

PART 1 - GENERAL

This section of the Telecommunications Construction Guide Specification has references, products, procedures, processes, and work descriptions/summaries that are common to many Washington State University Pullman (WSUP) campus telecommunications projects. This information is provided in specification format to serve as a guide to the Designer in producing a CSI-compliant specification that will meet the unique requirements of WSUP Telecommunications projects. However, this document is not intended to be a Master Specification. The information included in this section is not intended to be all-inclusive for any given project.

The Designer shall edit this section (adding and/or removing content where required) to meet the requirements of a given project.

Prior to publishing the specifications for bid or construction purposes, all edits shall be made using the MS Word Tracking Changes feature. **When submitting the specifications for review at each progress milestone, print the specifications showing the revision markings.**

Text in shaded boxes (such as this text) is included to aid the Designer in understanding areas of this section that may require modification for a particular circumstance. Although this text is generally written in declarative form, the Designer shall consider it guidance only. The Designer shall not assume that the content of this specification section is suitable or sufficient for any given project in its current form, and shall remain responsible for developing a thorough and complete specification that meets the requirements of the project being designed.

1.1 SUMMARY

Review and edit the following list of generic type products and work for relevance to this project. This listing should not include procedures, processes, preparatory work, or final cleaning.

Note that this section is specific to the communications system and shall be included in the Project Manual in addition to Division 26 - Conduits and Backboxes for Electrical Systems.

When an Electrical Systems section and a Communications Systems section are both in the Project Manual, a statement shall be added to the Conduits and Backboxes for Electrical Systems section similar to the following:

“For Telecommunications Raceway and Boxes, the requirements in Section 27 05 33 - Conduits and Backboxes for Communications Systems shall supercede the requirements in the section where they differ.”

- A. Provide all materials and labor for the installation of a pathway system for inside plant communications circuits. This section includes requirements for horizontal and building backbone raceways, fittings, and boxes specific to communications circuits (cabling) for voice and data.

Include this paragraph only if products will be furnished under this section but installed under other sections or by the Owner. When installations are “By Owner” consider referencing the installation to Division 1 Section 01010 (or equivalent) - Summary of Work (Owner Installed Items). If this paragraph is required for the project, the Designer must take care to clearly define any product warranty issues associated with the split responsibility. Include this paragraph only if unit pricing will be required for a specific part of the project. Include statements on how to measure the quantity. Specify technical information on the products and installation associated with the required unit pricing in the appropriate articles of PART 2 and PART 3.

Review and edit the following list of definitions for with applicability to this project. Add definitions for unusual terms that are not explained in the Conditions of the Contract and that are used in ways not common to standard references.

NOTE: Furnish, provide and install are used repeatedly throughout this specification. The Designer shall ensure that these terms are identified in the appropriate section of the project manual. The definitions of these terms shall be similar to the following:

Furnish - "Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations".

Install - "Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations".

Provide - "To furnish and install, complete and ready for the intended operation".

1.2 SYSTEM DESCRIPTION

Review and edit the following statement(s) for applicability to this project, restricted to describing performance, design requirements and functional tolerances of a complete system.

- A. Furnish, install, and place into satisfactory and successful operation all materials, devices, and necessary appurtenances to provide a complete Raceway system as hereinafter specified and/or shown on the Contract Documents. The Raceway system shall support an ANSI/TIA/EIA and ISO/IEC compliant communications Structured Cabling System (SCS) as specified in 27 15 00 - Communications Horizontal Cabling.
- B. The work shall include materials, equipment and apparatus not specifically mentioned herein or noted on the Contract Documents but which are necessary to make a complete working Raceway system.

1.3 QUALITY ASSURANCE

- A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NEC, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with NECA's "Standard of Installation" and with NEC Quality assurance.

1.4 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

Ensure that products listed under the PART 2 – Products paragraphs have corresponding installation instructions in PART 3 – Execution, or in another specification section if furnished but not installed under this section.

