

GENERAL SPECIFICATIONS FOR CONDUIT INSTALLATION

All conduits shall be installed in conformance with the plans and requirements of this standard. Trenches provided for RPU installed facilities shall also conform to these requirements.

1. CONDUIT

- 1.1 The size and type of conduit shall be as shown on the plans and in conformance with UGS-100.
- △ 1.2 All conduits shall be carefully aligned and laid to a uniform grade with no abrupt changes in grade or direction that would hinder the safe and effective pulling of underground cables, or be likely to cause damage to the conduit and/or cable being utilized.
 - a.) Horizontal changes in the direction of duct banks 4" and larger shall be limited to 12.5' radius minimum (per UGS-100).
 - b.) Vertical changes in direction (elevation) of duct 4" and larger shall be limited to 22.5° or less, also with 12.5' radius, except riser sweeps at pole, walls or pad mounted equipment (See UGS-115.1, UGS-116)
 - c.) Smaller radius bends/sweeps and/or increased degrees (more than 22.5°) may be used in shorter pull sections if necessary due to space limitation ONLY if subsequent pulling calculations show no adverse effects, and subject to engineer's approval.
- 1.3 A minimum cover is required over all conduits or cables. This cover is measured from the top of the conduit to finished surface grade and varies according to voltage and type of system. The minimum cover requirements are listed below. Depth may vary when entering structures.

Minimum Cover Required	Type of System
24"	Conduit for circuits to 750 volts
36"	Conduits for circuits over 750 volts

Cover over conduits or cables located within curbed streets shall be measured from the top of the conduit to the gutter flow line. One foot separation (vertical or horizontal) shall be maintained when telephone or cable TV are in joint trench. Electric conduits are on the bottom.

- 1.4 Conduits that are cracked, damaged or contain any roughness that would damage the cables shall not be installed.
- 1.5 To prevent floating, conduits requiring concrete encasement shall be securely anchored to the trench bottom and tied with conduit spacers prior to pouring concrete. See UGS 125.1 for conduit spacers.

2. CONDUIT TERMINATIONS AND CONNECTIONS

- 2.1 All conduits shall terminate in substructures with plastic end bells.
- 2.2 Conduit couplings shall be staggered a minimum of 6 inches from all other couplings.

3. EXCAVATION *

- 3.1 The contractor shall obtain a street opening from the City of Riverside Public Works Department, prior to excavating in any public right-of-way. The contractor shall also comply with Construction Safety Orders of the Division of Industrial Safety of the State of California and all other applicable laws, ordinances, and regulations.
- 3.2 Excavations shall be fully protected against hazard to the public and shall be braced to prevent caving. Proper protective measures shall be used where excessive caving is encountered or where protection is required for adjacent structures or roads. The requirements of the California State Construction Safety Orders and OSHA shall be complied with.
- 3.3 RPU reserves the right to specify when protective measures for excavation must be employed.
- 3.4 Contractor shall provide walkways and/or roadways around and over excavations to safely accommodate traffic along streets and into adjacent buildings such structures shall conform to existing local regulations.
- 3.5 Trench subgrades shall be brought to a uniform grade. Subgrade of spongy, unstable or other unsuitable material will be removed and replaced with suitable bedding material.
- 3.6 Where rocks are encountered during excavation, they will be removed to 6 inches below the trench bottom and the conduit structure laid on a bed of compacted sand.
- 3.7 Special care shall be taken to prevent damage to existing buried structures and facilities. Contractor shall assume responsibility for proper notification and restitution to interested parties in the event of damage to such structures and facilities.

4. GROUND WIRE

The size, type and location of ground wires shall be as shown on the plans and when shown shall be furnished and installed by the contractor. Refer to UGS-225.

5. CONCRETE ENCASEMENT

- △ 5.1 Concrete encasement or semi-encasement, as specified, is required on 4 or more conduits. Extreme care must be taken to prevent conduit collapse during encasement. Semi-encasement may be required by RPU inspector under certain circumstances.
- 5.2 Conduits
 - A. Full concrete encasement, when specified, shall have a minimum concrete coverage of 3 inches on top, bottom, and sides of the conduit.
 - B. Concrete semi-encasement, when specified, shall have a minimum concrete coverage of 3 inches on top and sides of conduit.
- 5.3 No concrete cap or encasement of any type will be poured without prior notice to the RPU inspector.
- 5.4 Concrete for conduit bank protection may have the following minimum proportions:
 - A. Water content sufficient to give a minimum slump of 2 inches and maximum of 4 inches;
 - B. Aggregate content of a maximum of 40% sand by weight and a coarse aggregate of 3/8-inch maximum size;
 - C. Cement content shall be a minimum of 190 pounds per cubic yard (2 sack);
 - D. Compaction may be by any suitable means that assures elimination of voids and does not damage the conduit;
 - E. Water reducing admixture ASTM C494 Type A shall be used to increase the workability of the concrete. Admixtures with calcium chloride are not acceptable. Admixtures shall be applied per manufacture recommendations.
 - F. Artificial color is not required.

