

Specification Standards Communications Underground Ducts, Raceways and Structures 27 05 43

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. The work required under this Section consist of all primary, secondary, Information Technology underground ducts and raceway, including manholes and handholes for the project as shown on drawings and/or as specified herein.
- B. The Contractor is held responsible to be familiar with the provisions contained herein and with other Sections of this Specification as applicable to provide a complete underground outside plant infrastructure for cable installation. The approved vendor, designed agent or employee is held responsible to be familiar with the provisions contained herein and is assumed to possess the proper license(s), bonding, knowledge, manpower, and material applicable to the completion of the installation.
- C. In addition to the requirements stated in this document, all components and systems including conduits systems, duct banks, manholes and grounding; shall fully comply to the requirements of the UNM PPD Engineering & Energy Services Design Standards, Electrical Specifications for Contractors and UNM Personnel doing work at the University of New Mexico and the Utility Division's Utility Design Guidelines including but not limited to Section 02060 General Site Requirements, 02221 Excavation, Trenching, and Backfilling Utilities Systems, 02270 Temporary Erosion Control, 16010 Basic Electrical Methods and Requirements, 16015 Electric Work, 16110 Ductbank, 16120 Manholes, 16121 Grounding and Installation Methods. These Guidelines are found on the UNM PPD web site.

1:02 RELATED SECTIONS:

- A. Division 02, Section 02 00 00 Site Improvements (is existing conditions)
- B. Division 26, Section 26 00 00 Electrical Systems
- C. Division 26, Section 27 11 13 Communications Entrance Protection
- D. Division 26, Section 31 00 00 Earthwork (excavation, backfill, compaction, ect.)
- E. Division 26, Section 32 00 00 Exterior Improvements (concrete work, blacktop, ect.)
- F. Division 27, Section 27 05 26 Grounding and Bonding for Communications Systems.
- G. Division 27, Section 27 05 28 Pathways for Communications Systems.
- H. Division 27, Section 27 05 53 Identification for Communications Systems.
- I. Division 27, Section 27 11 13 Communications Entrance Protection.
- J. Division 27, Section 27 11 19 Communications Terminal Blocks and Path Panels.

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- K. Division 27, Section 27 11 23 Communications Cable Management and ladder Rack.
- L. Division 27, Section 27 13 13 Communications Copper Backbone Cabling.
- M. Division 27, Section 27 13 23 Communications Optical Fiber Backbone Cabling.
- N. Division 27, Section 27 13 33 Communications Coaxial Backbone Cabling.

1.02 REFERENCES

- A. Design and install and test data distribution systems per manufacturer's requirements and in accordance with state codes, local codes, requirements of authorities having jurisdiction, and particularly the following standards and practices. The Design Team and Contractor is responsible to determine and adhere to the most recent edition of these standards when developing their responses and completing the project installation.
 - 1. UNM IT Specifications and Standards
 - 2. BICSI TDM, Current Edition
 - 3. BICSI Customer Owned Outside plant Design Manual
 - 4. NFPA 70, The National Electric Code
 - 5. NESC, the National Electrical Safety Code
 - 6. Common Ground Best Practices
 - 7. Title 18, Chapter 60 NMAC
 - 8. ANSI/TIA-568-C.0, *Generic Telecommunications Cabling for Customer Premises*
 - 9. ANSI/TIA/568-C.1, *Commercial Building Telecommunications Cabling Standard*
 - 10. ANSI/TIA/568-C.2, *Copper Cabling Components Standard*
 - 11. ANSI/TIA/568-C.3, *Optical Fiber Cabling Components Standard*
 - 12. ANSI/TIA/EIA-569-B, *Commercial Building Standard for Telecommunications Pathways and Spaces*
 - 13. ANSI/TIA/EIA-606-A, *Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*
 - 14. ANSI/J-STD-607-A, *Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications*
 - 15. ANSI/TIA-942, *Telecommunications Infrastructure Standard for Data Centers*

1.04 System Overview

- A. The exterior telecommunications Pathways will provide a campus distribution system for all cabling that will be served by the building Equipment Rooms. Exterior pathways are required to connect new buildings or existing buildings with inadequate or obsolete entrance pathways to the campus telecommunications distribution systems. The pathways to the campus distribution system may include all or some of the following, maintenance holes, handholes, innerducts, and conduits.