WSUP has standardized on certain manufacturers and certain products for all new Structured Cabling Systems in WSUP facilities. Products shall be specified accordingly. The Designer shall ensure that the latest part numbers are used for specified products. Any substitutions require WSUP pre-approval before specification.

If the Designer wishes to use products that deviate from WSUP standards, a Standards Variance Request shall be made, as described in the Technology Infrastructure Design Guide (TIDG). If the alternative product is approved, the Designer shall adapt this to reflect the approved changes.

The products listed throughout Part 2 - Products below are not all-inclusive for any given project. The Designer shall ensure that all required products are specified. The Designer shall also verify that the most current part number of each specified product is listed in this section.

2.1 GENERAL

- A. Materials shall consist of conduit, surface raceway, outlet boxes, fittings, enclosures, pull boxes, and other raceway incidentals and accessories as required for inside plant communications circuits.

2.2 MATERIALS

A. Conduit:

1. EMT: 1 inch minimum conduit size. Flexible metal conduit (FMC) is not acceptable.
 - a. Conduit: Galvanized steel tubing meeting ANSI C80.3.
 - b. Couplings: Steel, cast iron, or malleable iron compression type employing a split, corrugated ring and tightening nut, with integral bushings and locknuts. Indent-type and setscrew-type couplings are not permitted.
 - c. Insulated throat bushings: Arlington EMTxxx or approved equal.
 - d. Ground Wire Clamp: Penn-Union Zinc Die Cast Ground Clamp or approved equal.
2. RMC: 1 inch minimum conduit size.
 - a. Conduit: Hot dipped galvanized steel with threaded ends meeting ANSI C80.1.
 - b. Couplings: Unsplit, NPT threaded steel cylinders with galvanizing equal to the conduit.
 - c. Nipples: Same as conduit, factory-made up to 8 inches in diameter, no running threads.
 - d. Insulated throat bushings: Arlington RGDxxx or approved equal.
 - e. Ground Wire Clamp: Penn-Union Zinc Die Cast Ground Clamp or approved equal.

- B. Sleeves: EMT conduit, with insulated throat bushings for each end and ground wire clamp on one end.

- C. Weatherhead: Weatherproof fitting for rooftop penetrations, sized appropriate for the application.

- D. Outlet boxes: Minimum 4"x4" size, 2 7/8 inch minimum depth, with extension rings (if needed) and double-gang covers (i.e. mud rings), unless otherwise noted on the Contract Documents. Combined interior depth of outlet box, extension ring and cover shall be a minimum 2-1/2 inches. Stamped steel, deep drawn, galvanized, with knockouts for 1 inch trade size conduit or connector entrance, meeting NEMA OS 1.

1. Acceptable manufacturers for indoor applications:
 - a. Appleton, Raco, Steel City, or equal
2. Acceptable manufacturers for outdoor weatherproof applications:
 - a. Box: 4"x4" Taymac DB5100 with plugs for unused holes
 - b. Cover: Taymac MX6200 with GFCI device configuration
 - c. or equal.

- E. Surface-mounted outlet boxes: Minimum 4"x4" size, 2 3/4 inch minimum depth, supporting double-gang faceplates, unless otherwise noted on the Contract Documents.
 - 1. Acceptable manufacturers for indoor applications:
 - a. Wiremold or equal
- F. Outlet box mounting brackets: Rough-in brackets for mounting multiple device boxes in a single stud space.
 - 1. Acceptable manufacturers for indoor applications:
 - a. Appleton, Raco, Steel City, B-line, or equal
- G. Floor-boxes: See Division 26.
- H. Junction Boxes and Pull Boxes: Stamped steel, deep drawn one piece (without welds or tab connections), galvanized, with knockouts for conduit or connector entrance. Boxes 6"x6"x4" or larger may be code gauge fabricated steel continuously welded at seams and painted after fabrication.
 - 1. Dry locations: meeting NEMA OS 1.
 - 2. Wet locations: meeting NEMA OS 3R.
- I. Miscellaneous Fittings:
 - 1. Locknuts and conduit bushings: Malleable iron
 - a. Appleton, Crouse Hinds, OZ Gedney, or equal
 - 2. Through wall seals and floor seals:
 - a. OZ Gedney FS and WS series.
- J. Pull Strings: Plastic or nylon with a minimum test rating of 200 lb, with footage markings.