REVISION: Updated Format, Paragraph 1.2 Regarding Abrupt Changes, Removed EB Conduit Reference from Paragraph 5.1, Updated References from Greenbook

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CHECKED BY (FIELD): JH APPROVED BY: Stephen E. Sanford

PREPARED BY: SJR

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UGS

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6. BACKFILL

6.1 Conduit Bedding *

- A. Bedding shall be defined as that material supporting, surrounding, and extending to 1 foot above the facility.
- B. Where concrete protection is not used, bedding material shall be clean sand, pea gravel or native free-draining granular material having a sand equivalent of not less than 30 or having a coefficient of permeability greater than 1.4 inches/hour. Clean sand may be jetted where permitted.
- C. Where concrete protection of conduit is used, 6 inches of well-dampened earth shall be placed over concrete protection in the trench 2 hours after the concrete is poured. Backfilling of the trench excavation may then be completed.
- D. Conduit bedding will meet the requirements of Paragraph 5, Concrete Encasement.

6.2 Backfill *

- A. Backfill shall be considered as starting 1 foot above the pipe or conduit, or at the top of concrete bedding over the pipe or conduit. All material below this point shall be considered bedding.
- B. All backfill shall be placed as specified in Paragraph 6.3, Mechanically Compacted Backfill, and compaction requirements shall be in accordance with Paragraph 6.4, Backfill Compaction Requirements.
- C. Rocks greater than 6 inches in any dimension will not be permitted in backfill placed between 1 foot above the top of any pipe or conduit and 1 foot below pavement subgrade.
- D. Rocks greater than 2½ inches in any dimension will not be permitted in backfill placed within 1 foot of the pavement subgrade.
- E. The native material obtained from project excavations may be used as backfill provided that all organic material, rubbish, debris, and other objectionable material are first removed. Backfill soil shall be approved by the RPU Inspector.

6.3 Mechanically Compacted Backfill *

- A. Backfill shall be mechanically compacted by means of tamping rollers, vibrating rollers, stompers (impact-type pavement breakers), wackers, or other hand-held mechanical tamper.
- B. Prior to mechanically compacting backfill, determine proper moisture content of soil. Optimum moisture in all soil types is desirable for obtaining required compaction.
- C. Material for mechanically compacted backfill shall be placed in horizontal layers of thickness or lifts, which, prior to compaction, will not exceed the thickness specified below for the various types of equipment.
 - 1. Hand-directed mechanical tampers and walk-behind vibratory plates shall be used for a maximum uncompacted lift thickness of 4 inches.
 - 2. Rolling equipment, including sheepsfoot (both vibratory and nonvibratory), grid, smooth-wheel (nonvibratory), pneumatic-tired and segmented wheels shall be used for a maximum uncompacted lift thickness of 1 foot.
 - 3. Impact, free-fall, or stomping equipment - maximum uncompacted lift thickness of one foot.
- D. Mechanically compacted backfill shall be moistened or dried as necessary to obtain optimum moisture level (plus or minus 2%). Each layer shall be evenly spread and compacted until the specified relative compaction has been attained as specified on page 3.

6.4 Backfill Compaction Requirements *

Backfill will be densified to the following minimum relative compaction. See Trench Backfill Details (Page 6 of 6).

- A. 90% Relative Compaction:
 - 1. In upper 3 feet, measured from the pavement surface (or finished grade where there is no pavement), within the existing or future traveled roadway, shoulders, and other paved areas (or areas to received pavement).
 - 2. Within engineered embankments.
 - 3. Where lateral support for existing or proposed structures.
- B. 95% Relative Compaction:
 - 1. Within State Highways:
 - 2. Where pavement is placed directly on the compacted backfill, the top 6 inches immediately under the pavement will meet this requirement.

6.5 Sand Slurry Backfill *

All trenches 10 inches or less in width and other trenches when directed by RPU shall be backfilled using sand slurry with a minimum 1 sack per cubic yard of cement.⁵ California Department of Transportation jobs requiring sand slurry backfill shall have minimum of 1½ sacks per cubic yard of cement.