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1.05 QUALITY ASSURANCE

- A. UNM IT will inspect the installation in progress. It is the responsibility of the Contractor to schedule regular and milestone inspection times with UNM IT. It is incumbent upon the Contractor to verify that the installation and material used has been inspected before it is enclosed within building features, buried, or otherwise hidden from view. The Contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. The number, size, raceway duct material and arrangement shall be as indicated on drawings and / or as specified herein.

2.02 CONDUIT:

A. General:

1. All conduits shall minimally be 4 inches or 5 inches in diameter as specified in Section 3.01.
2. PVC utility ducts shall meet NEMA TC-6 standard. PVC conduits shall be minimum of schedule 40 constructions, including if concrete encased.
3. All bends shall be factory made and be 10 times the diameter of the conduit. The proper bend radius for a 4 inch conduit is 40 inches.
4. Provide bushing on all conduit terminations.
5. Splice conduits with fittings approved by the conduit manufacturer for the specified applications.
6. Install a locate wire: Insulation type THHN color orange 12 AWG and terminated on each end.

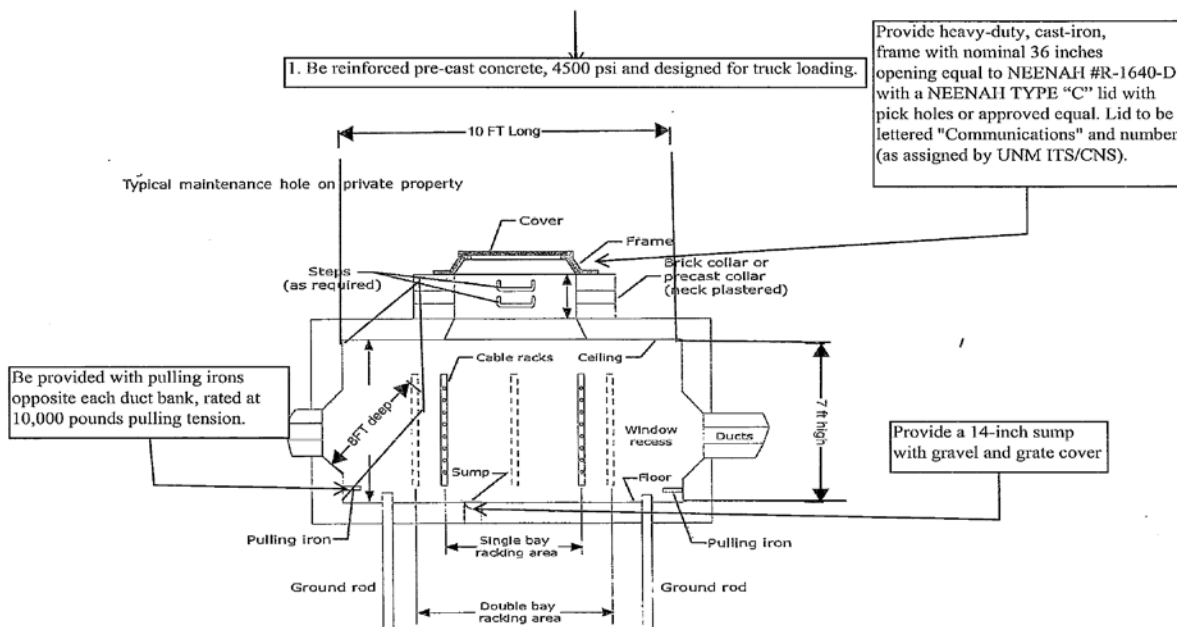
2.03 COMMUNICATIONS MAINTENANCE HOLES:

- A. Maintenance holes shall meet the requirements established in this section unless otherwise approved by UNM IT.