Surface-mounted raceway is generally not permitted at WSUP. Prior to designing a solution requiring surface-mounted raceway, the Designer shall first obtain the approval of the WSUP ITPM and FSPM.

2.3 GROUNDING AND BONDING

- A. Grounding Conductor: #6 AWG bare copper conductor.
- B. Bonding lugs and screws: UL Listed, NEC compliant, rated for use with grounding and bonding, and sized appropriate for the application.

2.4 LABELING AND ADMINISTRATION

- A. Labels: As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed, typed, and created by a hand-carried label maker or an approved equivalent software-based label making system. Handwritten labels are not acceptable.
 - 1. Labels:
 - a. Brady: BradyMaker Wire Marking Labels WML-511-292 (or approved equal)
 - b. Hand-carried label maker: Brady: ID Pro Plus (or approved equal).

PART 3 - EXECUTION

Ensure that products incorporated into the project under PART 3 paragraphs have corresponding Product information in PART 2 – Products, or in another specification Section if installed but not supplied under this Section.

The following paragraphs include installation requirements written specifically for the Products listed in Part 2 above. If other products are approved, the Designer shall ensure that appropriate Part 3 installation requirements are added/removed or modified as applicable and described in equal or greater detail to the following paragraphs.

All installation requirements shall be consistent with the manufacturer's requirements.

3.1 GENERAL

- A. Install the raceway system in a manner ensuring that communications circuits, when installed, are able to fully comply with ANSI/TIA/EIA Standards and NEC.

3.2 EXAMINATION

- A. Examine surfaces and spaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Notify the Engineer/Owner of conditions that may adversely affect the installation, subsequent use, or cause the conduits (or circuits to be subsequently installed in the conduits) to not comply with ANSI/TIA/EIA standards.

3.3 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions. Provide a raceway for each circuit indicated. Do not gang raceway into wireways, pullboxes, junction boxes, etc., without specific approval from the Designer. Do not group home runs or circuits without approval from the Designer.
- B. Conduit:
 - 1. Provide EMT unless other conduit as shown on the Contract Documents, as required by Code, or as permitted under these specifications.
 - 2. Provide RMC for outdoor applications and as shown on the Contract Documents, or as required by Code.
 - 3. Install conduit as a complete, continuous system without wires, mechanically secured and electrically connected to metal boxes, fittings and equipment. Blank off unused openings using factory-made knockout seals.
 - 4. Run conduit in the most direct route possible, parallel to building lines. Do not route conduit through areas in which flammable material may be stored.
 - 5. Keep conduit at least 6 inches away from parallel runs of flues and steam or hot-water pipes or other heat sources operating at temperatures above one-hundred degrees Fahrenheit. Install horizontal conduit runs above water piping.
 - 6. Keep conduit away from sources of electromagnetic interference as follows:
 - a. 5 inches from fluorescent lighting
 - b. 12 inches from conduit and cables used for electrical power distribution
 - c. 48 inches from motors or transformers
 - 7. Do not exceed 295 feet total length for a given conduit run to be used for distribution cabling (from outlet box to telecommunications room), including intermediate conduits and junction boxes.
 - 8. Install conduit exposed, except in finished areas or unless shown otherwise on the drawings. Do not install conduit below grade/slab unless specifically shown on the Contract Documents as being installed below grade/slab.
 - 9. Install exposed conduit in lines parallel or perpendicular to building lines or structural members except where the structure is not level. Follow the surface contours as much as practical. Do not

