27 08 00 Commissioning of Communications

See Appendix E3.
27 11 00  Communications Equipment Room Fittings

1.0  General – TELEPHONE RISERS:

A. All copper telephone riser cables must be type ARRM 24 gauge, have industry standard color coding, have 25 pair groups in 100 pair bundles, and meet the specifications outlined by the NEC and the EIA/TIA. ISU Telecommunications and Networking uses the following formula to determine sizing of riser cables in administrative or academic buildings. Number of telephone outlets times two plus 30 percent. Each telephone outlet has one dedicated path back to the nearest NODE site. When determining riser cable sizes each telephone outlet is counted whether active service is requested or not. For example if the closet will serve 60 telephone outlets: 2 X 60 = 120; then 120 X 1.30 = 156. Rounding up to the next larger standard cable size, a 200 pair copper riser cable would be required for this example. Sizing for residence hall copper riser cable should follow the same formula except that each closet will be figured at one pair per jack plus 30%. Installations that have been designated as “Voice Over IP” (VOIP) installations will only require a 25 pair riser cable per closet. Sizing the cable as described above will not be required.

B. The metallic sheath of all copper riser cables must be bonded to the building ground at each end of the cable using #6 AWG insulated copper wire. Riser cables must be bonded together and to the building ground at each splice point using #6 AWG insulated copper wire or bonding braid. As noted elsewhere in the specifications or drawings, the building ground will be installed by the contractor and terminate on a copper bus bar at each closet.

C. Splicing of copper riser cables should only be competed by qualified telephone cable technicians who may be sub-contracted to the general contractor or to the electrical contractor. ISU Telecommunications and Networking must approve the cable technicians qualifications prior to the start of any riser cable splicing. There should be no reason to splice riser cables at the BDF. At the IDF locations splices will be made using 3M brand stackable modules. Splice cases should be “Better Buried” brand, black, and be properly sized for the application. The splice cases do not need to be encapsulated. Splice cases should be firmly attached to the wall or backboard below the termination blocks and cable rings.

D. Termination of copper riser cable will be on mini split 50, 66 type punch down blocks with mounting brackets. Termination will follow industry and ISU color code standards. ISU Telecommunications and Networking will determine positioning of the riser cable on the terminal backboards.

Generally the riser cable in an IDF is to the far left of the backboard, at a BDF the riser cable is between the building entrance cable and station wire terminations. All riser cable must be routed across the bottom of the backboard for distribution up to
the 66 blocks. After termination and splicing is complete riser cables shall be tested for continuity. Including manufacturer defects and splicing errors, no more than one bad pair in each twenty-five pair group will be accepted. If one bad pair per 25 pair group per cable is exceeded the Contractor shall replace the riser cable at their expense.

E. Raceway requirements for telephone riser cables should consist of two 4” conduits from the BDF closet to each IDF closet. If IDF closets are stacked the upper IDF closet(s) will serve from the lower IDF closet(s) via two 4” conduits. One of the 4” conduits will be used for the installation of the telephone riser cable. The second 4” conduit will be for future applications. At the BDF two 4” conduits should be placed between the building entrance point and the BDF. One of the 4” conduits will be used for the installation of the telephone building entrance cable. The second four inch conduit will be for future applications.

1.1 General – DATA RISERS:

A. All data riser cables must be Siecor/Corning brand 12MM/12SM hybrid fiber optic cables. Each IDF closet will have a homerun 12/12 fiber optic riser cable to the BDF to serve the data electronics. The contractor will supply, place, terminate, and test the fiber optic riser cables. The contractor will supply and install 19” data racks (usually two) in the data closets. One of the 19” racks should be a four post rack to support the weight of the data electronics. Special circumstances may require data cabinets to be specified instead of data racks. Exact positioning of the data racks will be coordinated with ISU Telecommunications and Networking. The fiber optic cables should be routed to the far right data rack with post termination slack that reaches to the floor and back to the ceiling. The fiber optic cables must be protected from damage that may result from nearby construction or painting.

B. Unless otherwise specified, termination of the fiber optic riser cables will be completed by the contractor. This work will be coordinated by ISU Telecommunications and Networking. The termination hardware must be provided by the contractor. A partial list of required materials with corresponding Siecor/Corning part numbers follows:

1. Corning FDC-003 Combination distribution box for 24 fibers with splice trays. One per IDF.
2. Corning FDC-CM-12-58 12 strand single mode pigtail module. Two required per cable.
3. Corning 024X81-331XX-24 12MM/12SM hybrid fiber optic cable. Length (no splices) from the BDF to IDF determined by contractor. Homersuns from each IDF to BDF are required.
4. (24) Corning MM ST light guides, part# FDC-CP1P-15
5. (4) Corning MM ST connectors, part# 95-100-01R
C. Raceway requirements for fiber optic data riser cables should consist of one 2” conduit from the BDF closet to each IDF closet. If IDF closets are stacked the upper IDF closet(s) may serve from the lower IDF closet(s) via one 2” conduit. The 2” conduit will be used for the installation of the data riser fiber optic cable(s). At the BDF one 2” conduit should be placed between the building entrance point and the BDF. The 2” conduit will be used for the installation of the building entrance fiber optic cable.

1.2 General - TELEPHONE/DATA CLOSETS:

A. Dimensions of telephone/data closets will vary with each building design. ISU Telecommunications and Networking strongly suggests that EIA/TIA and BICSI specifications be adhered to. Basic requirements include space for a 4’X4’ telephone termination backboard and space for two data racks in each IDF. At the BDF the telephone termination backboard should be 4’HX8’W with space for two data racks. Suggested space for each data rack is a three foot square. High concentrations of data station wiring may make a third data rack necessary. Installations that have been designated as “Voice Over IP” (VOIP) installations may require less backboard space for telephone terminations and more rack space for data terminations.

Telephone backboards should be ¾” high grade plywood with front, back, and all edges painted with gray fire retardant paint. The plywood must be firmly attached to the wall. At the IDF the minimum plywood size is 4’WX4’H. At the BDF the minimum plywood size is 8’WX4’H. Paneling the entire tel/data closet with plywood is acceptable and usually preferred. Termination devices and cable management placement must be approved by ISU Telecommunications and Networking. In all instances all cable and station wire will be routed down the sides and bottom of the plywood using D-rings. The top of the plywood will be used for split jumper distribution rings only. Installations that have been designated as “Voice Over IP” (VOIP) installations may require less backboard space for telephone terminations.

C. Raceway/conduits should stop far enough above or below the plywood to allow an acceptable cable sweep to the D-rings. Each conduit should be firmly attached to the wall and have a bushing on the end.

Cable tray systems should “T” into the tel/data closets where wiring will transition to the termination devices via conduit sleeves or D-rings.

D. Each equipment data rack should have an isolated 110V duplex outlet behind it. Each data equipment rack that will have a UPS installed in it should also have a 30AMP 110V NEMA L5-30R outlet behind it. A duplex 110V service outlet should be installed below the telephone backboard.
Florescent lighting of sufficient wattage to illuminate the entire closet controlled by an accessible light switch should be installed. All electricity in the closet should serve from an EM panel if available.

E. Data electronics generate high heat outputs. Air conditioning should be installed in each IDF and in the BDF closet. The air conditioning should not be supplied by the same ducts that serve building heating. The air conditioning may be controlled by a thermostat. Air conditioning condensate collectors should not be installed above the tel/data termination blocks or the electronics rack.

