

**TELECOMMUNICATIONS
INFRASTRUCTURE
SPECIFICATIONS**

- PATHWAYS AND SPACES -

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A) Equipment and Materials Minimum Requirements

Supply all Equipment indicated for an installation, including but not limited to:

- Mounting brackets
- Grounding and bonding clamps, busbars, wire, etc.
- Hangers, clamps, and other mounting hardware
- Bushings, and other miscellaneous hardware
- Labels, etc.
- Fire-retardant 3/4" plywood backboards painted with a fire resistant, non-conductive, low gloss, light colored paint (fire rating label shall not be painted over).

B) Cables Not in Raceway

Cable routes shall be coordinated with the Rutgers University telecommunications project manager so as not to block access panels, utilize reserved space, etc.

Cables shall be routed parallel to walls.

The suspension method and height shall be code compliant and subject to approval by Rutgers University.

C) Cable Hangers and Supports

Supply all Equipment required for a safe, secure and code compliant installation, including but not limited to:

- Brackets, hangers, clamps, and other mounting hardware
- Bushings, and other miscellaneous hardware

The Contractor shall be responsible to review all cable racking and riser support details and confirm they are adequate to support the maximum loads resulting from the cabling that could be inferred from the current design. It shall be the Contractor's sole responsibility to provide anchors and miscellaneous hardware to insure the structural integrity of the cable supports.

D) Concealment Required

Except within Horizontal Cross-Connects (HCs) and Main Cross-Connects (MCs) and above accessible ceilings, all wiring shall be within raceway unless otherwise specified by Rutgers. Accessible ceilings shall include any ceilings with a void

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through which cable can be routed. Use best efforts to conceal wiring within walls and ceilings.

E) Metallic Surface Raceways

Hoffman Part Numbers: F22 Series and F44 Series

Raceway shall be of a type and color approved by Rutgers University.

Install parallel or perpendicular to the floor and walls.

Raceways shall include all required fittings, angles, etc. Raceways shall have fitting and/or end cap at each end. All angles shall be made using manufactured fittings, field cutting and mitering of the raceway will not be permitted. Code and manufacturers minimum bend radii for all cables shall be maintained.

Fastening raceways: Raceways must be securely fastened in place by means of approved screws, anchors, supports and fastenings. Arrangement and method of fastening raceway shall be subject to the direction and approval of Rutgers University. Double sided tape shall not be used in place of screws or other fasteners.

F) Non-Metallic Surface Raceways

Panduit Part Number: LDP Series

Raceways shall include all required fittings, angles, etc. Raceways shall have a fitting and/or bushing at each end. All angles shall be made using manufactured fittings, field cutting and mitering of the raceway will not be permitted. Code and manufacturers minimum bend radii for all cables shall be maintained.

Surface raceway shall be of a type and color approved by Rutgers University.

The station end of raceways shall be terminated in a box appropriate for the proposed jack.

Raceways shall be installed parallel or perpendicular to the floor and walls.

Fastening raceways: Raceways must be securely fastened in place by means of approved screws, anchors, supports and fastenings. Arrangement and method of fastening raceway shall be subject to the direction and approval of Rutgers University. Double-sided tape shall not be used in place of screws or other fasteners.

G) Conduit

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Conduit or Electrical Metallic Tubing (EMT) shall contain no more than two (2) 90 degree bends and have an aggregate bend of no more than one-hundred and eighty (180) degrees without a pull box. Pull boxes to be installed in straight sections only.

In new construction, one-inch conduit shall be installed to each WP backbox. Where conduit feeds raceway it shall be sized accordingly taking into consideration the number of cables the raceway will accommodate. Conduit shall stub out above accessible ceiling space. All conduit shall be reamed and bushed.

Install parallel or perpendicular to the floor and walls.

Conduits passing through fire rated construction: Seal opening with fire sealant.

Fastening conduit: Conduit must be securely fastened in place by means of approved screws, anchors, supports and fastenings. Arrangement and method of fastening conduit shall be subject to the direction and approval of Rutgers University.