- install crossovers or offsets that can be avoided by installing the conduit in a different sequence or a uniform line.
- a. Run parallel or banked conduits together, on common supports where practical.
 - b. Make bends in parallel or banked runs from same centerline to make bends parallel.
10. Conduits concealed above ceilings, furred spaces, etc., which are normally inaccessible may be run at angles not parallel to the building lines.
 11. Wherever practical, route conduit with adjacent ductwork or piping and support on common racks. Base required strength of racks, hangers, and anchors on combined weights of conduit and piping.
 12. Where conduits cross building expansion joints, use suitable sliding or offsetting expansion fittings. Unless specifically approved for bonding, use a suitable bonding jumper.
 13. Support conduits as specified in Section 27 05 00 – "Common Work Results for Communications."
 - a. Provide anchors, hangers, supports, clamps, etc. to support the conduits from the structures in or on which they are installed. Do not space supports farther apart than five feet.
 - b. Provide sufficient clearance to allow conduit to be added to racks, hangers, etc. in the future.
 - c. Support conduit within three feet of each outlet box, junction box, gutter, panel, fitting, etc.
 14. Ream conduits to eliminate sharp edges and terminate with metallic insulated grounded throat bushings. Seal each conduit after installation (until cable is installed) with a removable mechanical-type seal to keep conduits clean, dry and prevent foreign matter from entering conduits.
 15. Install a pull string in each conduit prior to the installation of cabling. Pull string shall be secured on each end to prevent inadvertent removal. Provide at least 12 inches of slack at each end of the string.
 16. For conduits entering through the floor of a telecommunications room, terminate conduits 4 inches above the finished floor.
 17. Do not install communications conduits in wet, hazardous or corrosive locations.
 18. Where conduit is shown embedded in masonry, embed conduit in the hollow core of the masonry. Horizontal runs in the joint between masonry units are not permitted.
 19. Where conduit is shown embedded in concrete, embed conduit a minimum of two inches from the exterior of the concrete. Do not place conduit in concrete less than five inches thick.
 - a. One inch trade size conduit shall be used. Conduits sized larger or smaller than one inch trade size conduit are not permitted embedded in concrete.
 - b. Run conduit parallel to main reinforcement.
 - c. Conduit crossovers in concrete are not permitted.
 20. Where conduit exits from grade or concrete, provide a rigid steel elbow and adapter.
 21. Where conduit enters a space through the floor and terminates in that space, terminate the conduit at 4 inches above the finished floor.
 22. Where conduits terminate at a cable tray, the conduits shall be consistently terminated no more than 8 inches from the cable tray, and have a visually uniform appearance.
 23. Where several circuits follow a common route, stagger pullboxes or fittings.
 24. Where several circuits are shown grouped in one box, individually fireproof each conduit.
 25. Bend and offset metal conduit with standard factory sweeps or conduit fittings. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
 - a. Conduit sweeps:
 - 1) Sweeps shall not exceed 90 degrees.
 - 2) Do not exceed 180 degrees for the sum total of conduit sweeps for a section of conduit (between conduit termination points).
 - 3) Sweep radius shall be at least 10 times the internal diameter of the conduit.
 - 4) 90-degree condulets (LB's) and electrical elbows are not acceptable.