D. Traditional telephone service is powered remotely from the telephone switching center. VOIP telephone service is powered locally from the IDF/BDF closets. It is recommended that an EM generator be designed into new construction and major renovations plans so that telephone and data services are not lost during a power outage. In situations when a generator cannot be installed, sufficient power must be provided in the IDF/BDF closets to support UPS devices.
1.3   General – TELEPHONE/DATA BLDG. ENTRANCE REQUIREMENTS:

A. Building entrance facilities for telephone and data service will tie to the Campus network via an extension of the Campus utility tunnel system or a connection to the nearest telecommunications manhole. Should service enter the building via a utility tunnel a cable tray must be installed in the tunnel that ties to the existing tunnel cable tray system. Should service enter the building from a telecommunications manhole a four cell concrete encased duct run should be placed between the manhole and the building. Three of the ducts will be 4” PVC or galvanized conduits. The fourth duct will be a quad duct consisting of four 1¼” color coded PVC conduits; white, blue, gray, & orange. At the manhole the new ducts should enter via pre cast holes if available. If no pre cast holes are available holes should be core drilled into the manhole, not chiseled and hammered. All manhole penetrations must be sealed and waterproofed. If logistics require the building service to feed from a telecommunications manhole to a utility tunnel then to the building, the four cell duct requirements specified above must be followed between the manhole and the tunnel. Duct entry into the tunnel from the manhole must be in an area away from other utilities that may block or not coexist well with telephone and data cables. Transition raceway from the duct entry point to the cable tray must be provided.

B. Raceway between the building entrance point and the BDF should consist of two 4” conduits and one 2” conduit. Each conduit should have a bushing installed on both ends.

C. The data entrance cable will consist of a continuous, unspliced, hybrid fiber bundle that is installed by the contractor from the building entrance termination point to a data switching center to be determined by ISU Telecommunications and Networking. This fiber bundle shall be contained in a black outer sheath and shall be a loose tube fiber design with a non-conductive center core. This fiber bundle shall consist of 62.5/125μm dual window multi-mode fiber and dual window single mode fiber. A Corning ALTOS Gel Free fiber hybrid bundle is the University standard and is required. The University will determine the fiber makeup during the design phase of the project. Larger facilities will generally require a 60 strand hybrid bundle consisting of 12 multi-mode strands and 48 single mode strands. Smaller structures will generally require a 24 strand hybrid bundle consisting of 12 multi-mode strands and 12 single mode strands. In rare situations when the 50’ transition rule cannot be achieved, the Corning brand Freedom Fiber should be used to avoid a transition splice. Corning brand fiber distribution boxes and termination modules should also be provided by the contractor. The contractor will be responsible for determining the exact length of fiber optic cable required. Refer to the fiber optic section of this document.
D. Data electronics generate high amounts of heat. Air conditioning should be installed in each IDF and in the BDF closet. The air conditioning should not be supplied by the same ducts that serve building heating. The air conditioning may be controlled by a thermostat and monitored by the Universities energy management system. Air conditioning condensate collectors should not be installed above the tel/data termination blocks or the electronics rack.

E. The copper telephone entrance cable must be a suitable type for the application. Usually a SealPic FSF type cable will be specified. The entrance cable must be new, 24 gauge, have industry standard color coding, have 25 pair groups in 100 pair bundles, and meet the specifications outlined by the NEC and the EIA/TIA. ISU Telecommunications and Networking uses the following formula to determine sizing of entrance cables in administrative or academic buildings.

\[
\text{Number of telephone outlets times two plus 30 percent. Each telephone outlet has one dedicated pair back to the nearest NODE site. When determining entrance cable size each telephone outlet is counted whether active service is requested or not. For example if the building has 60 telephone outlets: } 2 \times 60 = 120; \text{ then } 120 \\times 1.30 = 156. \text{ Rounding up to the next larger standard cable size, a 200 pair copper entrance cable would be required for this example. Sizing for residence hall copper entrance cable should follow the same formula except that each building will be figured at one pair per jack plus 30%.
\]

F. The metallic sheath of the copper entrance cable must be bonded to the building ground at each end of the cable using #6 AWG insulated copper wire. The entrance cable must be bonded together and to the manhole/tunnel ground at each splice point using #6 AWG insulated copper wire or bonding braid. As noted elsewhere in the specifications or drawings, the building ground will be installed by the contractor and terminate on a copper bus bar at the BDF closet.

G. Splicing the copper entrance cable should only be completed by qualified telephone cable technicians who may be sub-contracted to the general contractor or to the electrical contractor. ISU Telecommunications and Networking must approve the cable technician’s qualifications prior to the start of any entrance cable splicing. All splices will be made using 3M brand stackable modules. Indoor splice cases should be “Better Buried” brand, black, and be properly sized for the application. The indoor splice cases do not need to be encapsulated. Indoor splice cases should be firmly attached to the wall or backboard below the termination blocks and cable rings, or racked above the backboard. Exterior splice cases in manholes or tunnels must stainless steel Preformed Line Products (PLP) brand. Encapsulation requirements of exterior splice cases will be decided on a per splice basis by ISU Telecommunications and Networking.

H. Termination of the entrance cable at the BDF will be on 100 pair Emerson/Reliable brand RELTEC R366AA100D protectors. Each protector has a 100 pair factory stub that will be spliced into the building entrance cable. ISU Telecommunications
and Networking will determine positioning of the entrance cable protector on the BDF backboard. Generally the entrance cable in the BDF is to the far left of the backboard. All protector tip cables must be routed across the bottom of the backboard to the splice case. After termination and splicing is complete entrance cables shall be tested for continuity. Including manufacturer defects and splicing errors, no more than one bad pair in each twenty-five pair group will be accepted. If one bad pair per 25 pair group per cable is exceeded the Contractor shall replace the bad component or cable to correct the problem at their expense.

I. Raceway requirements for the telephone entrance cable should consist of two 4” conduits between the BDF closet and the building entrance point. One of the 4” conduits will be used for the installation of the telephone building entrance cable. The second four inch conduit will be for future applications.
27 13 23 Communications Optical Fiber Backbone Cabling

1.0 General

A. Work Included: Provide all labor, materials, and tools, required to perform all work and services for installation of all optical fiber and components as shown and indicated on the drawings, and/or herein specified, with the intent that the installation shall be completed as specified.

B. Standards: All work shall comply with the NEC, current edition, and all applicable state, federal and local codes. In addition, all optical fiber installation shall comply with manufacturer’s standard practice and recommendations.

C. Electrical/Communication Contractor Qualifications: Contractor shall have a minimum of five years experience in the installation and termination of single mode and multimode optical fiber.

D. Submittals: Provide verification of optical fiber manufacturer’s certification as an approved single mode and multimode optical fiber installer and/or documentation pertaining to recent similar installations by the contractor including customer names, addresses, and telephone numbers. In addition provide product data on the single mode splicing equipment and test equipment that will be used on this job. Provide as-built drawings in accurate, clear, legible, and reproducible form for use by the University. As-built drawings should include fiber pathing, cable tray and ladder rack design layout and all fiber termination locations.

2.0 Products

A. Building Entrance - Hybrid Optical Fiber: A continuous, unspliced, hybrid fiber bundle shall be installed from the building entrance termination point to a data switching center to be determined by ISU Telecommunications and Networking. This fiber bundle shall be contained in a black outer sheath and shall be a loose tube fiber design with a non-conductive center core. This fiber bundle shall consist of 62.5/125um dual window multi-mode fiber and dual window single mode fiber. A Corning ALTOS Gel Free fiber hybrid bundle is the University standard and is required. The University will determine the fiber makeup during the design phase of the project. Larger facilities will generally require a 60 strand hybrid bundle consisting of 12 multi-mode strands and 48 single mode strands. Smaller structures will generally require a 24 strand hybrid bundle consisting of 12 multi-mode strands and 12 single mode strands. In rare situations when the 50’ transition rule cannot be achieved, the Corning brand Freedom Fiber should be used to avoid a transition splice.
The following tube and fiber color codes are required. Each buffer tube shall contain twelve fibers.