Where riser conduits pierce floors slabs, rest on each floor with approved beam clamps or pipe straps. Do not support conduit from ductwork, piping or other equipment. Combined strength of supporting equipment and size and type of anchor shall be based on combined weights of conduit, hanger and cables.

Lubricant shall be used for pulls longer than ten feet (10') or containing more than ninety degrees in bends.

Conduit expansion fittings together with bonding jumper shall be provided where each conduit run crosses an expansion joint in concrete structure. Expansion fitting shall be installed on one side of joint with its sliding sleeve flush with joint and a length of bonding jumper in expansion joint equal to at least three times nominal width of joint.

H) Back boxes

WP's shall be installed using double gang back boxes with single gang mud rings in new construction, Carlon Zip Boxes in existing fishable walls and Panduit or Wiremold surface boxes.

Carlon Part Number: B100RB (single gang)
 B200R-CRD (double gang)

Panduit Part Number: JB1DIW-A (single gang) with JB1DB plate
 JBP2DIW (double gang)

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Wiremold Part Number: V5744 (single gang)
V5744-2 (double gang)

I) Sleeves

Sleeves shall be provided in all wall and floor penetrations. All sleeves in floor penetrations and in penetrations in fire-rated walls shall be fire stopped.

J) Ladder Tray

Where shown, ladder tray shall be provided and installed.

Ladder tray shall include Southwest Data Products Universal Cable Runway (SWDP Part #SWE2250-12G) and all associated components to make a complete and functional system. Including but not limited to: Support Brackets (SWDP Part #SWE2312-G), Wall Angle Cable Runway Support Kit (SWDP Part #SWE2421-12G), Cable Runway Radius Outside Bend (SWDP Part #SWE2723-12G), Cable Runway Radius Inside Bend (SWDP Part #SWE2724), Cable Runway E-Bend (SWDP Part #SWE2822) and Cable Runway Movable Cross Member (SWDP Part #SWE2115).

6 inch (SWDP Part#SWE2250-6G) and 18 inch (SWDP Part #SWE2250-18G) wide ladder racks, with all associated hardware, shall be provided as required for individual projects.

All cable trays and ladder racks shall be securely supported from the walls and ceilings, as required.

K) Tie Wraps

Tie wrap cable bundles every 4 feet, maximum, and support properly. Cables shall not be supported by sprinkler pipes, hung ceiling tiles, grid or other portions of the ceiling support system.

Tie wraps shall be rated for the purpose and location of installation. (i.e. Plenum rated tie wraps shall be used when installed in plenum spaces above certain hung ceilings).

L) Measuring Tapes and Pull Lines

Pull lines shall be provided in all empty conduits longer than 10 feet.

M) Innerduct

All optical fiber cable shall be run in innerduct.

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All innerduct used within buildings shall be riser-rated unless plenum rating is required.

Endot Industries Part #: ENDOCOR/PL (plenum) or equivalent
ENDOCOR/RI (riser) or equivalent

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A) Conduits

Lubricant shall be used for pulls longer than ten feet (10') or containing more than ninety degrees in bends.

The OSP facilities shall have 4" (four-inch) diameter schedule 40 conduits arriving at the building Telecommunications Entrance Facility in quantities appropriate with the requirements of the facility.

a) Duct Types

All ducts shall be Schedule 40, unless otherwise noted.

All PVC single cell duct shall be 4-inch inside diameter Carlon Plus 40 Rigid PVC or approved equal, conforming to NEMA standards T6-2 and UL651. Newly installed duct banks will require 3 1-1/4" inner ducts installed in one of the 4-inch conduits.

b) Bends

The minimum bend radius for all conduit between pulling points shall be ten times its diameter. There shall be no sharp bends or turns located between pulling locations. PVC elbows shall have a minimum radius of 36".