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1. Provide as specified in the project drawings specifications and as specified herein this section. All manhole specifications shall be submitted to UNM IT for approval prior to installation by RFI. Manholes are to be specified for all splice points unless otherwise specified.
2. Any conflicts in the requirements of these specifications shall be communicated to UNM IT in writing by RFI submittal.
3. Typical full size manholes shall be inside dimensions 10 feet long by 8 feet wide 7 feet high unless otherwise specified on the Drawings and Specifications. The exact manhole size and configuration shall be submitted to UNM IT Facilities for approval.
4. The manhole hole shall be constructed of reinforced pre-cast concrete, 4500psi and designed for truck loading.
5. Conduits shall enter and exit the maintenance hole in a straight line method. The remaining parallel walls are to remain free of conduit entrances. These walls are to remain free to allow cable support and splicing operations.



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6. Pulling irons shall to be provided on opposite side of the ducts, rated at 10,000 pounds pulling tensions.
7. Bonding jumpers shall be provide between each section and attached to reinforcing steel.
8. Pre-cast maintenance holes with reinforcing steel bonded together do not require an additional ground rod. Install a bonding ribbon horizontally around the top of the maintenance hole and attached to all cable racking and hardware. Continue installation vertically between bonding clamps so both top and bottom halves are bonded together on each side. The bonding ribbon will be used to bond all splice cases and hardware placed within the maintenance hole.
9. Cable racks shall be installed into the walls, arms and insulators must be provided with cable supports.
10. All manhole hardware shall have rubberized or hot dipped galvanized finish.
11. Provide heavy-duty, cast-iron, frame with nominal 36 inches opening equal to NEENAH #R-1640-D with a NEENAH TYPE "C" lid with pick holes or approved equal. Lid to be lettered "Communications" and number as assigned by UNM IT.
12. Provide 6 inch and 12 inch grade ring riser castings as required to elevate cover to approximately 1" above finished grade. The internal diameter of grade rings shall not to be less than internal diameter of manhole cover frame. Verify with manufacturer product availability to meet the installation requirements. Custom grade rings are acceptable upon prior approval of UNM IT. Cast-iron adjusting rings, Neenah #R1979 series or equal may be used to trim final elevations.
13. Securable and removable ladders are required for all handholes, and installed to meet OSHA guidelines. The distance from the top of the rim to the first ladder rung shall not be more than 18 inches.
14. Provide a 14-inch sump with gravel and grate cover.
15. Set manholes on leveled undisturbed earth with minimum 6 inches granular fill under the entire manhole before setting. If earth is disturbed during excavation,

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properly compact soil and provide 3 inches concrete leveling pad under entire manhole before setting.

16. Furnish and install manhole signage within chimney: to include manhole/handhole designator, measured distance to the next manhole, handhole access point or building, North designation and direction to adjoining maintenance holes and building entrance points. Signage shall be stamped metal attached to the chimney.

2.04 HAND HOLES

- A. Maintenance holes shall meet the requirements established in this section unless otherwise approved by UNM IT.
 1. Provide handholes as specified in the project drawings and specifications and as specified herein this section. All manhole specifications shall be submitted to UNM IT for approval prior to installation by RFI. Handholes should only be specified for pull through applications. Install manholes for all splice points unless otherwise approved by UNM IT.
 2. Any conflicts in the requirements of these specifications shall be communicated to UNM IT in writing by RFI submittal.
 3. The typical handhole inside dimensions are 4'L X 4"W by 4" H. The exact handhole size and configuration shall be submitted to UNM IT Facilities for approval.
 4. The handhole shall be constructed of reinforced pre-cast concrete, 4500psi and designed for truck loading.
 5. Conduits shall enter and exit the maintenance hole in a straight line method. The remaining parallel walls are to remain free of conduit entrances. These walls are to remain free to allow cable support and splicing operations.
 6. Pulling irons shall to be provided on opposite side of the ducts, rated at 10,000 pounds pulling tensions.