- 5) A third 90-degree bend is permissible only within 12 inches of the feed end of the conduit (typically near a cable tray) or when the overall length of the conduit run is less than 80 feet.
 - b. Factory-manufactured sweeps are required for bends in conduit larger than 1 inch trade size.
 - c. For bends in 1 inch trade size conduit, field-manufactured bends (using a hydraulic bender with a 1 inch boot) are permitted only when factory-manufactured sweeps are not suitable for the conditions. In all other cases, factory-manufactured sweeps are required. "Hickey-bender" use is prohibited.
26. Connect conduit to hubless enclosures, cabinets and boxes with double locknuts and with insulating type bushings. Use grounding type bushings where connecting to concentric or eccentric knockouts. Make conduit connections to enclosures at the nearest practicable point of entry to the enclosure area where the devices are located to which the circuits contained in the conduit will connect.
27. Penetrations for raceways:
- The Designer shall consider requiring approval by a licensed Structural Engineer prior to designing penetrations through building structural components.
- a. Do not bore holes in floor and ceiling joists outside center third of member depth or within two feet of bearing points. Holes shall be 1- $\frac{1}{4}$ inch diameter maximum.
 - b. Penetrate finished walls and finished surfaces with a PVC or sheet metal sleeve with an interior diameter (ID) at least $\frac{1}{4}$ inch greater than the outer diameter (OD) of the conduit, set flush with walls, pack with fiberglass, seal with silicone sealant and cover with escutcheon plate.
 - c. Penetrate poured-in-place walls and free slabs with a cast iron sleeve (or Schedule 40 PVC black pipe sleeve for above-grade only) with retaining ring or washer. Set sleeves flush with forms or edges of slab. Pack around conduit with fiberglass and seal with silicone sealant.
28. Rooftop conduit stubs shall be terminated with a weatherhead, properly sized for the application.
29. Raceway terminations and connections:
- a. Join conduits with fittings designed and approved for the purpose and make joints tight. Do not use set indent-type or screw-type couplings.
 - b. Make threaded connections waterproof and rustproof by applying a watertight, conductive thread compound. Clean threads of cutting oil before applying thread compound.
 - c. Make conduit terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 - d. Cut ends of conduit square using a hand saw, power saw or pipe cutter. Ream cut ends to remove burrs and sharp ends. Where conduit threads are cut in the field, cut threads to have same effective length, same thread dimensions and same taper as specified for factory-cut threads.
 - e. Provide double locknuts and insulating bushings at conduit connections to boxes and cabinets. Align raceways to enter squarely and install locknuts with dished part against the box. Use grounding type bushings where connecting to concentric or eccentric knockouts.
 - f. Where conduits are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
30. Install conduit sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed conduits, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
- a. Where conduits pass from warm to cold locations, such as the boundaries of air conditioned or refrigerated spaces and where conduits enter or exit buildings from outdoor areas, including underground ducts or conduit runs.

- b. Where otherwise required by the NEC.
 31. Conduit shall be clean and dry.
- C. Sleeves:
1. All applications:
 - a. Provide sleeves where required, sized as noted on the Contract Documents. Where not noted, sleeve sizing shall be determined by the type and quantity of cable to be routed through the sleeve per TIA/EIA 569A cable capacity standards, plus an additional 100% for future expansion.
 - b. Provide roto-hammering or core drilling where required for installation. Prior to creating penetrations, consult a structural engineer to verify that the penetration will not damage the structural integrity of the wall or floor.
 - c. Seal between sleeve and wall or floor in which the sleeve is installed. Firestop penetration to restore wall or floor to pre-penetration fire-rating.
 2. Riser Applications:
 - a. Riser sleeves and raceways shall be installed through floors terminating 4 inches above finished floor.
 - b. Riser sleeves shall be located no closer than 4 inches and no farther than 6 inches from the wall.
 - c. Riser sleeves shall be spaced with approximately 3 inches space between adjacent sleeves.
- D. Conduit Applications:
1. Unless otherwise indicated in the Contract Documents, conduit shall be provided as follows:
 - a. Penthouse devices shall terminate on the floor immediately below the penthouse.
 - b. Provide raceway sleeves through all fire and smoke separation walls.
 - c. Provide raceways to outlets located inside fixed casework or furnishings. This does not apply to modular "system" furniture.
 - d. Provide conduits from outlets to cable trays. Stubbing conduits up into the ceiling space, with J-hook (or similar) pathway from conduit stub to cable tray is not acceptable.
- E. Wire Gutter:
1. Provide wire gutter as shown on Contract Documents.
 2. Wire gutter shall be routed parallel to and perpendicular to surfaces or exposed structural members, and follow surface contours. Wire gutter shall not be warped during installation such that hinged cover operation is impaired.
 3. Wire gutter color shall be painted according to Architectural requirements.
 4. Wire gutter systems shall be completely installed, including insulating bushings and inserts as required by manufacturer's installation requirements. Unused openings in the surface raceway shall be closed using manufactured fittings.
 5. Wire gutter covers shall open and close without obstruction and shall swing freely on hinges. Closure mechanisms shall securely retain the covers in their closed position.
 6. Wire gutter shall be securely supported by screws or other anchor-type devices at intervals not exceeding 4 feet and with no less than six supports per straight section. Wire gutter shall be securely supported in accordance with the manufacturer's requirements. Tape and glue are not acceptable support methods.
 7. For wire gutter installed in outdoor environments, seal all penetrations against moisture intrusion.
- F. Outlet Boxes:
1. Provide outlet boxes and covers as shown on the Contract Documents and as needed. Verify that the appropriate cover type and depth is provided for each type of wall and finish. Provide extension rings as needed.
 2. Coordinate box locations with building surfaces and finishes to avoid bridging wainscots, joints, finish changes, etc.