**Buffer Tube Color Code**

- Blue (Single mode fibers)
- Orange (Single mode fibers)
- Green (Multi-mode fibers)
- Brown (Multi-mode fibers)
- Slate (Multi-mode fibers)

**Fiber Color Code**

- Blue (Fiber-1)
- Orange (Fiber-2)
- Green (Fiber-3)
- Brown (Fiber-4)
- Slate (Fiber-5)
- White (Fiber-6)
- Red (Fiber-7)
- Black (Fiber-8)
- Yellow (Fiber-9)
- Violet (Fiber-10)
- Rose (Fiber-11)
- Aqua (Fiber-12)

**B. Riser – Hybrid Optical Fiber:** A continuous, unspliced, hybrid, MIC riser rated 24 fiber bundle shall be installed from the building entrance room to each riser closet. This fiber bundle shall be contained in an orange outer sheath and shall be a loose tube fiber design with a non-conductive center core. This fiber bundle shall consist of 12 strands of 62.5/125μm dual window multi-mode fiber and 12 strands of dual window single mode fiber. A Corning-C (024XS4-AW175A20) 24-fiber hybrid bundle is the University standard and is required.

The following tube and fiber color codes are required. Each buffer tube shall contain six fibers.

**Buffer Tube Color Code**

- Blue (Single mode fibers)
- Orange (Single mode fibers)
- Green (Multi-mode fibers)
- Brown (Multi-mode fibers)

**Fiber Color Code**

- Blue (Fiber-1)
- Orange (Fiber-2)
- Green (Fiber-3)
- Brown (Fiber-4)
C. Optical Fiber Attenuation/Bandwidth: The maximum attenuation and the minimum bandwidth for all fibers contained in the hybrid bundle and the riser bundle shall be as follows:

<table>
<thead>
<tr>
<th>Fiber Type</th>
<th>Attenuation/km</th>
<th>Bandwidth/km</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single mode</td>
<td>.40db/.30db</td>
<td>NA</td>
<td>1310nm/1550nm</td>
</tr>
<tr>
<td>Multimode</td>
<td>3.50db/1.0db</td>
<td>160MHz/500MHz</td>
<td>850nm/1300nm</td>
</tr>
</tbody>
</table>

E. All optical fiber shall be shipped on a single reel, without splices. The manufacturer’s fiber test results on the fiber shall be provided to the University. All fiber shall be installed per the manufacture’s specifications. Consult drawings for main and riser tel/data room locations and other installation requirements.

F. Optical Fiber Terminations: All optical fiber will be terminated in Corning connector module housings. Multimode fiber will be terminated using Corning preloaded ST connector patch panels with 6 ST connectors per module. Single mode fiber will be fusion spliced and will then be terminated on Corning preloaded SC connector patch panels. All single mode fiber will be fusion spliced in Corning FDC splice trays and then placed in FDC splice module holder housings. FDC boxes will be rack mounted in pre-defined building entrance and riser closet locations.

- Multimode - Corning (FDC-CP1P-15) FDC panel-preloaded with 6 ST multimode adapters (CAI).
  Corning (95-100-01R) ST connectors UV, glass in ceramic, 125um, multimode 3.0mm jkt.

- Single mode – Building Entrance/Main Tel-Data Room
  Corning (FDM12P12-3C-RH000) 12 port, single mode, SC Ultra PC connector module with 900um, single mode, 3-meter MIC pigtails contained in one sheath. Terminating 48SM will require eight (8) modules.

- Single mode – Riser Tel-Data Room(s)
  Corning (FDM12P12-3C-RH000) 12 port, single mode, SC Ultra PC connector module with 900um, single mode, 3-meter MIC pigtails contained in one sheath. Terminating 12SM will require two (2) modules.
  Corning (M67-048) 12 fiber splice tray TR/HSF. Will require one tray for each 12 strand tube of single mode optical fiber.
Corning (2806031-01) fusion splice protection sleeve heat shrinks for splice tray.

FDC-72 Box - Corning (FDC-CMH-072) 72-F capacity FDC fiber distribution center. All fiber at the main tel/data entrance room will terminate in FDC-72 housings.

FDC-003 Box - Corning (FDC-003) 24-F capacity FDC fiber combination box with splice trays. All fiber in the tel/data riser rooms will terminate in a FDC-003 housing.

Splice Box - Corning (FDC-SMH-5) 24-tray capacity FDC fiber splice module housing. Required in the main entrance tel/data room only.

G. The outdoor Corning ALTOS Gel Free optical fiber is not plenum rated and must be placed in conduit between the building entrance point and the main tel/data entrance room. In rare situations when this is not possible the Corning brand Freedom Fiber should be used to avoid a transition splice. MIC riser fiber is plenum rated but should be placed in conduit or orange inner duct for protection and easy identification. Consult drawings for riser closet locations and other installation requirements.

H. No substitutions of material or processes may be done by Contractor without prior written approval from the Owner. Consistency of material types will be required. Mix and match of equivalent materials will not be acceptable.

3.0 EXECUTION

A. Provide a complete optical fiber installation including all fiber, splice trays, termination boxes and patch points including all termination parts and materials. All optical fibers will be terminated at both ends and tested from end to end.

B. General installation guidelines/Contractor responsibilities.
1. Workmanship and neat appearance shall be as important as the electrical and mechanical efficiency of the system. All installation work shall be done in a neat, high quality manner and in conformity with local and federal codes.
2. All optical fiber and equipment shall be held firmly in place following manufacturer guidelines. Fastenings and supports shall be adequate to support loads per manufacturers recommendations.
3. All optical fiber and equipment shall be installed per manufacturer’s guidelines.
4. All optical fiber shall be installed free of kinks. A kink is defined as a violation of the manufacturer’s minimum bend radius specification. Optical fiber shall be placed with sufficient bending radius so as not to
kink or damage the fiber such that it many cause deterioration to the transmission characteristics of the fiber.

5. Each optical fiber bundle shall be labeled following University color code standards. The labels shall not be handwritten, must be legible, with identification numbering corresponding to both ends.

6. All optical fiber shall be tested and documented after completion of terminations. All material faults must be cleared. Contractor shall replace all defective optical fiber and material faults at their expense.

7. Defective fiber shall be replaced in one continuous piece and shall no be spliced.

8. Contractor is responsible to track and document as-built information.

9. Provide all project documentation, test results, as-built information and so-forth to the University at completion of project or as directed.

10. Pathing and raceway requirements for optical fiber runs and infrastructure should be defined on the construction drawings. The optical fiber must be protected at all times even in inaccessible areas such as solid ceilings.

11. Splicing of optical fiber, other than in connection with single mode connector terminations, is prohibited.

12. All wall/floor penetrations shall be fire stopped.

C. Testing of optical fiber

1. Each optical fiber shall be tested from end to end at each patch panel to determine end to end attenuation.

2. Each optical fiber shall be tested for connector and splice loss.

3. Fiber test reports will be conducted at 1310nm and 1550nm for single mode fibers and at 850nm and 1300nm for multi-mode fiber.

4. If any fiber testing reveals an abnormal test result, outside of the manufactures normal parameters, then the contractor shall, at contractor expense, conduct a test of all fiber strands in the affected sheath with an Optical Time Domain Reflectometer (OTDR) to identify the source and location of the problem.

5. The manufacturer’s original optical fiber test results from the actual shipped reels of fiber shall be provided to the University.

6. The contractor should provide the owner the end to end length of each fiber optic cable installed from both the footage markers on the cable and the OTDR readings.

D. Riser Closet Racks

1. The contractor will provide approved 19 inch wide racks or data cabinets for each of the tel/data rooms that will be housing electronics. These racks/cabinets will be used for fiber terminations, data electronics, and data station wire terminations only.
2. The contractor will be required to install the racks/cabinets in their final locations as designated by the University.

3. Installation will consist of anchoring the racks/cabinets to the floor and then bonding each rack/cabinet to the ground bar.

4. The contractor must coordinate this work with the University.

E. Labeling
1. All optical fiber patch points shall be marked so identification number can be determined from either end. Labeling must follow the University’s color code and fiber placement, which has been previously defined.