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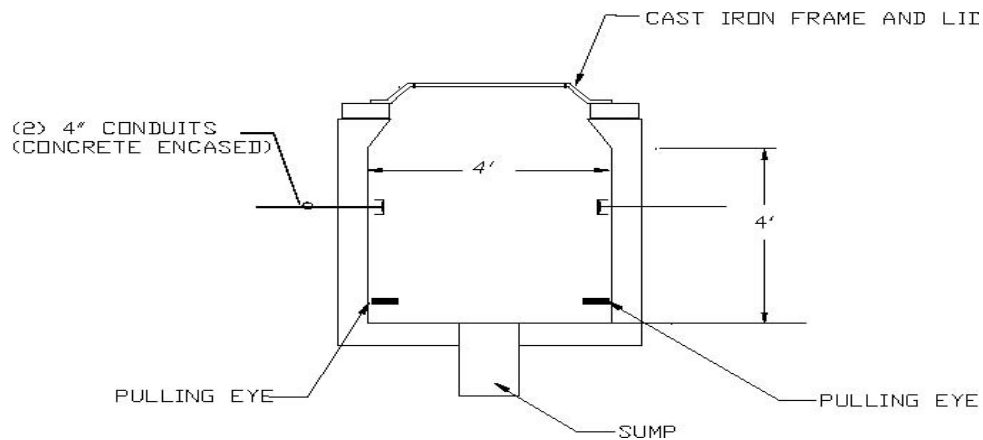
7. Bonding jumpers shall be provide between each section and attached to reinforcing steel.
8. Pre-cast handhole holes with reinforcing steel bonded together do not require an additional ground rod. Install a bonding ribbon horizontally around the top of the maintenance hole and attached to all cable racking and hardware. Continue installation vertically between bonding clamps so both top and bottom halves are bonded together on each side. The bonding ribbon will be used to bond all splice cases and hardware placed within the maintenance hole.
9. Cable racks shall be installed into the walls, arms and insulators must be provided with cable supports.
10. All manhole hardware shall have rubberized or hot dipped galvanized finish.
11. Provide heavy-duty, cast-iron, frame with nominal 30" to 36" inches opening equal to NEENAH #R-1640-D with a NEENAH TYPE "C" lid with pick holes or approved equal. Lid to be lettered "Communications" and number as assigned by UNM IT.
12. Provide 6 inch and 12 inch grade ring riser castings as required to elevate cover to approximately 1" above finished grade. Internal diameter of grade rings to be not less than internal diameter of manhole cover frame. Verify with manufacturer on availability. Custom grade rings are acceptable upon prior approval of UNM IT. Cast-iron adjusting rings, Neenah #R1979 series or equal may be used to trim final elevations.
13. Securable and removable ladders are required for all handholes, and installed to meet OSHA guidelines. The distance from the top of the rim to the first ladder rung shall be no more than 18".
14. Provide a 14-inch sump with gravel and grate cover.
15. Set on leveled undisturbed earth with minimum 6 inches granular fill under entire manhole before setting. If earth is disturbed during excavation, properly compact

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soil and provide 3 inches concrete leveling pad under entire manhole before setting.

- Furnish and install manhole signage within chimney: to include manhole/handhole designator, measured distance to the next manhole, handhole access point or building, North designation and direction to adjoining maintenance holes and building entrance points. Signage shall be stamped metal attached to the chimney.

17. Example of A Handhole:



2.05 INNER DUCT

A. Innerduct shall be installed where required and as specified and approved by UNM IT.

- Each innerduct shall have a one-half inch pre-lubricated, woven, 1250 pound tensile minimum polyester tape made from low friction, high abrasion resistant yarns placed within the innerduct and secured at each end. Tape shall be printed with sequential footage markings for accurate measurements.
- Install a single conductor locating wire in the inner duct conduit with a 14-gauge solid orange insulated wire for all non-metallic optical fiber cables.
- Where interlock armored fiber is the approved optical fiber cabling choice innerduct is not required or approved for empty conduit installations.
- Conduit and Innerduct sealing plugs shall be installed to seal all innerducts and conduits used or unused.