3. Install boxes in dry locations (not wet, corrosive, or hazardous).
 4. Attach boxes securely to building structure with a minimum of two fasteners. Provide attachments to withstand a force of one hundred pounds minimum, applied vertically or horizontally.
 5. Install boxes at the following heights to the bottom of the box, except where noted otherwise:

The Designer shall edit the mounting heights below as is appropriate for each project. Workstation telecommunications outlets shall be mounted at the same height as the electrical power receptacles.

 - a. Wall mounted telephones: 50 inches above finished floor.
 - b. Workstation outlets in office spaces: 4 inches above desktop height.
 - c. Workstation outlets not in office spaces: match height of power outlets, typically 16 inches above finished floor.
 - d. Place boxes for outlets on cabinets, countertops, shelves, and similar boxes located above countertops two inches above the finished surface or two inches above the back splash. Verify size, style, and location with the supplier or installer of these items prior to outlet box installation.
 6. Recessed mounted outlet boxes:
 - a. Recess boxes in the wall, floor, and ceiling surfaces in finished areas. Set boxes plumb, level, square and flush with finished building surfaces within 1/16th inch for each condition. Set boxes so that box openings in building surfaces are within 1/8th inch of edge of material cut-out and fill tight to box with building materials. Double gang opening shall extend at least to the finished wall surface and extend not more than 1/8th inch beyond the finished wall surface. Provide backing for boxes using structural material to prevent rotation on studs or joists.
 - b. Install floor boxes level and adjust to finished floor surface.
 7. Surface-mounted outlet boxes:
 - a. For boxes surface-mounted on finished walls, provide Wiremold (or similar product) outlet box. Cut box as necessary to accept conduit.
 - b. For boxes surface-mounted on unfinished walls (i.e. electrical rooms, mechanical rooms), provide 4" x 4" (minimum) outlet box with double gang cover.
 8. Outdoor outlet boxes:
 - a. For boxes mounted outdoors, provide weatherproof boxes and covers.
- G. Floor Boxes: See Division 26.
1. For floor boxes with combined power and telecommunications circuits, provide metal dividers to separate power from telecommunications circuits.
- H. Junction Boxes:
1. Provide junction boxes as shown on the Contract Documents and as required.
 - a. Where sizing is not shown on the Contract Documents, size junction box length and depth according to the size of the feeder conduit in the following table:

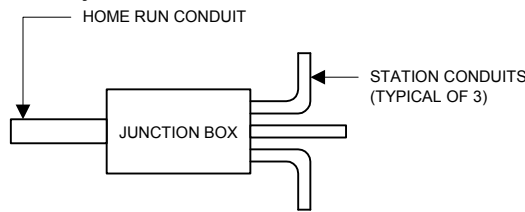
Feeder Conduit Size	Box Length	Box Depth
1"	12"	4"
1-1/4"	12"	4"
1-1/2"	12"	4"
2"	24"	4"
2-1/2"	24"	6"
3"	36"	6"
3-1/2"	48"	6"
4"	60"	6"