Where sharp bends or turns are required, prefabricated fittings will be used unless such bends or turns prohibit the pulling of large cables. No conduit or raceway run shall have more than three (3) bends and have an aggregate bend of not more than one-hundred and eighty (180) degrees without the use of a properly positioned manhole, or pull-box.

Where long turns or bends are required in the duct structure, the duct sections shall be formed, provided that large radius turns can be properly made without deformation of the duct cross-section.

Changes in direction of runs exceeding 10 degrees shall be accomplished by field bending conduits with a PVC bender for PVC ducts.

c) Joints and Fittings

Watertight joints between sections of ducts will be made using appropriate and approved couplings and solvent cement. Conduit fittings located where conduit enters building above grade shall be 4", large radius LB Mogul type fittings, as manufactured by Appleton Electric Company or approved equal.

Duct sections shall be joined by use of couplings installed as recommended by the Manufacturer of duct. Where duct lines enter buildings or manholes, the conduits shall terminate in standard end bells.

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d) Separators

Manufacturer- and Rutgers University-approved PVC duct separators shall be placed at intervals of approximately six (6) feet and fastened securely.

e) Rigid Conduit Required

Rigid hot dipped galvanized steel 4", Schedule 40, shall be used as part of the duct system where conduits are exposed, cross open ditches, are attached to bridges or similar structure, pass under railway tracks, etc. All exposed LB fittings shall be weatherproof design of the cast malleable iron type with a triple-coat finish of zinc electroplate, dichromate and an epoxy powder coat or approved equal. All exposed pull boxes, junction boxes, etc., shall be NEMA 4 enclosures of rigid hot dipped galvanized steel or approved equal. Galvanized steel conduits shall be used from the inside of buildings to undisturbed earth and from the inside of manholes/handholes to undisturbed earth to prevent a "shearing point" at the building or manhole/handhole edge. Conduits terminating inside a building or manhole/handhole will be installed so that the conduit extends four (4) inches beyond the surface from which it emanates. Conduits shall be plugged with inserts to ensure that foreign matter does not enter the building. The ends of metallic conduit shall be reamed, bushed and grounded according to the National Electric Code. All conduits are to be installed with a minimum 200-lb. test non-corrosive graduated pull tape. The routing of conduits under the building foundation shall be minimized.

When run inside of buildings, all OSP cables shall be enclosed by conduit or raceway where appropriate, such as when required by Fire Codes, exposed to steam pressure relief valves, or in public areas.

f) Mechanical Requirements

All conduit and innerduct shall be free from holes, splits, cracks, blisters, inclusions, and other performance affecting imperfections. The bores shall be free from dimensional non-uniformity, and the wall thickness shall be concentric in accordance with sound commercial practices.

g) Slope

The duct systems shall be sloped to permit penetrating water to drain towards the manhole(s). The highest point of the duct array will be at the center of each run, or the building entry point.

h) Cleaning and Sealing of Ducts

All conduit and innerduct shall be free of earth, debris, etc. All ducts utilized for cable placement shall be subsequently sealed through use of fire-rated UL listed duct seal putty, foam, etc. to provide a gas and watertight seal around the cables.

Conduit shall be thoroughly cleaned before placement. To prevent water from washing mud into the conduits, the ends of the conduits shall be plugged during construction and after the duct line is completed. Particular care shall be taken

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to keep the conduits clean of concrete or any other substance during course of construction.

Where connection is made to existing duct which is of a different material and shape than the duct being installed, a suitable coupling of the type recommended by the duct manufacturer shall be used.

i) Trench Depth

The recommended maximum trench depth is five feet. The minimum trench depth shall be no less than 3'-8" under pavement and 2'-6" under lawns. Trenches shall be excavated to a depth 4" below the bottom of the system. The minimum cover from the top of encasement shall be 2'-0" below finished grade or finished paving. If soft spots are encountered, the excavation shall be taken to soil of suitable bearing. Per OSHA requirements, trenches of four feet or greater must be properly sloped, benched, or shored.