2. All optical fiber pathways and fiber bundles shall be tagged and posted with orange warning labels indicate the presence of optical fiber. This shall be done at all pull box locations and at all locations where unprotected optical fiber bundles are accessible.

F. Documentation
1. The contractor shall provide electronically printed end-to-end fiber attenuation tests results for each fiber strand. Test results must be identified by location, fiber bundle, buffer tube color and fiber color within the buffer tube.
27 15 00 Voice/Data Wiring

1.0 General

A. Work Included: Provide all labor, materials, tools, and services required to perform all work and services for installation of all telephone/data cabling and components as shown and indicated on the drawings, and/or herein specified, with the intent that the installation shall be completed as specified.

B. Standards: All work shall comply with ISU Telecommunications and Networking standards, the NEC (current edition), TIA/EIA, and all applicable state, federal and local codes. In addition wiring installation shall comply with manufacturer’s specifications, standard practices, and recommendations.

C. Electrical/Communication Contractor Qualifications: Contractor shall have a minimum of two years experience in the installation of telephone station wiring and category 6 data station wiring. Contractor must be familiar with category 6 testing procedures as specified later in this document.

D. Submittals: Provide verification of wiring manufacturer’s certification as an approved category 6 wire installer and/or documentation pertaining to recent similar installations by the contractor including customer names, addresses, and telephone numbers. In addition provide product data relating to telephone/data jacks, cover plates, and telephone/data cable. Provide as-built drawings in accurate, clear, legible, and reproducible form for use by the owner. As-built drawings should include outlet locations identified by symbol as to type of outlet and by number corresponding to permanent wiring tags plainly visible on the outlet faceplate and attached to each wire at the wiring closet.

2.0 Products

A. Horizontal station wiring: The data station cable shall be: blue, plenum rated, UL listed as Type CMP meeting NEC Section 800: and meet category 6 cable performance requirements as listed in UL’s Cable Certification Program. Belden Data Twist 600e (7852A Blue) is the University standard and is required. All terminations must comply with manufacturer’s specifications. The telephone station wire shall be: white, plenum rated, UL listed as Type CMP meeting NEC Section 800: and meet category 3 cable performance requirements as listed in UL’s Cable Certification Program. Systimax 24 AWG 4 Pair station wire- Systimax product code 2010 004BWH 4/24 R1000, comcode 107 078 396, is the University standard and is required.

B. Station jacks: Station jacks and faceplates are to be provided by the contractor and installed in metal single or double gang outlet boxes. All outlet components
are Ivory colored, manufactured by Krone, are the University standard, and are required. Consult drawings for outlet location and type of installation.

1. Data station jacks are to be Krone modular inserts (6830-1-830-02), Ivory, 8 conductor, RJ45 jacks using the T568B standard.

2. Telephone station jacks are to be Krone modular inserts (6467-5-195-10), Ivory, 4 or 6 conductor, RJ11 jacks using the 568A standard.

3. Krone flush-mount Ivory faceplates are required. The most commonly used faceplate is the single gang Krone 4-Port (6644-1-154-02) faceplate that will accept four snap-in termination modules. The four port faceplate is used for most administrative installations where University standard telephone only, telephone/single data, or telephone/dual data wiring standards are specified. Other Krone faceplates for special applications are also allowed by prior approval from the University. In student resident rooms the Krone eight port (6644-1-178-02) two gang angled faceplate is required.

4. In situations where the faceplate is not fully populated the unused space in the faceplate will require a Krone Ivory blank insert (6645-1-160-02).

5. In student resident rooms the CATV service also terminates in the Krone eight port faceplate with the telephone and data jacks. The Krone F-81 connector insert (6645-1-157-02) that is used for CATV application is usually installed by others unless specified in the project documents.

C. Closet Termination Products: At the IDF/BDF or data cabinet all conductors of each station wire will be terminated.

1. Telephone station wiring will be terminated on standard 66M1-50 split 50 mini 66 blocks. 89B mounting brackets for each block are also required. A sole source manufacturer is not specified but prior product approval is required. The contractor must provide these products in all new construction and major rehabilitation projects. In situations where new wiring is being added to existing termination points the owner will supply these products.

2. Data station wiring will be terminated on Krone Ultim8 eight conductor high band blocks (6468-2-060-06). Each block will accept two four pair CAT6 station wires. The preferred termination of the high band blocks requires a Krone mounting bracket (6655-2-450-21/2) and a Krone frame (6652-2-100-00) which will mount onto a standard 19” data rack. Krone Type 105 label strips (6462-2-096-00) are also required. They do not come with the high band blocks. Krone Type 105 label holders (6630-2-004-05) are to be inserted in the top slot of each mounting bracket. This item must be ordered separately as well. The contractor must provide these products in all new construction and major rehabilitation projects. In situations where new wiring is being added to existing termination points the contractor will provide the Krone high band blocks and labels, the owner will supply the Krone mounting hardware.
D. Miscellaneous items: All concealed telephone/data wiring to be bundled with Velcro wraps and supported per manufacturer’s recommendations. Bundled cable may not lie on suspended ceilings. Contractor to provide and install all miscellaneous materials necessary for a complete installation.

E. No substitutions of material or processes may be done by Contractor without prior written approval from the Owner. Consistency of material types will be required. Mix and match of equivalent materials will not be acceptable.

3.0 Execution

A. Provide complete telephone/data, telephone only, or data only outlets including all wiring and outlet components. All category 6 data cables will be terminated at both ends and tested from station jack to end of cable. All telephone station wires will be terminated at both ends and tested from station jack to end of cable.

B. General installation guidelines/Contractor responsibilities.
   1. Workmanship and neat appearance shall be as important as the electrical and mechanical efficiency of the system. All installation work shall be done in a neat, high quality manner and in conformity with local and federal codes.
   2. All cables, wire, and equipment shall be held firmly in place. Fastenings and supports shall be adequate to support loads.
   3. All cable, wires, and equipment shall be installed per manufacturer’s guidelines.
   4. Cables and wires shall be installed free of kinks. A kink is defined as a violation of the manufacturer’s minimum bend radius specification. Cables and wires shall be placed with sufficient bending radius so as not to kink or damage the cable such that it may cause deterioration to the transmission characteristics of the cable.
   5. All wiring shall be color coded per industry and ISU standards. Cable terminations shall be terminated in order per industry and or ISU standard color code.
   6. All jacks and cables shall be labeled with mechanically printed permanent labels that are the same on both ends and are legible. The Universities labeling standard is detailed in this document. Clarification of the labeling standard and next available C# for data only installations will be provided by the ISU Telecommunications and Networking Structured Wiring division.
   7. All category 6 data cables shall be tested and documented. Cable faults must be cleared. No cable shall have greater than 0% bad cable pairs. If 0% bad cable pairs are exceeded in one cable sheath, the Contractor shall replace cable at their expense. All telephone station wire will be tested for continuity after termination of both ends is completed. Defective materials or faults that are determined to be caused by the contractor shall
be repaired at the contractor’s expense. Joint (ISU/Contractor) testing will
be completed to decide any discrepancies.
8. The contractor is responsible for documenting as-built information.
9. Provide all project documentation, test results, as-built information and so-
   forth to ISU at completion of project or as directed. Individual station
   wire test results must be received in the proper format prior to outlet
   activation by ISU Telecommunications and Networking.