- b. Where sizing is not shown on the Contract Documents, size junction box width according to the following formula:
- 1) From the table below, select the width associated with the largest conduit on the distribution side of the box. For each additional distribution conduit, add the "Increase Width" value associated with the size of that distribution conduit to the box width for the largest distribution conduit.
 - a) For example, if the distribution side of the junction box has one 1-1/4" distribution conduit and three 1" distribution conduits, the total distribution-side width would be 6"+2"+2"+2"=10".
 - 2) Repeat the above process for the feeder side of the junction box. Junction boxes are typically fed by a single conduit, therefore unless the box has more than one feeder conduit, the "Increase Width" part of the formula is unnecessary.
 - a) For example, if the feeder side of the junction box has two 2" feeder conduits the total feeder-side width would be 8"+5"=13".
 - 3) The larger of the two width calculations (distribution side vs. feeder side) shall be the width of the junction box to be provided.
 - a) For example, if the distribution-side width were 10" and the feeder-side width were 13", provide a 13" wide junction box.

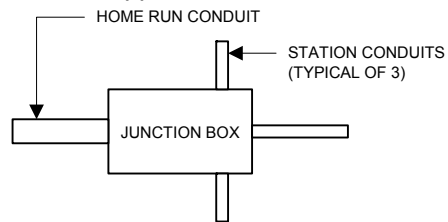
Conduit Size	Box Width	For each additional conduit Increase Width
1"	4"	2"
1-1/4"	6"	3"
1-1/2"	8"	4"
2"	8"	5"
2-1/2"	10"	6"
3"	12"	6"
3-1/2"	12"	6"
4"	15"	8"

2. A junction box may not be substituted for a 90-degree bend. *90 degree condulets (LB's) are not acceptable.*
3. Install junction boxes in an accessible location, readily accessible both at time of construction and after building occupation. Do not install junction boxes in inaccessible interstitial building spaces.

4. Where junction boxes are to be mounted on ceiling structure above ceiling grid, do not mount higher than 4 feet above grid (mount on wall instead).
5. Install hinged-cover enclosures and cabinets plumb, and supported at each corner.
6. Install junction boxes so that the access door opens from the side where the cable installer will normally work – typically from the bottom (floor side) of the box.
 - a. Where a junction box is installed in a ceiling space, provide full access to the junction box door and adequate working room for both the installation personnel and for proper looping of cable during installation.
 - b. Provide a lockable access cover (or junction box door if junction box is exposed) in hard lid ceilings.
7. Install junction boxes such that conduits enter and exit at opposite ends of the box as follows:



CORRECT INSTALLATION



INCORRECT INSTALLATION

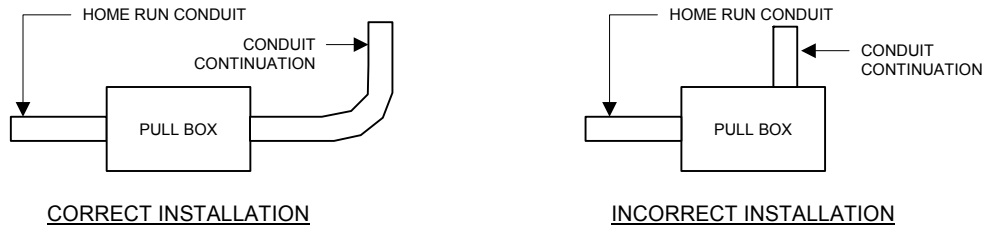
I. Pull Boxes:

1. Provide pull boxes as shown on the Contract Documents and as required.
 - a. Where sizing is not shown on the Contract Documents, size pull boxes as follows:

Size of Largest Conduit	Box Width	Box Length	Box Depth
1"	4"	12"	4"
1-¼"	6"	12"	4"
1-½"	8"	12"	4"
2"	8"	24"	4"
2-½"	10"	24"	6"
3"	12"	36"	6"
3-½"	12"	48"	6"
4"	15"	60"	6"