j) Trench Grading

A uniform trench grade shall be maintained to eliminate dips. The trench shall be graded so that it has a fall of four inches in 100 feet toward the lower manhole or from the high point of the section toward both manholes to allow for conduit drainage. The high point of the trench should conform to the high point of the ground surface. Where the ground between manholes is level, use the middle of the section as the high point and grade each way. Where the surface slopes between manholes, establish the trench high point twenty-five feet from the higher manhole and grade toward the lower manhole.

k) Trench Bedding

The trench base shall be evenly graded to provide an even bedding for the duct bank. Low spots shall be filled and tamped evenly. Ducts shall be placed on top of 4" of sand bedding.

l) Conduit Placement

PVC duct separators or spacers shall be used every six feet to provide positive construction and spacing of the conduits into a firm, single conduit assembly.

All conduits shall be rodded and mandrelled, and innerducts shall be installed where required. All ducts including inner ducts shall have a 200 pound test strength non corrosive graduated pull tape installed, and each end shall be sealed with a rubber or plastic duct plug or cap before the section can be accepted.

If it becomes necessary to cut, move, change or reconstruct any surface or subsurface, or connection, such work shall be done to the satisfaction of the University. The Vendor shall provide bridging, hangers or other supports to maintain and support in an entirely safe condition all surface and subsurface structures, and all their appurtenances encountered or affected during this work.

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For pavement, concrete or asphalt cutters shall be utilized. All cuts shall be replaced score to score. Cuts in sidewalk shall be made from score to score in order to provide uniform replacement of sidewalk.

m) Sand Filling

The lower part of the trench for its entire length shall be carefully back-filled with clean, uniformly graded sand. The remainder of the trench shall be back-filled with clean subsoil free of clay, organic matter, debris or other unsuitable material.

n) Concrete

The Vendor shall be responsible for the design mix. Concrete shall have an ultimate compressive strength of 3000 psi at 28 days.

Concrete shall not be placed when the air temperature is expected to fall below 40 degrees F. No frozen materials, nor calcium chloride, salt or other antifreeze material shall be used. For hot weather placement, mixture shall be kept below 90 degrees F.

o) Back-filling

All backfill materials shall be tamped in layers not to exceed eight-inches (8") in thickness and mechanically compacted to assure a compaction of fill of 95% maximum density.

12" below grade and centered along the duct bank, the Vendor shall place a continuous detectable metallic warning tape labeled "Communications".

After back-filling the trench, the Vendor is responsible for the removal from site and disposal of all unused excavated material.

p) Required Separation

The following minimum vertical or horizontal separations between telecommunications facilities and other facilities shall be maintained:

- ◆ From power or other foreign conduit, a minimum of 3-inches of concrete, or 4-inches of masonry, or 12-inches of well-tamped earth.
- ◆ From sewer, water, or other such utility pipes, a minimum separation of 6-inches when crossing and 12-inches when parallel.
- ◆ From gas, oil, or other such fuel pipes, a minimum separation of 36-inches whether crossing or parallel.
- ◆ From high temperature hot water lines, a minimum of 6 ft. Use 6" of insulating cement or such other quantity and/or type of insulation as

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designated as a further separator between the duct bank and the high temperature hot water lines.

These are minimum requirements. Note that local codes may require more stringent separations. It is the Vendor's responsibility to conform to all appropriate codes and regulations.

B) Innerduct

Innerduct shall be composed of extruded, corrugated wall, coilable PVC tubing, 1-1/4" I.D. as manufactured by:

- Arnco Corp. Strand-Guard Flexible Corrugated Figure-8 Duct, 1-1/4 in., 6.6 M strand (or equivalent) must be used for outdoor aerial runs.
- Endot Industries Enduct 166/11 with minimum 900 lb. pull tape is acceptable for use in non-aerial applications.
- Endot Industries Endocor 1250 with minimum 900 lb. pull tape is acceptable for use in non-aerial applications.
- Manufacturer's recommended installation guidelines must be followed.