C. Station Wire Installation
1. Install station cables from the designated BDF/IDF wiring closet to the
   information outlet (jack) location indicated on the drawings.
2. No exposed station wiring outside of the wiring closet will be permitted.
3. Wall/Floor penetrations shall require metal sleeves and sealing with fire-
   stopping compound.
4. Open topped cable tray is the preferred horizontal distribution method for
   telephone/data station wiring. Cable trays should be installed in all new
   buildings and in areas undergoing major renovations.
   Traditional aluminum cable tray is preferred. Wire basket type cable tray
   will be allowed if flat solid panels are installed in the bottom. Conduit is
   required from the outlet box to the nearest cable tray, or from the outlet
   box to an accessible ceiling space, or from the outlet box to the wiring
   closet if the pathway is inaccessible. Minimum conduit size per outlet is
   1”. Conduit is to be installed with a maximum of two-90 degree bends
   between outlets or junction boxes; conduit runs of more than 90 feet will
   require a pull box at 90’ maximum intervals. On projects where cable tray
   has not been specified the contractor should coordinate with ISU to
determine the best path for station runs. Routing generally shall follow a
   main backbone highway with station drops branching off as needed.
5. At the station outlet (user end) all four pairs of the telephone station wire
   will be terminated on two Krone Keystone RJ11 Ivory snap in jacks
   (Krone# 6467-5-195-10). The telephone station wire will have all pairs
   terminated, two pairs on one jack and two pairs on the second jack. The
   wb and wo of the station wire will follow the color coded terminals on the
   left RJ11 module. The wg and wbrn of the station wire will terminate on
   the wb and wo color coded terminals on the right RJ11 module. The
   telephone station wire will be terminated using TIA/EIA T568A and
   University standards. Proper alignment of the modules in the outlet
faceplate puts the strain relief notch for the telephone line cord toward the
   bottom. Both telephone jack modules will snap into the lower knockouts
   on the outlet faceplate. At the BDF/IDF closet location all pairs of the
   telephone station wire will be terminated on 66 type blocks according to
   ISU standards. Please NOTE that closet termination of telephone station
   wire follows a unique format at ISU. The category 3 telephone station
   wire will be terminated in the closet using type 66 standard mini split 50
   blocks with mounting brackets. All pairs of the station wire are
   terminated with the white/blue and white/orange pairs terminated on the
left side and the white/green and white/brown pairs terminated on the right side of the mini split 50 blocks.

6. At the station jack (user end) all four pairs of each Belden Data Twist 600e data station wire will be terminated on Krone Keystone RJ45 Cat6 Ivory modules (Krone# 6830-1-830-02). The data station wire will have all four pairs terminated following the color coded terminals on the RJ45 module using option B. All four pairs of the data station wire terminate on the jack using TIA/EIA T568B and University standards.

Telephone/single data applications will require a blank insert (Krone#6645-1-160-02) in the upper right faceplate position. Proper alignment of the module in the outlet faceplate puts the strain relief notch for the data line cord toward the bottom. The data jack modules will snap into the upper two knockouts on the outlet faceplate. At the BDF/IDF closet the CAT6 station wiring will be terminated on Krone high band blocks following the color coding on the blocks and all other manufacturer specifications and recommendations. The exception being routing station wiring through the factory hole provided for that purpose in the back of the Krone pans. The wire should be routed from the top or bottom but not through the hole. Ample slack must be left in the cable. Generally the cable will serve from above and be neatly dressed in the rack with slack looping to just above the floor and up to the termination blocks. Cables that feed from the bottom will follow the same pattern in reverse. The goal being that the entire Krone bracket can be adjusted up and down in the data rack to accommodate future modifications.

7. Splicing of any station cabling is prohibited.

8. A nylon pull-string shall be installed in all main distribution conduits to facilitate future wiring additions.

D. Station Wire Removal
1. In situations where new station wiring is replacing existing wiring and the existing wiring will no longer be used or designated as spare the contractor must remove the abandoned wiring end to end.

E. Grounding
1. One copper No. 6AWG insulated ground wire and a copper ground bus bar shall be installed in each new main distribution and riser closet. This ground bar shall be attached to a suitable building ground point by the contractor and shall be installed in compliance with current NEC and BICSI requirements.

2. All data racks and cabinets, telephone protectors, cable trays or other transport pathways within these new closets shall be bonded to this common ground bar by the contractor with 6AWG insulated copper wire.
F. Testing of cabling system
   1. All category 6 data station cabling shall be auto-tested end to end from the station jack to the termination in the BDF/IDF room. Any defects found while testing shall be repaired, and if cable cannot be repaired it shall be replaced at the Contractor’s expense.

   2. The category 6 data cable shall have a full range CAT6 certification test performed using a quality tester that will identify system faults and verify that the installed data wiring meets assigned standards and requirements. Signed and dated 81/2” X 11” legible paper print outs of the test results including the location and complete jack number must be submitted to ISU prior to outlet activation (by ISU) or final acceptance.

   3. Testing the telephone station wire will consist of verification of continuity.

G. Labeling
   1. The University has adapted a unique labeling standard. Jack numbers for telephone/data combination outlets are derived from the position of the new telephone wire on the 66 blocks in the closet. Data only wiring requires an individual ‘C#’ label for each jack and wire. The data wire “C#”s must be provided by the ISU Telecommunications and Networking Structured Wiring division.

   2. Each information outlet faceplate and each telephone and data wire shall be labeled following University standards. The labels shall be made of waterproof material and be mechanically printed with permanent black ink. The labels must be legible with the same identification numbering corresponding to both ends. Each information outlet faceplate has removable covers that hide the mounting screws. They are located above and below each pair of module knockouts. The approved adhesive backed label should be placed on the outside of the top removable cover. The generic Krone cover that comes with the faceplate should be used below the lower knockouts. At the BDF/IDF closet the telephone wiring shall be labeled on the 66 blocks with black indelible ink in numerical order. Data wiring at the BDF/IDF closet should be labeled with mechanically printed labels both on the wire and on the Krone high band blocks using the Krone Type 105 label strips (6462-2-096-00). Labeling products must be approved by ISU Telecommunications and Networking prior to use.

   3. The standard ISU Telecommunications and Networking outlet label format consists of:

   Bldg#-Room#-Floor#-Closet#-Jack#

   Building # = The Universities official building number, usually three digits.
   Room # - Room number where outlet is installed.
   Floor # - Is the floor that the terminal closet is located on.
   Closet # - Designates which closet on the floor that the outlet is served from.
H. Documentation

1. Contractor shall provide in writing, electronically (ACAD), and on a clearly marked floor plan the outlet numbers and corresponding locations to ISU.

2. Contractor shall provide the printed results of the Cat6 data certification auto-tests on legible individual 8 ½” X 11” paper sheets. The results must be identified by location and complete jack number. They must be signed and dated by the tester. The test results must be submitted to ISU prior to outlet activation.
27 15 50 Voice Over IP (VOIP)/Data Wiring

1.0 General

A. Work Included: Provide all labor, materials, tools, and services required to perform all work and services for installation of all telephone/data cabling and components as shown and indicated on the drawings, and/or herein specified, with the intent that the installation shall be completed as specified.

B. Standards: All work shall comply with ISU Telecommunications and Networking standards, the NEC (current edition), TIA/EIA, and all applicable state, federal and local codes. In addition wiring installation shall comply with manufacturer’s specifications, standard practices, and recommendations.

C. Electrical/Communication Contractor Qualifications: Contractor shall have a minimum of two years experience in the installation of telephone station wiring and category 6 data station wiring. Contractor must be familiar with category 6 testing procedures as specified later in this document.

D. Submittals: Provide verification of wiring manufacturer’s certification as an approved category 6 wire installer and/or documentation pertaining to recent similar installations by the contractor including customer names, addresses, and telephone numbers. In addition provide product data relating to telephone/data jacks, cover plates, and telephone/data cable. Provide as-built drawings in accurate, clear, legible, and reproducible form for use by the owner. As-built drawings should include outlet locations identified by symbol as to type of outlet and by number corresponding to permanent wiring tags plainly visible on the outlet faceplate and attached to each wire at the wiring closet.

2.0 Products

A. Horizontal station wiring: The telephone and data station cables shall be: blue, plenum rated, UL listed as Type CMP meeting NEC Section 800: and meet category 6 cable performance requirements as listed in UL’s Cable Certification Program. Belden Data Twist 600e (7852A Blue) is the University standard and is required. All terminations must comply with manufacturer’s specifications.

B. Station jacks: Station jacks and faceplates are to be provided by the contractor and installed in metal single or double gang outlet boxes. All outlet components are Ivory colored, manufactured by Krone, are the University standard, and are required. Consult drawings for outlet location and type of installation.

   1. Telephone and Data station jacks are to be Krone modular inserts (6830-1-830-02), Ivory, 8 conductor, RJ45 jacks using the T568B standard.
2. Krone flush-mount Ivory faceplates are required. The most commonly used faceplate is the single gang Krone 4-Port (6644-1-154-02) faceplate that will accept four snap-in termination modules. The four port faceplate is used for most administrative installations where University standard telephone only, telephone/single data, or telephone/dual data wiring standards are specified. Other Krone faceplates for special applications are also allowed by prior approval from the University.

3. In situations where the faceplate is not fully populated the unused space in the faceplate will require a Krone Ivory blank insert (6645-1-160-02).

C. Closet Termination Products: At the IDF/BDF or data cabinet all conductors of each station wire will be terminated.

1. Telephone and Data station wiring will be terminated on Krone Ultim8 eight conductor high band blocks (6468-2-060-06). Each block will accept two four pair CAT6 station wires. The preferred termination of the high band blocks requires a Krone mounting bracket (6655-2-450-21/2) and a Krone frame (6652-2-100-00) which will mount onto a standard 19” data rack. Krone Type 105 label strips (6462-2-096-00) are also required. They do not come with the high band blocks. Krone Type 105 label holders (6630-2-004-05) are to be inserted in the top slot of each mounting bracket. This item must be ordered separately as well. The contractor must provide these products in all new construction and major rehabilitation projects. In situations where new wiring is being added to existing termination points the contractor will provide the Krone high band blocks and labels, the owner will supply the Krone mounting hardware.

D. Miscellaneous items: All concealed telephone/data wiring to be loosely bundled with Velcro wraps and supported per manufacturer’s recommendations. Bundled cable may not lie on suspended ceilings. Contractor to provide and install all miscellaneous materials necessary for a complete installation.

E. No substitutions of material or processes may be done by Contractor without prior written approval from the Owner. Consistency of material types will be required. Mix and match of equivalent materials will not be acceptable.

3.0 Execution

A. Provide complete telephone/data, telephone only, or data only outlets including all wiring and outlet components. All category 6 data cables will be terminated at both ends and tested from station jack to end of cable.

B. General installation guidelines/Contractor responsibilities.
1. Workmanship and neat appearance shall be as important as the electrical and mechanical efficiency of the system. All installation work shall be done in a neat, high quality manner and in conformity with local and federal codes.
2. All cables, wire, and equipment shall be held firmly in place. Fastenings and supports shall be adequate to support loads.
3. All cable, wires, and equipment shall be installed per manufacturer’s guidelines.
4. Cables and wires shall be installed free of kinks. A kink is defined as a violation of the manufacturer’s minimum bend radius specification. Cables and wires shall be placed with sufficient bending radius so as not to kink or damage the cable such that it many cause deterioration to the transmission characteristics of the cable.
5. All wiring shall be color coded per industry and ISU standards. Cable terminations shall be terminated in order per industry and or ISU standard color code.
6. All jacks and cables shall be labeled with mechanically printed permanent labels that are the same on both ends and are legible. The Universities labeling standard is detailed in this document. Clarification of the labeling standard and next available C# for data installations will be provided by the ISU Telecommunications and Networking Structured Wiring division.
7. All category 6 data cables shall be tested and documented. Cable faults must be cleared. No cable shall have greater than 0% bad cable pairs. If 0% bad cable pairs are exceeded in one cable sheath, the Contractor shall replace cable at their expense.
8. The contractor is responsible for documenting as-built information.
9. Provide all project documentation, test results, as-built information and so-forth to ISU at completion of project or as directed. Individual station wire test results must be received in the proper format prior to outlet activation by ISU Telecommunications and Networking.

C. Station Wire Installation
1. Install station cables from the designated BDF/IDF wiring closet to the information outlet (jack) location indicated on the drawings.
2. No exposed station wiring outside of the wiring closet will be permitted.
3. Wall/Floor penetrations shall require metal sleeves and sealing with fire-stopping compound.
4. Open topped cable tray is the preferred horizontal distribution method for telephone/data station wiring. Cable trays should be installed in all new buildings and in areas undergoing major renovations. Traditional aluminum cable tray is preferred. Wire basket type cable tray will be allowed if flat solid panels are installed in the bottom. Conduit is required from the outlet box to the nearest cable tray, or from the outlet box to an accessible ceiling space, or from the outlet box to the wiring closet if the pathway is inaccessible. Minimum conduit size per outlet is 1”.

27 15 50-3
is to be installed with a maximum of two-90 degree bends between outlets or junction boxes; conduit runs of more than 90 feet will require a pull box at 90’ maximum intervals. On projects where cable tray has not been specified the contractor should coordinate with ISU to determine the best path for station runs. Routing generally shall follow a main backbone highway with station drops branching off as needed.

5. At the station jack (user end) all four pairs of each Belden Data Twist 600e data station wire will be terminated on Krone Keystone RJ45 Cat6 Ivory modules (Krone# 6830-1-830-02). The data station wire will have all four pairs terminated following the color coded terminals on the RJ45 module using option B. All four pairs of the data station wire terminate on the jack using TIA/EIA T568B and University standards.

6. Telephone and Data applications may require blank inserts (Krone#6645-1-160-02) in unused faceplate positions. Proper alignment of the module in the outlet faceplate puts the strain relief notch for the telephone and data line cords toward the bottom. The telephone and data jack modules will snap into the outlet faceplate starting in the upper left knockout, then the upper right knockout, then the lower left knockout, and finally the lower right knockout. At the BDF/IDF closet the CAT6 station wiring will be terminated on Krone high band blocks following the color coding on the blocks and all other manufacturer specifications and recommendations. The exception being routing station wiring through the factory hole provided for that purpose in the back of the Krone pans. The wire should be routed from the top or bottom but not through the hole. Ample slack must be left in the cable. Generally the cable will serve from above and be neatly dressed in the rack with slack looping to just above the floor and up to the termination blocks. Cables that feed from the bottom will follow the same pattern in reverse. The goal being that the entire Krone bracket can be adjusted up and down in the data rack to accommodate future modifications.

7. Splicing of any station cabling is prohibited.

8. A nylon pull-string shall be installed in all main distribution conduits to facilitate future wiring additions.

D. Station Wire Removal
1. In situations where new station wiring is replacing existing wiring and the existing wiring will no longer be used or designated as spare the contractor must remove the abandoned wiring end to end.

E. Grounding
1. One copper No. 6AWG insulated ground wire and a copper ground bus bar shall be installed in each new main distribution and riser closet. This ground bar shall be attached to a suitable building ground point by the contractor and shall be installed in compliance with current NEC and BICSI requirements.
2. All data racks and cabinets, telephone protectors, cable trays or other transport pathways within these new closets shall be bonded to this common ground bar by the contractor with 6AWG insulated copper wire.

F. Testing of cabling system
1. All category 6 telephone and data station cabling shall be auto-tested end to end from the station jack to the termination in the BDF/IDF room. Any defects found while testing shall be repaired, and if cable cannot be repaired it shall be replaced at the Contractor’s expense.
2. The category 6 data cable shall have a full range CAT6 certification test performed using a quality tester that will identify system faults and verify that the installed data wiring meets assigned standards and requirements. Signed and dated 81/2” X 11” legible paper print outs of the test results including the location and complete jack number must be submitted to ISU prior to outlet activation (by ISU) or final acceptance.

G. Labeling
1. The University has adapted a unique labeling standard. Each telephone and data jack requires an individual ‘C#’ label for each jack and wire. The “C#’s must be provided by the ISU Telecommunications and Networking Structured Wiring division.
2. Each information outlet faceplate and each telephone and data wire shall be labeled following University standards. The labels shall be made of waterproof material and be mechanically printed with permanent black ink. The labels must be legible with the same identification numbering corresponding to both ends. Each information outlet faceplate has removable covers that hide the mounting screws. They are located above and below each pair of module knockouts. The approved adhesive backed label should be placed on the outside of the top removable cover to identify the top two jacks and on the outside of the bottom removable cover to identify the lower jacks. Telephone and Data wiring at the BDF/IDF closet should be labeled with mechanically printed labels both on the wire and on the Krone high band blocks using the Krone Type 105 label strips (6462-2-096-00). Labeling products must be approved by ISU Telecommunications and Networking prior to use.
3. The standard ISU Telecommunications and Networking outlet label format consists of:

   Bldg#-Room#-Floor#-Closet#-Jack#
Building # = The Universities official building number, usually three digits.
Room # - Room number where outlet is installed.
Floor # - Is the floor that the terminal closet is located on.
Closet # - Designates which closet on the floor that the outlet is served from.
Jack # - The individual outlet number used to identify the wire on both ends, this number will always start with a ‘C’. There will only be one “C1” per building.

H. Documentation
1. Contractor shall provide in writing, electronically (ACAD), and on a clearly marked floor plan the outlet numbers and corresponding locations to ISU.
2. Contractor shall provide the printed results of the Cat6 data certification auto-tests on legible individual 8 ½” X 11” paper sheets. The results must be identified by location and complete jack number. They must be signed and dated by the tester. The test results must be submitted to ISU prior to outlet activation.
27 20 00 Data Communications

See Sections 27 15 00 Voice/Data Wiring and 27 15 50 Voice Over IP (VOIP)/Data Wiring.
27 30 00 Voice/Data Wiring

1.0 General

A. Work Included: Provide all labor, materials, tools, and services required to perform all work and services for installation of all telephone/data cabling and components as shown and indicated on the drawings, and/or herein specified, with the intent that the installation shall be completed as specified.

B. Standards: All work shall comply with ISU Telecommunications and Networking standards, the NEC (current edition), TIA/EIA, and all applicable state, federal and local codes. In addition wiring installation shall comply with manufacturer’s specifications, standard practices, and recommendations.

C. Electrical/Communication Contractor Qualifications: Contractor shall have a minimum of two years experience in the installation of telephone station wiring and category 6 data station wiring. Contractor must be familiar with category 6 testing procedures as specified later in this document.

D. Submittals: Provide verification of wiring manufacturer’s certification as an approved category 6 wire installer and/or documentation pertaining to recent similar installations by the contractor including customer names, addresses, and telephone numbers. In addition provide product data relating to telephone/data jacks, cover plates, and telephone/data cable. Provide as-built drawings in accurate, clear, legible, and reproducible form for use by the owner. As-built drawings should include outlet locations identified by symbol as to type of outlet and by number corresponding to permanent wiring tags plainly visible on the outlet faceplate and attached to each wire at the wiring closet.

2.0 Products

A. Horizontal station wiring: The data station cable shall be: blue, plenum rated, UL listed as Type CMP meeting NEC Section 800: and meet category 6 cable performance requirements as listed in UL’s Cable Certification Program. Belden Data Twist 600e (7852A Blue) is the University standard and is required. All terminations must comply with manufacturer’s specifications. The telephone station wire shall be: white, plenum rated, UL listed as Type CMP meeting NEC Section 800: and meet category 3 cable performance requirements as listed in UL’s Cable Certification Program. Commscope White 24 AWG 4 Pair station wire- Commscope Plenum 3504, is the University standard and is required.

B. Station jacks: Station jacks and faceplates are to be provided by the contractor and installed in metal single or double gang outlet boxes. All outlet components are Ivory colored, manufactured by Krone, are the University standard, and are required. Consult drawings for outlet location and type of installation.
1. Data station jacks are to be Krone modular inserts (6830-1-830-02), Ivory, 8 conductor, RJ45 jacks using the T568B standard.

2. Telephone station jacks are to be Krone modular inserts (6467-5-195-10), Ivory, 4 or 6 conductor, RJ11 jacks using the 568A standard.

3. Krone flush-mount Ivory faceplates are required. The most commonly used faceplate is the single gang Krone 4-Port (6644-1-154-02) faceplate that will accept four snap-in termination modules. The four port faceplate is used for most administrative installations where University standard telephone only, telephone/single data, or telephone/dual data wiring standards are specified. Other Krone faceplates for special applications are also allowed by prior approval from the University. In student resident rooms the Krone eight port (6644-1-178-02) two gang angled faceplate is required.

4. In situations where the faceplate is not fully populated the unused space in the faceplate will require a Krone Ivory blank insert (6645-1-160-02).

5. In student resident rooms the CATV service also terminates in the Krone eight port faceplate with the telephone and data jacks. The Krone F-81 connector insert (6645-1-157-02) that is used for CATV application is usually installed by others unless specified in the project documents.

C. Closet Termination Products: At the IDF/BDF or data cabinet all conductors of each station wire will be terminated.

1. Telephone station wiring will be terminated on standard 66M1-50 split 50 mini 66 blocks. 89B mounting brackets for each block are also required. A sole source manufacturer is not specified but prior product approval is required. The contractor must provide these products in all new construction and major rehabilitation projects. In situations where new wiring is being added to existing termination points the owner will supply these products.

2. Data station wiring will be terminated on Krone Ultim8 eight conductor high band blocks (6468-2-060-06). Each block will accept two four pair category 6 station wires. The preferred termination of the high band blocks requires a Krone mounting bracket (6655-2-450-21/2) and a Krone frame (6652-2-100-00) which will mount onto a standard 19” data rack. Krone Type 105 label strips (6462-2-096-00) are also required. They do not come with the high band blocks. Krone Type 105 label holders (6630-2-004-05) are to be inserted in the top slot of each mounting bracket. This item must be ordered separately as well. The contractor must provide these products in all new construction and major rehabilitation projects. In situations where new wiring is being added to existing termination points the contractor will provide the Krone high band blocks and labels, the owner will supply the Krone mounting hardware.

D. Miscellaneous items: All concealed telephone/data wiring to be bundled with Velcro wraps and supported per manufacturer’s recommendations. Bundled cable
may not lie on suspended ceilings. Contractor to provide and install all miscellaneous materials necessary for a complete installation.

E. No substitutions of material or processes may be done by Contractor without prior written approval from the Owner. Consistency of material types will be required. Mix and match of equivalent materials will not be acceptable.

3.0 Execution

A. Provide complete telephone/data, telephone only, or data only outlets including all wiring and outlet components. All category 6 data cables will be terminated at both ends and tested from station jack to end of cable. All telephone station wires will be terminated at both ends and tested from station jack to end of cable.

B. General installation guidelines/Contractor responsibilities.
1. Workmanship and neat appearance shall be as important as the electrical and mechanical efficiency of the system. All installation work shall be done in a neat, high quality manner and in conformity with local and federal codes.
2. All cables, wire, and equipment shall be held firmly in place. Fastenings and supports shall be adequate to support loads.
3. All cable, wires, and equipment shall be installed per manufacturer’s guidelines.
4. Cables and wires shall be installed free of kinks. A kink is defined as a violation of the manufacturer’s minimum bend radius specification. Cables and wires shall be placed with sufficient bending radius so as not to kink or damage the cable such that it may cause deterioration to the transmission characteristics of the cable.
5. All wiring shall be color coded per industry and ISU standards. Cable terminations shall be terminated in order per industry and or ISU standard color code.
6. All jacks and cables shall be labeled with mechanically printed permanent labels that are the same on both ends and are legible. The Universities labeling standard is detailed in this document. Clarification of the labeling standard and next available C# for data only installations will be provided by the ISU Telecommunications and Networking Structured Wiring division.
7. All category 6 data cables shall be tested and documented. Cable faults must be cleared. No cable shall have greater than 0% bad cable pairs. If 0% bad cable pairs are exceeded in one cable sheath, the Contractor shall replace cable at their expense. All telephone station wire will be tested for continuity after termination of both ends is completed. Defective materials or faults that are determined to be caused by the contractor shall be repaired at the contractor’s expense. Joint (ISU/Contractor) testing will be completed to decide any discrepancies.
8. The contractor is responsible for documenting as-built information.