- b. Where a pull box is required with conduits 1 inch trade size or smaller, an outlet box may be used as a pull box. Where outlet boxes are used as pull boxes, the outlet boxes shall be dedicated for use as a pull box and shall not host cable termination hardware.
2. A pull box may not be substituted for a 90-degree bend. *90 degree condulets (LB's) are not acceptable.*
3. Install pull boxes in an accessible location, readily accessible both at time of construction and after building occupation. Do not install pull boxes in inaccessible interstitial building space.
4. Where pull boxes are to be mounted on ceiling structure above ceiling grid, do not mount higher than 4 feet above grid (mount on wall instead).
5. Install hinged-cover enclosures and cabinets plumb, and supported at each corner.
6. Install pull boxes so that the access door opens from the side where the cable installer will normally work (typically from the bottom, or floor side, of the box).
 - a. Where a pull box is installed in a ceiling space, provide full access to the junction box door and adequate working room for both the installation personnel and for proper looping of cable during installation.

- b. Provide a lockable access cover (or pull box door if pull box is exposed) in hard lid ceilings.
7. Install pull boxes such that conduits enter and exit at opposite ends of the box as follows:



3.4 GROUNDING/BONDING:

- A. Grounding and bonding work shall comply with the Uniform Building Code, Uniform Fire Code, WAC, National Electrical Code, UL 467, ANSI/TIA/EIA standards and the references listed in Section 27 05 00 – “Common Works Results for Communications” PART 1 – STANDARDS AND CODES, as well as local codes which may specify additional grounding and/or bonding requirements.
 - 1. Bond metallic raceway together and to the nearest TGB (as provided under Section 27 05 26 – “Grounding and Bonding for Communications Systems”). Ensure that bonding breaks through paint to bare metallic surface of painted metallic hardware.
- B. Conduits and Sleeves:
 - 1. For conduits and sleeves terminating at a cable tray, provide a bonding conductor to the cable tray grounding conductor, terminated with bonding lugs. Where multiple conduits terminate adjacent to each other, it is permissible to daisy-chain the bonding conductor between conduits and route a single conductor to the cable tray grounding conductor.
 - 2. For conduits and sleeves terminating in a telecommunications room, provide a bonding conductor to the TGB or TMGB in that room. Where multiple conduits terminate adjacent to each other, it is permissible to daisy-chain the bonding conductor between conduits and route a single conductor to the TGB or TMGB.
- C. For Wire Gutter:
 - 1. Provide a continuous grounding conductor running the length of the wire gutter.
 - 2. Bond each section of wire gutter to the grounding conductor.
 - 3. Ensure that the grounding/bonding hardware breaks through painted surfaces.

3.5 LABELS:

- A. Conduits: Label each conduit end in a clear manner by designating the location of the other end of the conduit (i.e. room name, telecommunications room name, pull box identifier, outlet identifier, etc.). Use the label of the first port of the outlet as the outlet identifier. Indicate conduit length on the label.
 - 1. Where a conduit is intended for future cabling use outside of the Contract, the conduit shall be labeled in a clear manner by designating the location of the other end of the conduit (i.e. room name, telecommunications room name, pull box identifier, etc.) along with a sequential number for each spare conduit terminated into a single room. Indicate conduit length on the label.
 - a. Suggestion: The second spare conduit (whether spare or in use) between Room 100 and telecommunications room 1A might be labeled in the telecommunications room as “100 - #2, ___ feet.” In Room 100 the same conduit might be labeled “1A - #2, ___ feet.”
- B. Pull Boxes: Label each pullbox with a unique identifier. Identifiers shall be of the form “RN-Y” where “RN” is the room name of the room closest to (or containing) the pull box, and “Y” is the sequential number of the pull box for each “RN”.

1. Example: The second pull box in the vicinity of room "100" would have the label "100-2".

3.6 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and in accordance with accepted industry practice, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.7 CLEANING

1. On completion of installation (including outlet fittings and devices), inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION