

University of Houston Master Specification

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SECTION 27 0543 – UNDERGROUND DUCT AND RACEWAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
 - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas available on the web site of the Texas Facilities Commission.
 - 2. The University of Houston's Supplemental General Conditions and Special Conditions for Construction.

1.2 SUMMARY

- A. Section includes:
 - 1. Cutting and Patching Asphalt and Concrete.
 - 2. Trenching and Excavation.
 - 3. Underground Conduit Systems.
 - 4. Cable Routing Hardware.
 - 5. Horizontal Directional Drilling – Also commonly referred to as Directional Boring or Guided Horizontal Boring.
- B. Work covered by this Section consists of providing all services, labor, materials, tools, and equipment required for the complete and proper installation of exterior telecommunications pathways as called for in these Specifications and related Drawings.
- C. Detailed Summary of Work:

Designer to provide a detailed summary of all work to be performed.)

 - 1. Incoming Service Duct-bank: **[Description]**
 - 2. Primary Duct-bank: **[Description]**
 - 3. Feeder Duct-bank: **[Description]**
 - 4. Innerduct: **[Description]**

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1.3 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Follow the Submittal Administrative Requirements as stated in Section 01 3300 "Submittal Procedures" Use electronic format only.

1.4 ACTION SUBMITTALS

- A. Before installation begins:
 - 1. Provide notification, in writing, of conditions detrimental to proper completion of the Work or conditions deviating from Drawings.
 - 2. Provide Shop Drawings of all pathway, vaults, boring, cutting or core drilling locations for review and approval by both the Owner's Project Manager and UIT Project Manager prior to work engagement.

1.5 INFORMATIONAL SUBMITTALS - Not Used

1.6 QUALITY ASSURANCE

- A. Perform all installation work for the new exterior telecommunications pathways in a neat and workmanlike manner.
- B. For horizontal directional drilling, follow all procedural precautions necessary to ensure that the essential aspects of proper directional bore installation are adequately controlled.

PART 2 - PRODUCTS

2.1 PARTS AND MANUFACTURERS

- A. Refer to Section 01 2500 "Substitution Procedures" for variations from approved manufacturers or parts. Obtain written approval for substitutions from both the Owner's Project Manager and the UIT Project Manager.
- B. TRENCH/BACKFILL MATERIALS
 - 1. Refer to Section 31 2333 "Trenching, Backfilling, and Compaction" for requirements.
- C. CONDUIT SYSTEM
 - 1. Non-Metallic Conduit:
 - a. PVC plastic pipe: ASTM D1785, Schedule 40, Type PVC 1120 if encased in concrete. If not, Schedule 80 is required.
 - b. Tone Tape: Arnco DL WP12LC Tone Tape, or equivalent.
 - 2. Electrical Metallic Tubing (EMT): Electro-galvanized steel tubing $\frac{3}{4}$ inch and larger diameter per project requirements.

