

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Raceway
 - 2. Rigid Metal Conduit and Fittings
 - 3. Electrical Metallic Tubing and Fittings
 - 4. Conduit Accessories
 - 5. Penetration Sealing Systems
 - 6. Telecommunications Outlet Boxes
 - 7. Pull Boxes
 - 8. J-Hooks
- B. This Section specifies the requirements to provide communications conduit raceways, boxes, cable trays, innerduct and fittings.

1.2 RELATED SECTIONS

- A. Contents of Division 27, Communications and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. Provide plan drawings showing completions and as-built corrections which indicate type, size, placement, routing and/or length for raceway and cable tray components; e.g., manholes, handholes, conduit, boxes, enclosures, etc.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.

1.7 DEFINITIONS

- A. Cabinet: A freestanding floor-mounted modular enclosure designed to house and protect rack-mounted electronic equipment.
- B. Conduit: Round raceway.

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- C. Conduit Body: Separate portion of a conduit or tubing system that provides access through removable cover(s) to the interior of the system at a junction of two or more sections of the system or at a terminal point of the system.
- D. Pull Box Enclosure: Box with a cover installed in one or more runs of raceway to facilitate pulling conductors through the raceway system. There are no openings in the cover.
- E. Raceway: Enclosed channel designed expressly for holding wires or cables. Metal or insulating material and the term includes conduit, tubing, wireways, underfloor raceways and surface raceways; does not include cable tray.
- F. Surface Raceway: Surface-mounted metal channel or plastic duct with snap-in removable covers for housing and protecting electrical wires and cables. Raceway and fittings are designed so sections can be electrically and mechanically coupled together without subjecting cables to abrasion.
- G. Wire Basket Runway Systems: Includes, but are not limited to straight sections of type wire basket runway cable trays, bends, tees, elbows, drop-outs, supports and accessories.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Raceway:
 - 1. Koppers Bitumastic
 - 2. Scotchwrap
 - 3. Or approved equivalent.
- B. Rigid Metal Conduit and Fittings:
 - 1. Sealing Fittings:
 - a. Crouse-Hinds
 - b. Or approved equivalent.
- C. Electrical Metallic Tubing and Fittings:
 - 1. Allied Tube and Conduit
 - 2. Wheatland Tube
 - 3. Appleton
 - 4. Or approved equivalent.
- D. Conduit Accessories:
 - 1. Duct Spacers:
 - a. Carlon
 - b. Allied Tube and Conduit
 - c. Or approved equivalent.
 - 2. Expansion/Deflection Fittings:
 - a. Appleton
 - b. Emerson
 - c. Or approved equivalent.
 - 3. Pulltape:
 - a. George-Ingraham
 - b. Greenlee
 - c. Or approved equivalent.
 - 4. Duct Plugs:

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- a. Carlon
 - b. Vikimatic
 - c. Or approved equivalent.
- E. Penetration Sealing Systems:
 - 1. SEMCO
 - 2. Or approved equivalent.
- F. Telecommunications Outlet Boxes:
 - 1. Raco
 - 2. Or approved equivalent.
- G. Pull Boxes:
 - 1. Hoffman
 - 2. Oldcastle (concrete)
 - 3. Or approved equivalent.
- H. J-Hooks:
 - 1. Erico
 - 2. Or approved equivalent.

2.2 RACEWAYS

- A. Raceways: Labeled and/or listed as acceptable to the AHJ as suitable for the use intended.
- B. Table 1: Product Identification:

Product Designation	Product Type
RGS	Rigid Galvanized Steel
CRS	PVC Externally Coated RGS
EMT	Galvanized Steel Tubing
PVC	Polyvinylchloride Conduit
LMC	Liquidtight Metal Conduit
LNC	Liquidtight Nonmetal Conduit

- C. The product identification codes used for the Communications Raceways and Boxes in Part 2, Products, are summarized in Table 1.
 - D. Bitumastic material or plastic tape.
- 2.3 RIGID METAL CONDUIT AND FITTINGS
- A. Conduit:
 - 1. Type RGS: Rigid galvanized steel.
 - 2. Type CRS: PVC externally coated conduit; rigid steel conduit with external PVC coating and internal galvanized surface.
 - B. Fittings and Conduit Bodies: In-line straight-through, threaded, galvanized steel fittings and Type C conduit bodies only; do not use bends or tees, e.g., Lbs.
 - 1. Bonding and Grounding Locknuts and Wedges: Malleable iron with set screws and lug screws.
 - 2. Insulated Bushing: Malleable iron with integral insulated throat, rated for 150C.