6.6 Base (Also See City of Riverside P.W. Standard 453)

- A. Base material shall be reconstructed to the same dimensional thickness with the same or equivalent materials used in the original work.
- B. Where the original thickness is 6 inches or less, the base material may be compacted in one layer. Where the original thickness is more than 6 inches, the base material will be compacted in two or more lifts of approximately equal thickness and the maximum compacted thickness of any one layer shall not exceed 6 inches.
- C. The relative compaction of each layer of compacted base material shall not be less than 95%.

7. PAVEMENT RESURFACING

7.1 Temporary Resurfacing (Also See City of Riverside P.W. Standard 453)

- A. Unless permanent pavement is placed immediately, temporary pavement shall be placed immediately after backfilling. Temporary bituminous resurfacing 4 inches thick shall be placed and maintained wherever excavation is made through pavement or driveways. In sidewalk areas, the temporary resurfacing shall be at least 2 inch thick; in all other areas it shall be at least 2 inches thick. At major intersections and other critical locations a greater thickness may be required.
- B. Placement of permanent resurfacing shall be performed within two weeks after the placement of temporary resurfacing.

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7.2 Permanent Resurfacing - General

All surface pavement damaged or removed as a result of the excavation work will be reconstructed to the same dimensions, except for pavement thickness below, and with the same type material used in the original work. All jagged cuts should be cut straight prior to resurfacing. Resurfacing will be 1 inch greater in thickness than existing pavement.