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- a. Conduit joint couplings and connectors - steel double set screw indenter fittings.
 - b. Metal bushings for 3/4-inch and 1-inch conduit.
 - c. Insulated metallic bushings for 1-1/4 inch and larger conduit.
 - d. Insulated metallic bushings with grounding lugs as required.
 - e. Conduit sweeps - minimum 10 times the conduit inside diameter.
 - f. Include required conduit straps and hangers, heavy-duty malleable iron or steel. Perforated pipe strap and wire hangers are not permitted.
3. Inside Pull-Boxes: Refer to Section 27 0528 "Pathways for Communications Systems" for inside pull-boxes for conduit entering building.
 4. Outside Pull-Boxes: Minimum 14-gauge galvanized steel with weatherproof locking cover and hardware for surface mounting as required for Project. Dimensions as required for Project.
 5. Test mandrel: shall be 1/4 inch smaller than inside conduit diameter and minimum 12 inches long.
 6. Pull-rope: 1/4-inch Nylon pull rope.
 7. Core Drill Seals for Outside Building Walls: Link-Seal waterproof assembly or equal. Manufactured by PSI/Thunderline/Link-Seal.
 8. Conduit Caulking Compound: Choose compounds for sealing conduit ducts that have putty-like consistency workable with hands, at temperatures as low as 35 degrees Fahrenheit, do not slump at a temperature of 300 degrees Fahrenheit, and do not harden materially when exposed to air. Compounds shall readily caulk or adhere to clean surfaces of plastic conduit, metallic conduits, or conduit coatings; concrete, masonry; any cable sheaths, jackets, covers or insulation material and common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect on the hands of workers or upon materials.
 9. Underground Plastic Line marker: Manufacturer's standard permanent, continuous-printed polyethylene film tape with metallic core, intended for direct burial service; not less than 3 inches wide x 4 mils thick. Provide orange tape with black text reading "CAUTION FIBER OPTIC CABLE BELOW".
 10. Ground Wire: Bare Copper # 6
 11. Tracer Box: NEMA-3 4-inch x 4-inch weatherproof box
 12. Spacers for 4-inch Conduit: Carlon S289NJN Intermediate Spacer and S288NJN Base Spacer.
 13. Precast Concrete Vault:
 - a. General: Provide precast concrete communications vault as detailed on the Drawings and as required for installation of new duct-bank systems and connection to existing duct-bank systems at locations shown on the Drawings. Provide 4-foot x 8-foot x 6-foot deep precast vault.
 - b. Design: Vaults shall be steel reinforced and the complete vault assembly designed for H-20-44 bridge loading. Clearly indicate in submittals all dimensions and reinforcing steel.
 - c. Concrete: Construct vaults using concrete with a 4500 psi 28-day strength. Concrete mix shall be designed in accordance with ASTM standards.

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- d. Reinforcing Steel: Use intermediate or hard grade billet steel conforming to ASTM A15, deformed in accordance with ASTM A305.
 - e. Vaults: Vault and pull box covers for all non-traffic areas shall be made of ductile iron cover; covers in parking and traffic areas shall be cast iron and rated for heavy vehicular traffic. Mount covers in a 30-inch Type "B" or "WRM" frame. Dowel the frame and neck into the vault to prevent movement away from the opening. Mark voice and data communications vaults and pull box covers with the text "TELECOMMUNICATIONS".
 - f. Conduit Entry: For plastic conduits, include a bell end inside the vault or pull box, mounted flush and grouted to seal openings. Provide precast fiber type terminators for each duct-bank entry.
 - g. Grounding: A #4/0 bare copper ground wire shall penetrate the side wall in the bottom section of each vault and pull box and extend 48 inches inside and outside of the vault pull box.
 - h. Accessories: Provide knockouts, cable racks, sumps, steps, joint seals and other accessories shown on the Drawings or as required for a complete installation.
 - i. Duct Plug 4-inch: General Machine Products (GMP) 6668R16
 - j. End Bell 4-inch: Carlon E297N
14. Multi-cell Fabric Mesh Duct:
- a. Manufacturer: MaxCell.
 - b. Use only manufacturer's fittings, transition adapters, terminators, accessories and installation kits.

D. CABLE ROUTING HARDWARE

- 1. Cable Rack with Support Hardware as required:
 - a. 18-Hole: Condux 08380200, Chance C203-1126
 - b. Other sizes as required: Condux, Chance
- 2. Cable Rack Steps/Hooks:
 - a. 4-inch: Condux 08380600, Chance C203-1131
 - b. Other sizes as required: Condux, Chance
- 3. "S" Rack Supports: Condux, Chance
- 4. Step Lock Wedge: Panduit CHW-C20

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which the new exterior telecommunications pathways are to be installed.
- B. Verify field measurements and pathway routing conditions are as shown on Drawings.

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- C. If discrepancies or problems are found, notify Architect and wait for direction. Beginning of telecommunications pathway installation indicates Contractor's acceptance of existing conditions.