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3. Bonding and Grounding Bushing: Malleable iron with integral insulated throat, rated for 150C, with solderless lugs or lug screws.
4. Sealing Fittings: Threaded type conduit seal fittings and sealing compound suitable for hazardous location installations in accordance with NEC:
 - a. Crouse-Hind retrofit sealing fitting EYSR.
 - b. Crouse-Hind CHICO A sealing compound.

2.4 ELECTRICAL METALLIC TUBING AND FITTINGS

- A. Type EMT: Electrogalvanized steel tubing.
- B. Fittings and Conduit Bodies:
 1. In-line straight-through steel or malleable iron fittings and Type C conduit bodies only; do not use bends or tees, e.g. Lbs.
 2. Wet Areas: Steel compression-type couplings and nipples.
 3. Dry Areas: Set screw-type couplings and nipples.
 4. Bonding Locknuts:
 - a. Malleable iron with set screws and lug screws.
 - b. Insulated Bushing: Malleable iron with integral insulated throat, rated for 150C.
 - c. Bonding and Grounding Bushing: Malleable iron with integral insulated throat, rated for 150C, with solderless lugs or lug screws.

2.5 CONDUIT ACCESSORIES

- A. Duct Spacers:
 1. Nonmetallic base and intermediate duct spacers with locking keyways designed specifically for use with nonmetallic conduit; e.g., Carlon SNAP-LOC duct spacers for 4-inch diameter conduit with 1-1/2-inch separation.
 2. Base Spacer: S288NHN.
 3. Intermediate Spacer: S289NHN.
- B. Expansion/Deflection Fittings: Similar to Crouse-Hinds XD expansion/deflection coupling or Appleton DF Series deflection and expansion coupling.
- C. Pulltape: Measuring and pulling tape constructed of synthetic fiber with plastic jacket, printed with accurate sequential footage marks; e.g., George-Ingraham 1/2-inch tape 9216-JK.
- D. Duct Plugs:
 1. Aboveground Conduit Openings: Tapered PVC plugs with tab for pulltape; e.g., Carlon 4-inch PVC plugs with pull tab, P258NT.
 2. Underground or Underslab Conduit Openings: Removable screwtight compression type duct plugs with wing-nut and corrosion resistant hardware; e.g. Vikimatic 4-inch, Part Number 40D402U. Use appropriate part number according to duct size.

2.6 PENETRATION SEALING SYSTEMS

- A. Firestopping: Provide fire barrier penetration sealing materials as specified in Division 07, Firestopping Section.
- B. Duct Water Seal: Products suitable for closing underground and entrance duct openings, where innerduct or cable is installed, to prevent entry of gases, liquids, or rodents into the structure; e.g., SEMCO PR 851.

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2.7 TELECOMMUNICATIONS OUTLET BOXES

- A. Sheet Metal Outlet Boxes: Minimum 4-inch square by 2-1/8-inch deep, galvanized steel for use with single- or double-gang plaster rings.
- B. Five Square Outlet Boxes: Minimum 5-inch square by 2-7/8-inch deep with built-in cable management for use with single- or double-gang plaster rings. Randl P/N T-55017 approved.
- C. Nonmetallic Outlet Boxes: Minimum 4-inch square by 2-1/2-inch-deep. Provide gasketed, watertight single- or double-gang cover.
- D. Cast Boxes: 4-inch square by 2-1/8-inch deep cast Feralloy, gasketed single- or double-gang cover, threaded hubs. For hazardous locations, provide boxes approved for applicable atmosphere classification.
- E. Floor Boxes for Installation in Cast-In-Place Concrete Floors: Flush mounted and fully adjustable formed steel as shown on the Drawings. Floor boxes provided by Division 26, Electrical.
- F. Plaster Rings: Single- or Double-gang as shown on the Drawings.