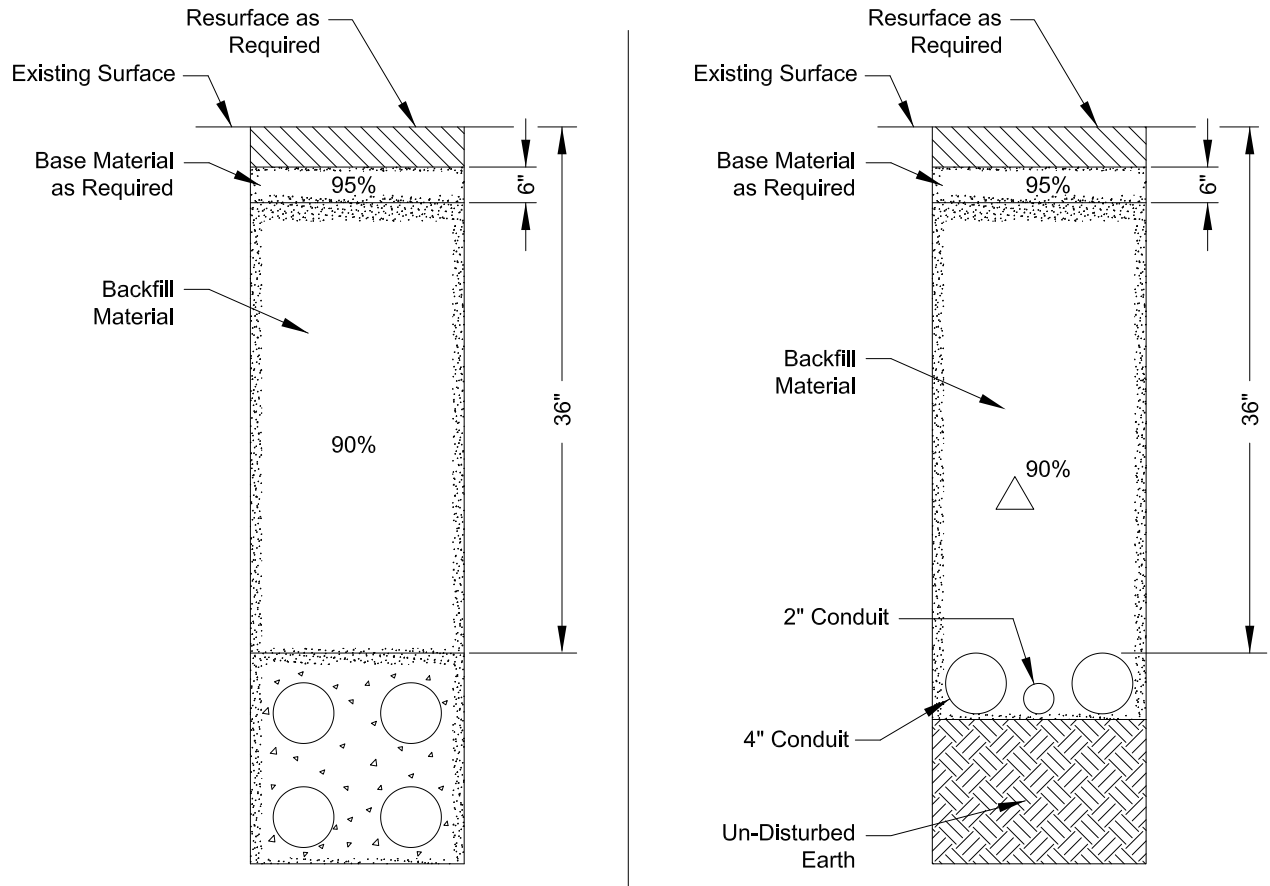
7.3 Asphalt Pavement

- A. Edges of the surface surrounding a patch repair must be free of water, foreign material, or dust. The prepared edges should be tack coated to ensure a bond between them and the patch material. Enough time should be allowed for the emulsion to "break" and most of the water to dry out before the patch-mix is placed.
- B. Asphalt pavement will be compacted to density of 95%. To ensure a good surface seal along the cut (joint) line, a 4 inch wide band of emulsion shall be applied over the joint at the surface level, covered with a light coating of sand.
- C. Upon completion, the pavement shall be true to grade and cross section. When a 10 foot straightedge is laid on the finished surface parallel to the centerline of the excavation, the surface shall not vary from the edge of the straightedge more than 1/8"

7.4 Concrete Pavement

- A. Concrete shall be reconstructed with the same type of material used in the original work or approved substitute. Concrete shall be placed on a subgrade sufficiently dampened to ensure that no moisture will be absorbed from the fresh concrete.
- B. Immediately after being mixed, the concrete shall be deposited on the subgrade to the required depth over the entire width of the section.
- C. The concrete surface shall be finished true to grade and cross section. Upon completion, the surface shall be free of any unevenness greater than 1/8 inch when checked with a 10 foot straightedge placed on the surface of the pavement.

Trench Backfill Details



CONCRETE PROTECTED
 4 or more conduits fully encased in concrete with stands & spacers (2x2) per UGS-125

DIRECT BURIED
 Three conduits or less; Place 2" at discretion of inspection

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8. MANDRELLING, CLEANING, AND MULE TAPE INSTALLATION

- 8.1 A mandrel shall be pulled through each conduit upon completion of the duct bank including all existing conduits that were intercepted.
- 8.2 All mandrelling must be done in the presence of the RPU Inspector.
- 8.3 All cement, sand, and foreign matter shall be removed. If obstructions are found that cannot be removed by cleaners so as to pass the specified mandrel, the conduit shall be removed and relaid at the Contractor's expense.
- 8.4 If the existing conduit does not mandrel and is being extended solely for the Customer's benefit, replacement shall be at the Customer's expense.
- 8.5 Mule tape, 3/4 inch, with a minimum breaking strength of 2500 pounds, shall be left in each conduit. A 5 foot length of mule tape shall be left projecting from the conduit at each substructure, and adequately secured in place with a plug installed. An equivalent mule tape, if approved by RPU, may be substituted.
- 8.6 All mule tape shall be new. Used or spliced mule tape is not acceptable.

9. Railroad Crossings

- 9.1 All conduit within railroad rights-of-way must have a minimum of 4 feet of cover from bottom of rail.
- 9.2 When specified on the working drawing, the following is required:
 - A. HDG conduit (or steel casing) when under the rail bed.
 - B. Full concrete encasement on conduit not under the rail bed.
 - C. Install marker tape (Alarmoline, Cat. No. AL-6100-YE) directly above conduit, 1 foot below grade.

* RPU Standards are in compliance with Standard Specifications for Public Works Construction, 2015 Edition (*Greenbook*)

Section 5 (Utilities)

- Subsection 5-2 (Protection)

Section 200 (Construction Materials)

- Subsection 201 (Rock Materials)
 - Subsection 201-1 (Portland Cement Concrete)
 - Subsection 201-1.1.2, Mix 100-E-100 (Trench Backfill)
 - Subsection 201-6 (Controlled Low Strength Materials (CLSM))
- Subsection 217 (Bedding & Backfilling Materials)
 - Subsection 217-1 (Bedding Materials)
 - Subsection 217-2 (Trench Backfill)

Section 300 (Construction Methods)

- Subsection 301 (Subgrade Preparation, Treatment Materials, and Placement of Base Materials)
 - Subsection 301-2.3 (Untreated Base / Compacting)
- Subsection 302 (Roadway Surfacing)
 - Subsection 302-5.6.2 (Asphalt Concrete Pavement / Rolling / Density & Smoothness)
- Subsection 306 (Open Trench Conduit Construction)
 - Subsection 306-3 (Trench Excavation)
 - Subsection 306-4 (Shoring & Bracing)
 - Subsection 306-6 (Bedding)
 - Subsection 306-12 (Backfill)
 - Subsection 306-12.2 (Backfill for Narrow Trenches)
 - Subsection 306-12.3 (Mechanically Compacted Trench)
 - Subsection 306-13.2 (Permanent Resurfacing)