C) Manholes

a) Placement

Manholes shall be placed in accordance with University documents and drawings.

b) Maximum Run Length

Maximum distances between manholes and from manholes to buildings shall not be greater than 600 feet for a straight run or for a run containing an aggregate of 45-degree bend, and 400 feet for a run containing an aggregate of 90-degree bend. The total number of bends in a conduit run shall not exceed two 90 degree bends or equivalent of sweeps and radius bends. Each bend will have a minimum radius in accordance with existing standards (ten times the I. D. Minimum for the bend radius). Exceptions dependent upon actual physical limitations shall be reviewed on a per-case basis.

c) Type

Manholes shall be pre-cast steel reinforced concrete construction with a minimum test strength of 4000 psi at delivery and 5000 psi at 28 days with rubber gasket joints. All pre-cast manholes to be designed to minimum standards for vehicular traffic loads. A PVC water barrier shall be installed at all construction joints. Splayed duct entry points at one or both sides of an end wall are

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preferred. Conduit entry points shall be at opposite ends of the manhole and not through the side walls. Shop submittal shall be made for each manhole size and type to be used by Vendor. These drawings shall also include all hardware, frames and covers.

All manholes, even those to be used as pull points for straight-through cable runs, shall be planned as potentially housing splices or bends. These shall be sized 6'Wx12'Lx7'D (interior) in-line manholes allowing two splicing bays and 6'Wx8'Lx7'D (interior) auxiliary manholes as needed. Prefabricated manholes preferred whenever possible. Wall to be 6" thick with drop front ladder rungs, 12" o.c. Base, as a minimum, shall be 6" thick with #4 bars, 12" o.c. both ways. In instances where the depth of the duct bank (or other considerations) require the manhole to be placed below normal depth, the manhole roof shall be placed at normal depth below ground level and the headroom shall be increased. This eliminates the need for deep collars and also provides better lighting and ventilation in the manhole.

Joint manholes will not be permitted.

In existing non-water proofed pre-cast manholes with bonded steel, a welded or clamped bonding insert attached to rebar, or in new or existing water proofed manholes, a driven ground rod with an associated bonding ribbon is required to ground all racking. A ground identification plate shall be placed equidistant from each end wall and seven inches (7") below the manhole roofline.

Pulling irons shall be set in concrete walls opposite duct entrances to provide points of attachment for blocks, sheaves and tackle necessary for cable installation. The pulling-in irons shall provide a clear opening of approximately three-inches (3") in the eye. The pulling irons should be placed in the walls opposite each duct entrance, from six to twelve inches below the ducts with which they are associated, and in line with the centerline of the duct bank.

A sump of at least twelve-inches (12") in diameter by at least eight inches (8") deep shall be provided. Manholes shall be provided with a sump cast into the floor next to the ladder into which a portable sump pump can be installed. Floor shall slope to sump. See section 13.12.8.7 Sump Pumps. All hardware in manholes must be galvanized.

d) Frames and Covers

All manhole frames and covers shall be sized at thirty-inches (30") diameter.. Manhole covers shall be round, having a standard manhole frame and cover. Install frame and cover assembly on pre-cast concrete rings to allow adjustments to surrounding finish grade. Generally, Type B frames and covers ten-inches (10") high are most commonly employed for new construction. Type B frames with thirty-inch (30") openings permit manhole steps to be placed on the roof opening or manhole neck without extending into the area below the manhole frame opening. A minimum cover of twelve-inches (12") to accommodate potentially heavy vehicular traffic shall be provided. A pre-cast concrete grade ring, pre-cast collar or equivalent, shall be employed with the Type B frame to obtain the minimum required cover.

The manhole opening shall be placed at the center of the manhole except where the opening would be within three feet (3') of railroad tracks or other obstructions. In such cases the opening shall be relocated to the furthest end of the manhole from the obstruction.