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2.06 Pull Boxes - Special Purpose

A. Special Approval Requirements

1. Verify and get approval for exact size, fit out and load requirements of special purpose handholes from UNM IT using a RFI submittal.

2.07 Directional Boring – Coil-able Duct

- A. In areas where surface obstructions make standard open trenching undesirable or cost-prohibitive, directionally boring a coil-able duct provides a viable option to the University. The coil-able duct shall be high-density polyethylene (HDPE) orange in color, sizes of 3", 4" or 5" nominal inside diameter, as specified on the Drawings. UNM IT specifies the following for coil-able duct:

- 3" SDR-13.5 (0.259" min. wall) per ASTM D-1248
- 4" SDR-13.5 (0.333" min. wall) per ASTM D-1248
- 5" SDR-13.5 (0.413" min. wall) per ASTM D-1248

- B. All vertical bends shall be made using Schedule 40 PVC bends with belled or coupled ends as specified. Under no circumstances shall a vertical bend be fabricated by "sweeping" it up to grade using the guided boring machine.

PART 3: EXECUTION

3.01 CONDUIT INSTALLATION

A. General Conduit / Duct Requirements

1. The exact number of building entrance conduits shall be determined and approved by UNM IT upon considering the site and building requirements. Furnish and install typically 4 - 4" building entrance conduits encased in concrete from the building main entrance or equipment room to the nearest telecommunications manhole or connection point, with the exception of boring applications.
2. Exact backbone conduit requirements shall be engineered and approved by UNM IT. Outside plant backbone pathways shall be typically comprise of two 5 inch conduits and four 4 inch conduits typically. Exact backbone conduit requirements shall be engineered and approved by UNM IT.
3. All bends must be manufactured factory long, sweeping bends with a ten times the internal diameter of conduits larger than (4 inches).
4. In underground raceways, angle couplings and bends alone or in combination



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with straight sections shall be used for direction changes. Direction changes made by skewing straight sections of conduits will not be permitted.

5. Orange locatable caution tape shall be installed in two rows 12 inches above all underground conduits.
6. Conduits may be non-metallic (PVC) or Rigid Galvanized Conduit heavy wall (RGC) conduit (as outlined in items B and C below) and indicated on the drawings and/or as specified herein.
7. Conduits shall be capped with manufactured caps (Duct Plugs) when installation is temporarily discontinued.
8. Conduits shall be cleaned by passing a wire brush mandrel and/or rubber duct swab (or approved alternative) of appropriate size back and forth until all foreign materials and water are removed.
9. Conduits shall be checked by pulling a round test mandrel, $\frac{1}{4}$ inch less than conduits size for each duct from both directions to remove obstructions.
10. Conduits shall be provided with continuous 1250 pound tensile strength conduit measuring pull tape in each duct terminated to prevent pullout.
11. No section of conduit shall have more than 180° of bends with a manhole or handhole installed for and access point.
12. No conduit run shall extend more than 350 feet without a manhole or handhole installed as an access point.
13. Conduit connections from buildings to manholes shall be installed with a minimum of 6 inch fall per 100 feet of conduit towards the manhole and sloping away from the building
14. Conduits shall be inspected and approved for correct formations and tied to prevent ducts from floating when concrete is poured.
15. The minimum separation from other utilizes is a follows
 - a. Power up to one KVA:
 - 12 inches of well- packed earth
 - 4 inches of masonry
 - 3 inches of concrete

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- b. Gas, Oil, Water, etc.:
 - 12 inches when parallel
 - 6 in. when crossing

16. A minimum of 30 inches bury depth (measured from top of concrete encasement to finished grade) is required.
17. Install a 6" orange warning tape labeled fiber optics. Install tape 12 inches above the entire conduit or ductbank.