2.8 PULL BOXES

- A. Construction: NEMA Standard No. 250. Type 1 galvanized steel enclosures designed for use as junction boxes and pull boxes with flat screw-applied covers, with or without knockouts and gray enamel finish.

2.9 J-HOOKS

- A. Constructed of galvanized steel, stainless steel or hot dipped zinc.
- B. Wires or all-thread supports mounted to structure.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Workmanship:
 - 1. Provide, condition, apply, install, connect and test manufactured products, materials, equipment and components in accordance with the manufacturer's specifications and printed instructions.
 - 2. The installation of system components to be carried out under the direction of qualified personnel. Appearance to be considered as important as mechanical and electrical efficiency. Workmanship to meet or exceed industry standards.
 - 3. Place support for raceways, cable trays, backboards, equipment racks and cabinets.
- B. Protection During Construction: Protect products from the effects of moisture, corrosion and physical damage during construction. Except during installation activity in a section, keep openings in conduit, tubing and wireway capped with manufactured seals during construction.
- C. Concrete Sleeves: Conduits routed perpendicular through floors, walls, or other concrete structures to pass through cast-in-place conduit sleeve openings wherever possible, or appropriate size holes to be bored to accommodate the installation of conduit sleeves. The size and location of the holes to not impair the structure's integrity.

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1. Concrete Boring: Bore a hole in the concrete with a diameter of 1/2 to 1-inch larger than the conduit sleeve to be installed. Grout around the conduit sleeve and finish to match existing surroundings.
 2. Conduits that rise vertically through a slab to be stubbed 6-inches above the floor and capped pending future use.
- D. Drywall/Gypsum Board Sleeves: Install insulating throat bushings on both ends of conduit sleeves placed in fire-rated walls using drywall construction.
- E. Where conduit enters a structure through a concrete roof or membrane waterproofed wall or floor:
1. Provide a watertight seal.
 2. With Concrete Encasement: Install watertight entrance seal device on the accessible side.
 3. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
 4. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
- F. Provide continuous sleeving through walls, floors and ceilings separating each telecom outlet from its respective MER/TR room, using sleeve conduit size as required per Standards. Restore penetrations through rated assemblies to original fire rating per NFPA and local codes.
- G. Locate sleeves as shown on Drawings. Where sleeves are not shown on Drawings, install sleeves above suspended ceilings and locate to minimize length of pathway for future cable from telecom outlet to MER/TR rooms.
- H. Where sleeves are routed between rooms with floating ceilings, extend conduits horizontally 2-feet over edge of floating ceiling to avoid exposed cabling from being seen at floor level.
- I. Make floor penetrations no more than 4-inches from wall. Install conduit stubs to extend 4-inches from floor base. Cap conduits for protection.
- J. Provide removable heat-expanding pillows at fire barrier penetrations as specified in Firestopping section and described as Firestop Material Type 7 (indicated as FSM-7).
- K. Grounding: Provide ground connections and bonding continuity between raceway and wire basket runway sections, boxes, enclosures, cabinets and fittings as required per code and industry standard.
- L. Provide plenum rated products, components and accessories for installation in plenums.

3.2 RACEWAYS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Raceway Identification Banding:
1. Degrease and clean surfaces to receive tape labels.
 2. Exposed conduits and wireway, including raceways above lay-in or accessible ceilings, together with associated pull boxes to be banded at intervals of not over 10-feet and at direction changes. Two-band identification to be different contrasting colors as follows:

Raceway Use	Color
Grounding	Green

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Telecom/datacom	Yellow
CCTV	White
Building monitoring and security	Grey