3.2 EXCAVATING, TRENCHING AND BACKFILLING:

- A. Comply with applicable provisions of Section 31 2333 "Trenching, Backfilling, and Compaction." Refer instances of uncertain applicability to the Architect/Engineer for resolution before proceeding with the Work.
- B. Before excavation, notify Owner's Project Manager and UIT Project Manager of work to be done so that service interruptions in existing fiber pathways can be prevented. A UIT employee must be present during excavation.
- C. Service outages, both planned and emergency, must follow the requirements set forth in the "Outage Planning Form" included in Division 00 and available in "Master Specifications" on the University's Facilities Planning and Construction web site.
- D. Locate and exposed all utilities, as necessary, prior to construction. Mark pavement as required.
- E. If any unknown and/or uncharted utilities are encountered during excavation, promptly notify Architect/Engineer and wait for instructions before proceeding.
- F. If unknown utilities are encountered and work is continued without contacting the Architect/Engineer for instructions, and damage is caused to said utilities, Contractor shall repair such damage, at his own expense, to the satisfaction of Owner or utility company concerned.
- G. Voice and data communications duct-banks shall be independent and not shared with any other systems.
- H. Accurately grade the bottom of trenches to provide proper fall and uniform bearing and support for each section of the conduit on undisturbed soil or 2 inches of sand fill at every point along its entire length. In general, grading for voice and data communications duct-banks and conduits shall be from building to vault, and from a high point between vaults to each vault.
- I. Do not backfill trenches until all required tests have been made by Contractor and approved by Architect/Engineer.
- J. Backfill shall be cement stabilized sand up to 6 inches above the top of conduit or duct-bank. Backfill up to grade shall be in maximum 6-inch lifts with minimum 95 percent compaction of lifts. Refer to Section 31 2333 "Trenching, Backfilling, and Compaction" for additional requirements.
- K. Opening and Re-closing Pavement, Landscape Areas and Lawns:
 - 1. Size cuts only as large as required for Work to be accomplished.
 - 2. Patch or replace using materials to match those removed.

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3. Ensure that patches are level and thoroughly bonded with the original surfaces.

L. Excavation in Vicinity of Trees: Comply with applicable requirements as stated in Section 31 1013 "Site Preparation" and on the tree protection Drawings.

M. Perform all trenching and backfill for new underground conduit system placement as shown on the Drawings.

3.3 CONDUIT SYSTEM PLACEMENT

A. Place new conduit system including maintenance holes as shown on the Drawings.

B. Maintain 12-inch clearance from all utilities. Conduit is to be encased in concrete slurry (flow fill) where proper distance cannot be obtained.

C. Cross telecommunications conduit ducts below gas piping.

D. Thoroughly clean all conduits before laying or using.

E. During construction, plug the ends of the conduits to prevent water washing mud into the conduits, vaults or buildings. Take particular care to keep the conduits clean of concrete, dirt or any other substance during the construction.

F. Pour a concrete cap on all new and reopened trenches under asphalt roadways and parking lots where concrete encasement is not used.

G. Support multiple conduits on preformed nonmetallic separators to provide not less than 1-inch spacing between exterior surfaces of conduit (Type 5). Space separators close enough to prevent sagging of conduits or breaking of couplings and watertight seals.

H. Place moistened pea-sized gravel and sand mixture in the trench for 20 feet on each side of the vaults (Type 4).

I. Multi-cell Fabric Mesh Duct:

1. Install all fabric mesh duct per manufacturer's requirements.
2. Populate all fabric mesh duct with a measured pull tape.

J. Securely anchor conduits in place with nylon tie-downs to prevent movement during the placement of concrete slurry (flow fill), moistened pea-sized gravel and sand mixture, and other backfill materials. Wire tie-downs are prohibited.

K. Conduit Joint Couplings:

1. Install PVC non-metallic fittings with solvent applied couplings.
2. Use an approved transition coupling to connect metal to plastic (PVC) conduits.