B. Requirements for Non-metallic Raceways

1. Install for all raceways except where rigid conduit is required.
2. Install only manufacturer approved system components and methods.
3. Typical non metallic conduits installation consists of a minimum of PVC Type Schedule 40 with concrete encasement.
4. Provide minimum of 30 inches bury depth measured from the top conduit to finished grade.
5. Bond PVC duct with couplings using manufacturer approved adhesives.
6. Install metallic threaded adapter when attached to rigid conduit.
7. Protected from deformation during stockpiling. Maintain circular shape. Other configurations will not be permitted.
8. Comply with the manufacturers requirements for bending and cutting.
9. All joints wrapped with 1.5" or larger Scotch #88 tape as temporary concrete seal.
10. Provide with end bells flush with inside wall of manhole or vault.
11. Install an orange insulated 14 AWG copper locate wire in the ductbank and outside of any conduits and terminated in a approved method as specified by UNM IT.
12. Install a 6" orange warning tape labeled fiber optics. Install tape 12 inches above the entire conduit or ductbank.
13. Cover with select compactable soil free of stones and debris.

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C. Requirements for Rigid Galvanized Conduit Heavy Wall

1. Provide as specified in Section 26 05 33 - Raceways and Fittings.
2. The substitution of thin wall or medium wall conduit is not permitted for applications where rigid conduit is required or specified.
3. All entrance conduits shall be rigid conduit and also shall be used within excavated portion of building, where concrete encasement is not used
4. Extended 10 feet minimally from building into undisturbed earth.
5. Use for all conduit sweeps stubbed "in," or "out" of concrete bases for equipment housings or building entrances.
6. Provide in areas of extended backfill, requiring maximum strength against shear.
7. Provide crossing under tunnels.
8. Provide crossing under roadways when concrete encased ductbank or railways.
9. All joints wrapped with 1.5" or larger Scotch #88 tape as temporary concrete seal.
10. Provide with end bells flush with inside wall of manhole or vault.
11. Install an orange insulated 14 AWG copper locate wire in the ductbank and outside of any conduits and terminated in a approved method as specified by UNM IT.
12. Install a 6" orange warning tape labeled fiber optics. Install tape 12 inches above the entire conduit or ductbank.
13. Cover with select soil free of stones and debris.

D. Concrete Envelope

1. Provide as shown on drawing and in accordance with these specifications. Ductbanks shall not receive less than 3 inches of concrete cover all around and 1-1/2 inches between raceways.
2. 3000 psi, class 2, concrete ready mix per ASTM-94 shall be provided for all duct banks unless otherwise approved by UNM IT.

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3. Provide with a fine sand cover for initial curing except where waived by UNM IT in writing.
4. Rebar reinforcement is required where duct banks will cross roadways, railways or similar heavily traffic areas.
5. Install a 6 inch orange warning tape labeled fiber optics. Install tape 12 inches above the entire conduit or duct bank.
6. Install an orange insulated 14 AWG copper locate wire in the ductbank and outside of any conduits and terminated in a approved method as specified by UNM IT.
7. Protected against rain, flooding, freezing, etc., during curing.
8. Ensure no honeycombing occurs and be properly vibrated with small vibrator. Do not vibrate between ducts.
9. Concrete for the duct bank shall be placed in such a way that the duct bank will not be disturbed and that the sides of the trench do not crumble, using splash boards, proper placement, etc. The vertical drop of concrete from chute shall not exceed 30 inches.
10. Concrete shall be poured continuous from manhole to manhole. No pours shall originate between manholes.
11. Interval between base or intermediate spacers shall not exceed 8 feet with a minimum of two supports per length of duct.
12. Make provisions, such as nylon ties, to prevent the ducts from floating when concrete is poured.
13. Color top layer of concrete encasement by using "ORANGE" (for telecommunications) chalk dust while still wet, or dye the concrete.

E. Backfill:

1. Per Division 31 00 00 Earthwork (excavation, backfill, compaction, etc.).

3.02 DIRECTIONAL BORING

- A. Boring Depths - Coil-able duct shall be directionally bored at standard burial depths of 36" of cover for ducts housing primary cables and 24"-36" of cover for ducts housing secondary cables. UNM IT shall approve any exceptions in writing to the specified burial depths, up to a maximum 60" of cover from final grade.