3.3 RIGID METAL CONDUIT AND FITTINGS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Conduit Type:
 - 1. Install the following types of circular communications raceway in the locations listed unless otherwise indicated on the Drawings.
 - a. Exterior, Exposed Including Roof: Rigid steel conduit.
- D. Conduit Bends and Sweeps:
 - 1. Make changes in direction of communications conduit runs with sweeps of the longest possible radius.
 - 2. Make sweeps in parallel or banked runs of conduits, 2-inches and larger in diameter, from the same center or centerline so that sweeps are parallel and of neat appearance.
 - 3. Field-Made Bends and Sweeps:
 - a. Use an acceptable hickey or conduit-bending machine.
 - b. Do not heat metal raceways to facilitate bending.
 - c. Before installing 4-inch field-made sweeps in duct banks, pull a 3-1/2-inch diameter by 12-inch long mandrel through duct sections to verify circularity and sweep radius.
 - 4. The angular sum of the bends between pull points and/or pull boxes to not exceed 180 degrees.
 - 5. Minimum Inside Bend Radius for Communications Conduit Bends, Sweeps, Boxes and Fittings:
 - a. One-inch conduit, 11-inches
 - b. Two-inch conduit, 21-inches
 - c. Three-inch conduit, 36-inches
 - d. Four-inch conduit, 48-inches
 - e. Other sizes, 10 times the inside diameter of the conduit.
 - 6. Do not install boxes, bends, elbows, tees, conduit bodies and other conduit fittings, which do not provide for the minimum inside cable bend radius specified in paragraph E above.
 - a. Conduit Bodies: In-line straight-through Type C conduit fittings can be used as pull boxes for conduit up to a maximum of 2-inches ID. Other conduit fittings, which include direction changes such as E, L, LB, LR, LL, LRT, TA, TB and X, are not allowed.
 - b. Refer design or installation conflicts with these requirements to the Architect.
- E. Aboveground Conduit Installation:
 - 1. Support conduit installed in aboveground interior and exterior locations at a maximum of 7-feet on center.
 - 2. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps.
 - 3. Securely attach aboveground conduit under the provisions of this Section.

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4. Only conduit servicing elevator equipment can be installed through elevator shafts or equipment rooms. These conduits may only enter the room and go directly to the equipment being supplied.
 5. Keep power wiring independent of communication system wiring.
 6. Arrange conduit to maintain headroom and present neat appearance.
 7. Do not install conduits on surface of building exterior, across roof, on top of parapet walls, or across floors, unless otherwise noted on drawings.
 8. Exposed conduits are permitted only in the following areas:
 - a. Mechanical rooms, electrical rooms or spaces where walls, ceilings and floors will not be covered with finished material.
 - b. Existing walls that are concrete or block construction.
 - c. Where specifically noted on drawings.
 - d. Route exposed conduit parallel and perpendicular to walls, tight to finished surfaces and neatly offset into boxes.
 9. Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block area passage's intended usage.
 10. Keep conduits a minimum of 12-inches away from steam or hot water radiant heating lines (at or above 104 degrees F) or 3-inches away from waste or water lines.
 11. Run exposed and concealed conduits parallel or perpendicular to walls, structural members, or intersections of vertical planes to provide a neat appearance. Follow surface contours as much as possible.
 12. No section of conduit located within buildings to exceed 100-feet in length between pull points and/or pull boxes.
 13. Expansion/Deflection Joints:
 - a. Where indicated on the Drawings, provide specific purpose expansion/deflection fittings for conduit crossing building expansion/deflection joints in structures or concrete slabs. Expansion fittings to have copper bonding jumper.
 - b. For PVC conduit, provide expansion/deflection joints for 25 degrees F maximum temperature variation. Install in accordance with manufacturer's written instructions.
 - c. For rigid steel conduit located in exterior areas, provide expansion/deflection joints for maximum site temperature variation, installed in accordance with manufacturer's written instructions.
 14. Provide each conduit passing from a nonhazardous or noncorrosive area to a hazardous area and each conduit entering an enclosure within a hazardous area with a sealing fitting in accordance with NEC Article 500. The sealing fitting is to be UL listed and to be filled with approved sealing compound of the same manufacture.
 15. Hubs, Bushings and Insulating Sleeves:
 - a. Interior Box and Cabinet Connections: Install insulating throat connectors wherever conduit terminates in boxes or cabinets. In addition, install bonding type locknuts at metallic conduit terminations.
 - b. Wet and Hazardous Box and Cabinet Connections: Use watertight threaded conduit sealing hubs with insulated throat and bonding type locknuts for fastening rigid steel conduit to cast or sheet metal pull boxes.
 - c. Exposed Conduit Terminations: Cap exposed steel communication conduit ends with bushings or smooth collars to protect cable sheath.
- F. Pulltape and Duct Plugs:
1. Following conduit installation, install pulltape (muletape) with preprinted foot markers in each empty conduit containing a bend or over 10-feet in length, except sleeves and nipples. Tie the pulltapes securely at each end.

