6.1.2 Epoxy resin adhesive shall have minimum ultimate shear strength of 500 psi and a minimum joint pullout resistance of 6000 pounds in accordance with ASTM D2517, Standard Specification for Reinforced Epoxy Resin Gas Pressure Pipe and Fitting, and D2105, Standard Test Method for Longitudinal Tensile Properties of Fiberglass Pipe and Tube, respectively.
- 6.1.3 Epoxy resin shall be FRE Composites, Incorporated Adhesive Kit Number 20-0164 or equal. Each kit shall contain the necessary components and instruction sheets, which shall include information regarding cure time, pot life, and other data deemed necessary by the manufacturer.
- 6.1.4 Epoxy shall be applied by using a putty knife or equivalent.

6.2 **Fiberglass Conduit Assembly.**

- 6.2.1 All bell and spigot ends of the fiberglass conduits shall be sanded and cleaned to remove any transit residues.
- 6.2.2 After sanding, cleaning, and drying the bell and spigot ends of the fiberglass conduits, a liberal and uniform coat of epoxy resin shall be applied to both the interior of the bell and the exterior of the spigot, covering a four (4) inch wide section.
- 6.2.3 Due to the pot life of the epoxy resin, the joint shall be assembled immediately after the last epoxy application. If the epoxy resin dries before assembly, the bell and spigot ends of the fiberglass conduits must be re-sanded and cleaned before applying any additional epoxy.
- 6.2.4 Slip the conduit spigot straight into the joining bell with a slight twist until it bottoms. The joint members shall be cured and left undisturbed for 30 minutes or more before they are handled and/or transferred. After this initial set, care must be exercised in handling to prevent twisting or pulling the joint.

6.2.5 An approved soft paddle may be used to aid the assembly of the fiberglass conduit joints. Partial mixing of the resin and hardener will not be allowed.

7.0 Spacers for Conduit Installation.

7.1 Maximum span between duct spacers for each duct size is listed below:

Duct Size (inches)	Spacing (feet)
3	8
4 to 6	6

8.0 Encased Buried Conduit Installation.

8.1 **Spacing.** Maintain a minimum of two (2) inch spacing between adjacent conduits.

8.1.2 **Maximum Span Between Spacers.** Refer to Section 7, Appendix I.

8.2 **Conduit Cover.** Maintain a minimum of three (3) inch and a maximum of six (6) inch concrete cover on top, bottom, and sides of a single conduit or around a group of conduits in a duct-bank.

8.3 **Fastening.** Tie and fasten all conduits in a multi conduit run with zip ties or equivalent to prevent floating.

8.3.1 Whenever smaller diameter conduits are placed in spacers intended for larger size conduits, all such conduits shall be securely tied to the spacers with zip ties or equivalent. This is to provide lateral stability to the spacers and to avoid floating of the smaller diameter conduits during the concrete encasement process.

8.4 **Inspection.** The concrete for encasement shall not be placed until the conduit has been inspected and approved by the Department Representative in accordance with Section 3 of Specification 104.

APPENDIX II
Reference Tables
 * (Revised 11-07-2025)

Table 1. Concrete Ready-Mix Specifications			
Item	Application	Mix Type	Specification
Vaults/MH/HH/TP			
1	Barrier posts	330-C-1700 or 420-D-1700	C702-50
2	Pour in place structure mix	DWP 3000-1.0	
3	Concrete collar around structure	DWP 3000-1.0	
4	Conduit anchor next to structure	330-C-1700 or 420-D-1700	
5	Fill the gap between neck rings > 1 ½"	DWP 3000-1.0	
6	Fill the gap between neck rings < 1 ½"	Dry Pack Grout (Non- Shrinkable)	ASTM C-1107
7	High water area. Grout on the joints and unused ground rod locations	Hydraulic Cement (Non-Shrinkable)	
Conduit Construction			
8	Encasement	330-C-1700 or 420-D-1700	C702-50
9	Encasement – pump mix	565-E-2000P	Greenbook Sect 201
Slurry Backfill			
10	Conduit & structures in city streets	100-E-100	Greenbook Sect 201
11	Conduits & structures in state highways	2-Sack Slurry	State Approved

Note. For Job-Site Concrete Hand-Mix Specifications, see Standard Drawing No. C702-50.

Table 2. Depth Specifications for Conduit and Substructure Installations				
Item	Application	Duct Bank Below 600V	Duct Bank Over 600V	Vaults & Man Holes (i)
1	Private Property, Landscaped	24 inches min. clearance below finished surface	36 inches min. clearance below finished surface (ii)	24 inches min. clearance below finished surface
2	Private Property, Paved	24 inches min. clearance below finished surface	30 inches min. clearance below finished surface (iii)	24 inches min. clearance below finished surface
3	Property Line Dead Ends	30 inches min. clearance below gutter grade	30 inches min. clearance below gutter grade	N/A
4	Public Right-of-Way, Paved	30 inches min. clearance below gutter grade	30 inches min. clearance below gutter grade	24 inches below finish surface or 18 inches below gutter grade, whichever is greater
	Public Right-of-Way Unpaved or Parkway	30 inches min. clearance below finished surface	36 inches min. clearance below finished surface	24 inches min. clearance below finished surface
5	State Highway Paved or Unpaved	42 inches min. clearance below finished surface	42 inches min. clearance below finished surface	42 inches min. clearance below finished surface
6	Railroad Crossings (Light Rail)	42 inches min. clearance below base of the lowest rail (iii,iv)	42 inches min. clearance below base of the lowest rail (iii,iv)	N/A
7	Railroad Crossings (Heavy Rail)	66 inches min. clearance below base of the lowest rail (iii)	66 inches min. clearance below base of the lowest rail (iii)	N/A

Note. All clearances shall be measured from top of concrete encasement for encased buried, or top of conduit for direct buried. All depths shall be as specified herein or as requested by the excavation permit.

- i. For substructure installations, all clearances are to the highest point on the roof of the structure and shall not exceed 48 inches, unless approved by Department Representative.
- ii. Except for conduit duct-banks within 20 feet from the outside wall of the hand-hole, transformer pad or switchgear pad not meeting this depth requirement; cover for these sections shall be 24 inches minimum clear below finished surface or as otherwise noted.
- iii. The minimum depth may be increased if required by rail road company.
- iv. A minimum clearance of 66 inches is recommended under Los Angeles Metro Light Rail for track drains and track power/signal/communication duct banks.

Table 3. Conduit Bend Radius Specifications			
Item	Application	Conduit Size	Min. Radius* (feet)
1	Main Line in Public Right-of-Way 34.5kV	All	35
2	Main Line in Public Right-of-Way 4.8kV	All	12.5
3	Service Conduits, Public Right-of-Way or Private Property	Up to 4" Dia.	3
4	Service Conduit, Public Right-of-Way or Private Property	Over 4" Dia.	4
5	Pole Dip Sweep (Risers), Galvanized or PVC	Up to 4" Dia.	3
6	Pole Dip Sweep (Risers), Galvanized or PVC	Over 4" Dia.	5
7	Field Bends if Required	All	65

* Unless otherwise noted on the construction drawings.