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- B. Duct Joining - Sections of coil- able duct shall be joined using fusion couplings. Where the coil-able duct is to be joined with PVC conduit, the Contractor is to fuse a 24" straight piece of matching size PVC conduit to the coil-able duct. Prior to fusing, the Contractor shall make circumferential scores around the outside of the PVC conduit at the end that is to be installed into the fusion coupling. This will allow the fusion coupling to adhere to the dissimilar PVC conduit. A special epoxy is also available that joins the coil-able duct with standard PVC couplings. The epoxy and its application shall be approved with UNM IT prior to installation.

- C. Connections into Vaults and Manholes - Bored coil-able duct shall end 4' -5' from a new vault or manhole. This coil-able duct shall then be transitioned to the same size PVC before connecting into the structure. The transition to PVC shall be made using the techniques described in duct joining.

3.03 MANHOLE CABLE SUPPORT

- A. The cable supports described on the drawings or herein are intended to assist the Contractor in obtaining a satisfactory job and shall be altered to fit job conditions.

- B. In general, all cables in manholes shall be supported on 4 feet maximum centers for straight runs, on each side of splices, and within 2 feet of cable entering or existing a duct or termination.

- C. Do not install supports so that cables will block or cross ducts.

3.04 EXCAVATION

- A. Coordinated excavation with other trades, disciplines, specifications and drawing before starting work.

- B. Verify all elevations and arrangements are correct and there are no conflicts with other utilities. Verify that the entryways into manholes, buildings and other structures meet UNM IT Standards. It will be the responsibility of the Contractor and Design Team to ensure UNM requirements are met. All corrections needed to meet UNM Standards are the responsibility of the Contractor.

- C. Verify all utilities have been located. Complete all requirements of New Mexico One Call before excavating. Report any conflicts or omitted utility locates to UNM PPD and UNM IT.

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- D. If soil conditions are such that because of the depth or any other reasons the trench/excavation cannot conform to the size of the duct bank, provide forms and bracing as required.
- E. Contractor shall open entire length of trench and establish proper grades before beginning installation of any portion of connecting duct runs.
- F. Coordinate and comply with the requirements of Division 310000 - Earthwork and Division 020000 and all related sections of the project specifications for Excavation, Backfill, Concrete, Asphalt Repairs and Related Work.
- G. Depth of excavation shall be such that the required bury depths (top of concrete encasement) are met. UNM IT prior to installation shall approve any deviation from required depths. It is the responsibility of the contractor to call for an UNM IT inspection before closing any work.

3.05 REINFORCING:

- A. Reinforcing shall be installed when the following conditions are present and as specified in the project documents and References listed with this section.
 - 1. Where noted on drawings and /or as specified herein.
 - 2. Where connected to buildings and manhole walls, anchor there using projecting re-bars.
 - 3. Where crossing trenches for other work.
 - 4. At conduit joints.
 - 5. If continuous pour is impractical, provide (4) #4 reinforcing bars extending 6 feet into first and second pour.
 - 6. Where trenches cross roadways and railways.
 - 7. Reinforcing shall be supported from bottom of trench at least one inch and is not required if conduits are supported by saddles.

3.06 BACKFILL

- A. Shall not be installed until after concrete has reached initial set.
- B. Cover with select fill void of stones and debris.



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- C. Meet all requirements of the University Standards for excavation, backfill, compaction, and restoration.
- D. The Contractor shall restore landscape to its original condition or as specified by the project documents.

4.06 WARRANTY & AS-BUILDS

- A. The Contractor shall provide a 5 year warranty on materials and labor for all work associated with duct banks, manholes, handholes, associated apparatus and all other infrastructure components associated with this section. A certificate of warranty shall be provided to UNM IT as part of closeout prior to final invoice.
- B. The Contractor shall provide as-built drawings and documentation to UNM IT prior to final payment for this work.
- C. As-built information shall be in electronic (Auto Cad) drawings. Indicate location of all underground routes within the work area.
- D. If construction drawings are not utilized, Contractor shall provide all telecommunications location information on an accurate scaled Auto Cad formatted site plans.

End of Section