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2. Immediately after pulltape installation, install removable manufactured plugs in empty conduit and wireway openings. For underground conduit openings, use screwtight, removable, watertight and dust-tight duct plugs.
3. Verify lengths at the time of installation and provide as-built documentation.

3.4 ELECTRICAL METALLIC TUBING AND FITTINGS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Minimum Conduit Size: Size recessed conduits to surface raceway serving multiple data outlets as follows. Sizing is based on TIA/EIA 569-B for 28 percent conduit fill, assuming Category 6 cables (nominal outer diameter 0.24-inch) to each data outlet. Provide recessed backbox between surface raceway and recessed conduit sized for conduit.

1 to 6 cables	1-inch conduit
7 to 10 cables	1-1/4-inch conduit
11 to 15 cables	1-1/2-inch conduit
16 to 20 cables	2-inch conduit
Above 20 cables	Use multiple runs of conduit from surface raceway based on above table

- D. Minimum Backbone Conduit Requirements: Install three 4-inch conduits from MER to each TR, unless otherwise noted on Drawings.
- E. Conduit Type:
 1. Install the following types of circular communications raceway in the locations listed unless otherwise indicated on the Drawings.
 - a. Interior Dry Locations, Exposed: EMT with set screw fittings.
 - b. Interior Dry Locations, Concealed (Not Embedded in Concrete): EMT with set screw fittings.
 - c. Interior Wet Locations: EMT with compression fittings.
- F. Conduit Bends and Sweeps:
 1. Make changes in direction of communications conduit runs with sweeps of the longest possible radius.
 2. Make sweeps in parallel or banked runs of conduits, 2-inches and larger in diameter, from the same center or centerline so that sweeps are parallel and of neat appearance.
 3. Field-Made Bends and Sweeps:
 - a. Use an acceptable hickey or conduit-bending machine.
 - b. Do not heat metal raceways to facilitate bending.
 - c. Before installing 4-inch field-made sweeps in duct banks, pull a 3-1/2-inch diameter by 12-inch long mandrel through duct sections to verify circularity and sweep radius.
 4. The angular sum of the bends between pull points and/or pull boxes to not exceed 180 degrees.
 5. Minimum Inside Bend Radius for Communications Conduit Bends, Sweeps, Boxes and Fittings:
 - a. One-inch conduit, 11-inches
 - b. Two-inch conduit, 21-inches

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- c. Three-inch conduit, 36-inches
- d. Four-inch conduit, 48-inches
- e. Other sizes, 10 times the inside diameter of the conduit.
- 6. Do not install boxes, bends, elbows, tees, conduit bodies and other conduit fittings, which do not provide for the minimum inside cable bend radius specified in paragraph E above.
 - a. Conduit Bodies: In-line straight-through Type C conduit fittings can be used as pull boxes for conduit up to a maximum of 2-inches ID. Other conduit fittings, which include direction changes such as E, L, LB, LR, LL, LRT, TA, TB and X, are not allowed.
 - b. Refer design or installation conflicts with these requirements to the Architect.

3.5 CONDUIT ACCESSORIES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Duct Spacers: Install per manufacturer's recommendation.
- D. Expansion/Deflection Fittings: Install per manufacturer's recommendation.
- E. Pulltape: Install per manufacturer's recommendation.
- F. Duct Plugs: Install per manufacturer's recommendation.

3.6 PENETRATION SEALING SYSTEMS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Seal conduit entering structures at the first box or outlet to prevent the entrance of gases, liquids, or rodents into the structure.
 - 1. Empty Conduits: Removable screwtight duct plugs.
 - 2. Innerduct Installed: Suitable duct water seal between conduit and innerduct. Manufactured seals in empty innerduct.
 - 3. Cable Installed: Suitable duct water seal between conduit and cable, or between innerduct and cable.