L. Conduit Joint Couplings:

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1. Install PVC non-metallic fittings with solvent applied couplings.
 2. Use an approved transition coupling to connect metal to plastic (PVC) conduits.
 3. Couplings may be threaded and/or glued to provide watertight seal at conduit junctions.
- M. Seal all conduit junctions and fittings watertight prior to pour of concrete slurry (flow fill). Make conduit couplings in accordance with the manufacturer's recommendation for the particular type of conduit and coupling selected and as approved.
- N. Unless otherwise noted on Drawings, a minimum 24-inch depth of cover is required above the top of all conduits.
- O. Provide communications drain box in conduit 6 feet from building outside wall penetrations as shown in Drawings.
- P. Transition to PVC coated Galvanized Rigid Conduit (GRC) at 5 feet from building outside wall penetrations.
- Q. For all offsets and sweep bends, provide fiberglass or PVC coated GRC.
- R. All conduit bends are to be minimum 3-foot radius or larger as noted on Drawings.
- S. Bury underground plastic line marker 12 inches above the telecommunications conduit.
- T. Cast into concrete a #6 bare copper ground wire directly above the telecommunications conduit and extend 4 inches into each vault space. Extend 6 inches of tracer wire into tracer box on outside wall of building directly above conduit entry point.
- U. Provide plastic conduit bell ends at each PVC conduit termination and for all conduit entering vaults.
- V. Avoid boring under concrete sidewalks. Remove and replace sidewalks as necessary.
- W. Extend the new conduit through the wall into the building, tunnel, or crawl space a minimum of 4 inches.
- X. Building, tunnel and vault core drills shall be sealed around conduits with approved waterproof plugging compound.
1. Seal openings around conduits that pass through inside building wall core drills with UL listed foamed silicone elastomeric compound. Refer to Section 07 9200 "Joint Sealants" for requirements.
 2. Seal openings around conduits that pass through outside building walls with a complete Link-Seal assembly for a waterproof seal. Slope conduit away from building.
 3. Seal openings around conduits that pass through vault walls with foundation foam on the interior of the core and silicone sealer on the inside and outside of the core for a waterproof seal.

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- Y. Place Maintenance Holes (MH) with the long dimension in line with the main conduit run. The conduit shall enter opposite ends of the MH on the short sides. Do not use the MH as a 90-degree bend in cable installations.
 - Z. Ream and bush the ends of the metallic conduit:
 - 1. Insulated metallic bushings for 1-1/4 inch conduit and larger.
 - 2. Insulated metallic bushings with grounding lugs for conduit entering Network Facilities (NFs).
 - AA. After conduit duct installation has been completed and concrete has set, pull "D" test mandrel through all new conduit ducts to verify duct integrity and ensure smooth interior surfaces free from burrs or obstructions that might damage cable sheaths.
 - BB. Following mandrel testing, draw cylindrical wire brush with stiff bristles through each conduit to clean the conduit and remove any concrete, dirt or other obstructions.
 - CC. Stub out conduits into NFs, and cabinets only enough to attach connector and bushings with grounding lugs, except conduits shall rise a minimum of 6 inches above the finished floor.
 - DD. Install new pull rope in all new conduit and extend three feet into each building space.
 - EE. Plug ends of the new conduit with watertight rubber conduit plugs, conduit caulking compound or conduit caps to ensure foreign matter does not enter the building.
- 3.4 CABLE ROUTING HARDWARE
- A. Place new cable routing hardware in the tunnels and in crawl spaces beneath the building as required and as shown on the Drawings.
 - B. Perform installation of routing hardware including anchoring and supports, grounding and bonding as specified in Section 27 0526 "Grounding and Bonding for Communications Systems."
 - C. Place new ladder, pulling-in irons, cable racks, "S" rack supports, and steps in new and existing vaults as required for backbone cable routing.
- 3.5 HORIZONTAL DIRECTIONAL DRILLING
- A. Notify Owner at least 48 hours in advance of starting horizontal directional drilling work. Do not begin directional drilling until Owner is present at the job site and agrees that proper preparations have been made.
 - B. No work shall commence until Traffic Control and Construction Permits are in place.
 - C. Site Preparation
 - 1. Prior to any alterations to work site, mark the entry and exit points.

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2. Make no alterations to the work site beyond what is required for operations.
3. Confine all activities to designated work areas.

D. Drill Path Survey

1. Accurately survey the entire drill path with entry and exit stakes placed in the appropriate locations within the areas indicated on Drawings.
2. If a magnetic guidance system is being used, the drill path shall be surveyed for any surface geomagnetic variations or anomalies.

- E. Following drilling operations, de-mobilize the equipment and restore the worksite to its original condition.

3.6 SAFETY

- A. Adhere to all applicable state, federal and local safety regulations and conduct all operations in a safe manner.
- B. Comply with Owner's Environmental Health & Life Safety (EHLS) procedures as provided on the University's EHLS web site.

3.7 CLOSE-OUT DOCUMENTATION

A. As-Built Drawings:

1. Submit Drawings in .dwg, .rvt and .pdf formats with notations reflecting any variations from the Specifications and Drawings, including as-built conduit routing.
2. Provide Excel spreadsheet with GPS coordinates of all handholds and manholes.

END OF SECTION 27 0543

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