All manhole frames and covers must meet industry standards for vehicular traffic loads. The manhole cover shall be clearly labeled in accordance with University approved naming conventions. Unless otherwise specified by local regulations, solid covers rather than perforated covers shall be used.

e) Coring

All holes required in concrete structures for installation of outside/inside plant shall be mechanically cored. Rigid galvanized metallic conduit shall be installed for PVC ducts. Such rigid galvanized metallic conduit shall extend into the manhole and nine feet into undisturbed earth to prevent shearing and provide a ground reference and shall connect to the PVC ducts.

f) Damp-proofing

The manholes shall be dampproofed with cold applied asphalt bituminous damp-proofing or approved equal. Asphalt bitumen material shall conform to Federal Specification SS-C-153C, Type 1 and shall be Trowell Mastic as manufactured by W. R. Meadows, Inc. or approved equal.

The application of dampproofing shall be trowel applied to seal penetrations, small cracks and honeycomb in substrate and duct bank entry and exit points. The application shall be in one coat, continuous and uniform at a rate of 0.08 gallons per square foot for 1/8" thickness. All exterior manhole surfaces, top, bottom and sides shall be dampproofed.

g) Manhole Racking and Ladders

All manholes shall be equipped with the following interior hardware:

Permanent manhole steps solidly embedded in a minimum of three-inches (3") of cement mortar shall be placed in the manhole neck. The steps shall be formed from 3/4-inch diameter rod of hot-dipped galvanized steel and shall be in the shape of a U with hooked ends and a dropped front so that a foot cannot slide off their sides.

Standard manhole ladders of Hubbard Co. type H-9113, or approved equal, with one end having hooks to engage a manhole step shall be provided for each manhole. The placement of ladders shall in no way eliminate the need for permanent manhole steps in the neck. The steps and ladders shall be positioned in such a way as to allow the workers to face oncoming traffic. A 6' 6" galvanized straight steel ladder is required when the chimney height is 12 inches or less. When the chimney height is 12 inches or more, a hooked ladder is required and manhole steps are to be provided at 12 inch intervals. All ferrous metal shall be galvanized.

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Cable racks, cable rack supports, cable rack hooks and locking clips shall be used to support and secure cables and splice cases. If necessary, corner brackets shall also be provided. All of the above hardware and accessories shall be galvanized. The cable rack supports shall be secured to the walls by means of 1/2" by 2-1/2" galvanized machine bolts which are screwed into concrete inserts that are cast in place. If the concrete inserts have not been placed, drill at appropriate locations and install 1/2" by 2-1/2" double expansion shield anchors.

D) Handholes

Handholes are only permitted, upon approval by Rutgers University, in routes having less than four (4) ducts where no branches are required, or in other areas where manhole construction is not feasible or desirable.

E) Riser Pole Guards

All OSP conduits terminating at a riser pole shall be suitably sealed to prevent infiltration by weather and pests. Contractor shall provide riser pole guards to cover cables/innerduct from the point where they emerge from the OSP conduit. Guard shall be heavy duty schedule 40 PVC and shall be mounted to the pole per manufacturer's specifications. Similar to Carlton PV-Mold non-metallic pole riser system with appropriate adapters and couplings.

F) Restoration Requirements

The Vendor shall repair all Rutgers University grounds and property to their pre-construction condition using materials of same or better type or quality. This includes, but is not limited to, repaving, reseeding, walls, fences, landscaping, utilities, signs, painting, curbing, etc. All Bituminous materials should be used where necessary for roads, parking areas, and footpaths. Restoration shall follow the original construction drawings, shop drawings, other documentation and visual observation, in order to match the existing conditions. Prior to restoration the Vendor shall submit a plan to the University for approval.

Rutgers University reserves the right to inspect all materials to be used in the restoration process, and to demand changes in type and quality in order to meet Rutgers University standards. Such changes will be at the Vendor's expense unless Rutgers University requires materials of a higher quality than original.

In all cases concerning determination of "original condition", Rutgers University will be the judge and have final approval.

The Vendor shall be responsible for cleaning-up and restoring work areas to at least their original condition.

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MODIFICATIONS

2/26/03 Modified Section 17140-B Heavywall Innerduct

9/26/03 Modified Filename.