3.7 TELECOMMUNICATIONS OUTLET BOXES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. Provide 4-inch by 4-inch by 2-1/8-inch deep outlet boxes for mounting telecommunications outlets with single-gang or double-gang plaster rings as required, or as indicated on the Drawings.
- D. Do not install outlet boxes back to back in walls. Provide minimum 6-inch separation, except provide minimum 24-inch separation in acoustic-rated walls.
- E. Locate outlet boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for outlet boxes. Use boxes with sufficient depth to permit conduit hubs to be located in masonry void spaces.

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- F. Provide knockout closures for unused openings.
- G. Support telecommunications outlet boxes independently of conduit.
- H. Use multiple-gang boxes where more than one device is mounted together; do not use sectional outlet boxes.
- I. Install outlet boxes in walls without damaging wall insulation.
- J. Coordinate mounting heights and locations of outlet boxes mounted above counters, benches and backsplashes.
- K. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlet boxes in hollow stud wall.
- L. Provide cast outlet boxes in exterior and wet locations.

3.8 PULL BOXES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's written instructions and recommendations.
- C. In-Ground: Size and install per manufacturer's recommendations.
- D. Aboveground: Size and install per manufacturer's recommendations.

3.9 J-HOOKS

- A. Install J-hooks rated for Category 6 cable for support of cabling from the wire basket tray to the outlet location.
- B. J-hooks are to be installed on dedicated wires or all thread rods mounted to structure. J-hooks are not to attach to ceiling grid wires.

END OF SECTION

UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Vaults
 - 2. Vault Covers
 - 3. Precast Vault Concrete Materials
 - 4. Vault Components
 - 5. Handholes

1.2 RELATED SECTIONS

- A. Contents of Division 27, Communications and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 27 05 28, Pathways for Communications Systems

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Shop drawings detailing items provided under this Section:
 - a. Vault cover assigned designators
 - b. Duct entry schedule
 - c. Pulling iron working load
 - d. ASTM load designation and percentage increase in live load for impact
 - e. Vault Section weights.
 - f. Rebar and piling support details.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Installer will have documented experience in the placement of vaults for a minimum of 3 years.
 - 2. Manufacturer will have documented experience in the manufacturer of vaults for minimum of three years.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 27 00 00, Communications Basic Requirements and Division 01, General Requirements.

UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATION SYSTEMS

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Vaults:
 - 1. Oldcastle Precast
 - 2. Or approved equivalent.
- B. Vault Covers:
 - 1. Oldcastle Precast
 - 2. Neenah Foundry
 - 3. Or approved equivalent.
- C. Precast Vault Concrete Materials:
 - 1. Oldcastle Precast
 - 2. Or approved equivalent.
- D. Vault Components:
 - 1. Pull-In Irons:
 - a. McGraw-Edison
 - b. Joslyn
 - c. Oliver
 - d. Or approved equivalent.
 - 2. Vault Cable Rack Hardware:
 - a. Chance
 - b. Or approved equivalent.
 - 3. Grade Rings:
 - a. Neenah Foundry
 - b. Or approved equivalent.
- E. Handholes:
 - 1. Oldcastle Precast
 - 2. Chapman Electric Supply, Inc.
 - 3. Jensen Precast
 - 4. Or approved equivalent.

2.2 VAULTS

- A. Vaults will be precast, reinforced concrete Sections (top, base and where required, extension Sections) with knockouts or duct terminators PVC end bells or Carlon (utility vault Term-A-Duct) for main conduit entrances with recessed keyways and subsidiary duct entrances.
- B. Concrete inserts will be set in interior surfaces of walls of each Section to provide for cable rack mounting. Base Section will be equipped with pulling-in irons located opposite each main cable entrance.

2.3 VAULT COVERS

- A. Manufactured from metal casting, conforming to ASTM A48-83.
- B. Class 35B gray cast iron, with machine finished flat bearing surface.

UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATION SYSTEMS

2.4 PRECAST VAULT CONCRETE MATERIALS

- A. Concrete:
 - 1. Conforms to ASTM C478.
 - 2. Compressive Strength: 5000-PSI minimum at 28 days.
 - 3. Air Content: 4 percent minimum.
 - 4. Cementitious Materials: Minimum of 564-lbs/cu yd.
 - 5. Course Aggregates: ASTM C33. Sound, Crushed, Angular Granite Stone only. Smooth or rounded stone will not be used.
 - 6. Fine Aggregates: ASTM C33. Free from organic impurities.
 - 7. Chemical Admixtures: ASTM C494. Calcium chloride or admixtures containing calcium chloride will not be used.
 - 8. Air Entraining Admixtures: ASTM C260.
- B. Reinforcing Steel: ASTM A615 grade 60 deformed bar, ASTM A82 wire, or ASTM A185 welded wire fabric.
- C. Lift Loops:
 - 1. ASTM A416 steel strand.
 - 2. Lifting loops made from deformed bars are not allowed.
- D. Flexible Joint Sealants:
 - 1. Butyl rubber based conforming to Federal Specification SS-S-210A, AASHTO-198, Type B-Butyl Rubber and maximum of 1 percent volatile matter.
 - 2. Suitable for application temperatures between 10 and 100 degrees F.
- E. Epoxy Gels:
 - 1. 2-component, solvent-free, moisture-insensitive, high modulus, high strength, structural epoxy paste adhesive.
 - 2. Must meet requirements of ASTM C-881, Type I and II, Grade 3, Class B and C, epoxy resin adhesive.

2.5 VAULT COMPONENTS

- A. Lifting inserts, holes and devices to comply with OSHA Standard 1926.704. Size lift holes and inserts for precision fit with lift devices and will not penetrate through structure wall. Precast manufacturer will provide lifting devices.
- B. Internally seal joints between tongue and groove; additionally, seal around external perimeter of the joint as follows:
 - 1. External seals to consist of polyethylene backed flat butyl rubber sheet no less than 1/16-inch thick and 6-inches wide applied to outside perimeter of joint.
 - 2. Internal seals to consist of plastic or paper-backed butyl rubber rope no less than 14 feet long and having cross-sectional area no less than annular space times height of joint.
 - 3. At option of Contractor, internal seals on round joints may consist of O-ring gasket conforming to ASTM C443, installed according to Precast Manufacturer's recommendation.
- C. Precast base Sections will be cast monolithically without construction joints or with approved galvanized or PVC water stop cast in the cold joint between base slab and walls.

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- D. Wall and inside slab finish resulting from casting against forms standard for industry will be acceptable. Form ties through the wall are not allowed. Exterior slab surfaces below grade will have float finish. Small surface holes, normal color variations, normal form joint marks and minor depressions, chips and spalls will be tolerated. Dimensional tolerances will be as set forth in appropriate references.
- E. Conduit openings will not extend into corners of structures, but may extend across joint with Engineer's approval.
- F. Knockout panel dimensions will be as required by structural design at their maximum burial depth using design loads specified.
- G. Design components in accordance with ACI, ASTM C890 and the following loads:
 - 1. Horizontal load on walls and knockout panels will be load of 80 psf per foot of burial depth (using a burial depth of 20-feet) plus a live lateral surcharge due to HS20 traffic load of 80 psf.
 - 2. Vertical load on below grade adaptor slabs and tops will be fill height of 20-feet assuming soil unit weight of 100 lbs/ft, plus live HS20 traffic load.
 - 3. Vertical load on covers supported around perimeter will be live HS20 traffic load.
- H. Rectangular sub-grade components to be designed and manufactured in conformance with ASTM C913 and as follows:
 - 1. Joints between precast components will be keyways or tongue and groove. Joints to accept cast iron frames will be flat and no less than 5-inches wide.
 - 2. Construct access vault structures to sizes and elevations shown on Drawings.
 - 3. Manholes and Hardware:
 - a. Each manhole will be provided with one galvanized 3/4-inch rebar x 16-inches wide bolt-on ladder, mounting pads and mounting hardware. Rungs will be at 12-inches centers. Side rails will be 2-inches x 5/16-inches flat bar.
 - b. Each manhole entrance will be supplied with one galvanized 3/4-inch x 16-inches wide bolt-on manhole step.
- I. Pull-In Irons:
 - 1. Each wall of each vault will have a 7/8-inch hot-dipped galvanized pull-in iron centered under the new and future duct line openings. Pull-in irons will be McGraw-Edison, Joslyn, or Oliver.
- J. Vault Cable Rack Hardware:
 - 1. Cable Rack: Chance #1225
 - 2. Cable Rack Hooks: Chance #1231
 - 3. Cable Rack Insulators: Chance #1121
- K. Grade Rings:
 - 1. Rings, covers and frames will be Class 35 gray iron. Covers and frames will be equal to Neenah Foundry #R-1530 manhole frame Type B non-rocking lid.

2.6 HANDHOLES

- A. Housing: Polyester pre-mix with calcium carbonate and polyester resins interlaced with fiber fiberglass and ultraviolet inhibitors.
- B. Extension Rings: Capable of accepting up to 18-inches of extension rings to adapt to re-leveling of grade during Phase 2 construction (see site plans for phased site construction).

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- C. Lid: Reinforced concrete with concrete leading lid same size as opening of housing for as much hand space as possible for cable access.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Requirements for Precast Concrete Vaults: Coordinate delivery of precast concrete manhole components to jobsite with manufacturer. Handling of materials will be done in accordance with ASTM C891 and manufacturer's recommendations. Handle and store components on job site using methods that will prevent damage.
- B. Cleaning Vaults: Vaults will be clean and left free of debris, silt and rocks from installation work.

3.2 VAULTS

- A. Excavate to required depth and remove materials that are unstable or unsuitable for good foundation. Prepare level, compacted foundation extending 6-inches beyond base. Some vaults may be piling supported. Check structural drawings and details.
- B. Set base plumb and level.
- C. Provide minimum 18-inches of pea gravel below pull vault for stability and drainage.
- D. Thoroughly clean bells and spigots to remove dirt and other foreign materials that may prevent sealing. Unroll butyl sealant rope directly against spigot or keyway. Leave protective wrapper attached until sealant is entirely unrolled. Do not stretch. Overlap from side to side, not top to bottom.
- E. When recommended by manufacturer, fill void between horizontal joint surfaces with sand cement grout around the outside perimeter.
- F. After joining Sections, apply butyl sealant sheet around outside perimeter of joint.
- G. Lift holes leaving less than 2-inches of wall thickness will be plugged from outside using sand cement mortar then covered with butyl rubber sheet. Lift holes penetrating wall will be additionally sealed with epoxy gel on interior.
- H. Set frames or tops to required elevation sealing joints with butyl sealant rope and sheet.
- I. Provide pulling-in irons opposite and above each conduit entrance.
- J. Provide cable racks in each vault for support of conductors.
- K. Provide 3/4-inch by 10-foot copper ground rod at each vault.

3.3 VAULT COVERS

- A. Reference 3.01, General Installation Requirements and 3.02, Vaults, above.
- B. Install per manufacturer's instructions and recommendations.

3.4 PRECAST VAULT CONCRETE MATERIALS

- A. Reference 3.01, General Installation Requirements and 3.02, Vaults, above.

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- B. Install per manufacturer's instructions and recommendations.

3.5 VAULT COMPONENTS

- A. Reference 3.01, General Installation Requirements and 3.02, Vaults, above.
- B. Install per manufacturer's instructions and recommendations.

3.6 HANDHOLES

- A. Excavate to required depth and remove materials that are unstable or unsuitable for good foundation. Prepare level, compacted foundation extending 6-inches beyond base. Some vaults may be piling supported. Check structural drawings and details.
- B. Set base plumb and level.
- C. Provide minimum 12-inches of pea gravel below handhole for stability and drainage.
- D. Turn conduits up into handhold with required bend radius per guidance in 27 05 28, Pathways for Communications Systems; and TIA/EIA standards for fiber optic cabling.
- E. Engrave cover of handhole to identify its purpose (examples: "Power," "Emergency Power," "Signal," "Fire Alarm").

END OF SECTION