9. Provide all project documentation, test results, as-built information and so-forth to ISU at completion of project or as directed. Individual station wire test results must be received in the proper format prior to outlet activation by ISU Telecommunications and Networking.

C. Station Wire Installation

1. Install station cables from the designated BDF/IDF wiring closet to the information outlet (jack) location indicated on the drawings.

2. No exposed station wiring outside of the wiring closet will be permitted.

3. Wall/Floor penetrations shall require metal sleeves and sealing with fire-stopping compound.

4. Open topped cable tray is the preferred horizontal distribution method for telephone/data station wiring. Cable trays should be installed in all new buildings and in areas undergoing major renovations. Traditional aluminum cable tray is preferred. Wire basket type cable tray will be allowed if flat solid panels are installed in the bottom. Conduit is required from the outlet box to the nearest cable tray, or from the outlet box to an accessible ceiling space, or from the outlet box to the wiring closet if the pathway is inaccessible. Minimum conduit size per outlet is 1”. Conduit is to be installed with a maximum of two-90 degree bends between outlets or junction boxes; conduit runs of more than 90 feet will require a pull box at 90’ maximum intervals. On projects where cable tray has not been specified the contractor should coordinate with ISU to determine the best path for station runs. Routing generally shall follow a main backbone highway with station drops branching off as needed.

5. At the station outlet (user end) all four pairs of the telephone station wire will be terminated on two Krone Keystone RJ11 Ivory snap in jacks (Krone# 6467-5-195-10). The telephone station wire will have all pairs terminated, two pairs on one jack and two pairs on the second jack. The wb and wo of the station wire will follow the color coded terminals on the left RJ11 module. The wg and wbrn of the station wire will terminate on the wb and wo color coded terminals on the right RJ11 module. The telephone station wire will be terminated using TIA/EIA T568A and University standards. Proper alignment of the modules in the outlet faceplate puts the strain relief notch for the telephone line cord toward the bottom. Both telephone jack modules will snap into the lower knockouts on the outlet faceplate. At the BDF/IDF closet location all pairs of the telephone station wire will be terminated on 66 type blocks according to ISU standards. Please NOTE that closet termination of telephone station wire follows a unique format at ISU. The category 3 telephone station wire will be terminated in the closet using type 66 standard mini split 50 blocks with mounting brackets. All pairs of the station wire are terminated with the white/blue and white/orange pairs terminated on the left side and the white/green and white/brown pairs terminated on the right side of the mini split 50 blocks.
6. At the station jack (user end) all four pairs of each Belden Data Twist 600e data station wire will be terminated on Krone Keystone RJ45 Cat6 Ivory modules (Krone# 6830-1-830-02). The data station wire will have all four pairs terminated following the color coded terminals on the RJ45 module using option B. All four pairs of the data station wire terminate on the jack using TIA/EIA T568B and University standards.

Telephone/single data applications will require a blank insert (Krone#6645-1-160-02) in the upper right faceplate position. Proper alignment of the module in the outlet faceplate puts the strain relief notch for the data line cord toward the bottom. The data jack modules will snap into the upper two knockouts on the outlet faceplate. At the BDF/IDF closet the category 6 station wiring will be terminated on Krone high band blocks following the color coding on the blocks and all other manufacturer specifications and recommendations. The exception being routing station wiring through the factory hole provided for that purpose in the back of the Krone pans. The wire should be routed from the top or bottom but not through the hole. Ample slack must be left in the cable. Generally the cable will serve from above and be neatly dressed in the rack with slack looping to just above the floor and up to the termination blocks. Cables that feed from the bottom will follow the same pattern in reverse. The goal being that the entire Krone bracket can be adjusted up and down in the data rack to accommodate future modifications.

7. Splicing of any station cabling is prohibited.

8. A nylon pull-string shall be installed in all main distribution conduits to facilitate future wiring additions.

D. Station Wire Removal

1. In situations where new station wiring is replacing existing wiring and the existing wiring will no longer be used or designated as spare the contractor must remove the abandoned wiring end to end.

E. Grounding

1. One copper No. 6AWG insulated ground wire and a copper ground bus bar shall be installed in each new main distribution and riser closet. This ground bar shall be attached to a suitable building ground point by the contractor and shall be installed in compliance with current NEC and BICSI requirements.

2. All data racks and cabinets, telephone protectors, cable trays or other transport pathways within these new closets shall be bonded to this common ground bar by the contractor with 6AWG insulated copper wire.
F. Testing of cabling system
1. All category 6 data station cabling shall be auto-tested end to end from the station jack to the termination in the BDF/IDF room. Any defects found while testing shall be repaired, and if cable cannot be repaired it shall be replaced at the Contractor’s expense.

2. The category 6 data cable shall have a full range CAT6 certification test performed using a quality tester that will identify system faults and verify that the installed data wiring meets assigned standards and requirements. Signed and dated 8 1/2” X 11” legible paper print outs of the test results including the location and complete jack number must be submitted to ISU prior to outlet activation (by ISU) or final acceptance.

3. Testing the telephone station wire will consist of verification of continuity.

G. Labeling
1. The University has adapted a unique labeling standard. Jack numbers for telephone/data combination outlets are derived from the position of the new telephone wire on the 66 blocks in the closet. Data only wiring requires an individual “C#” label for each jack and wire. The data wire “C#”s must be provided by the ISU Telecommunications and Networking Structured Wiring division.

2. Each information outlet faceplate and each telephone and data wire shall be labeled following University standards. The labels shall be made of waterproof material and be mechanically printed with permanent black ink. The labels must be legible with the same identification numbering corresponding to both ends. Each information outlet faceplate has removable covers that hide the mounting screws. They are located above and below each pair of module knockouts. The approved adhesive backed label should be placed on the outside of the top removable cover. The generic Krone cover that comes with the faceplate should be used below the lower knockouts. At the BDF/IDF closet the telephone wiring shall be labeled on the 66 blocks with black indelible ink in numerical order. Data wiring at the BDF/IDF closet should be labeled with mechanically printed labels both on the wire and on the Krone high band blocks using the Krone Type 105 label strips (6462-2-096-00). Labeling products must be approved by ISU Telecommunications and Networking prior to use.

3. The standard ISU Telecommunications and Networking outlet label format consists of:

   Bldg#-Room#-Floor#-Closet#-Jack#

Building # = The Universities official building number, usually three digits.
Room # = Room number where outlet is installed.
Floor # = Is the floor that the terminal closet is located on.
Closet # = Designates which closet on the floor that the outlet is served from.
Jack # - The individual outlet number used to identify the wire on both ends. For data only installations this number will always start with a ‘C’.

H. Documentation
1. Contractor shall provide in writing, electronically (ACAD), and on a clearly marked floor plan the outlet numbers and corresponding locations to ISU.
2. Contractor shall provide the printed results of the category 6 data certification auto-tests on legible individual 8 ½” X 11” paper sheets. The results must be identified by location and complete jack number. They must be signed and dated by the tester. The test results must be submitted to ISU prior to outlet activation.

Voice Over IP (VOIP)/Data Wiring

1.0 General

A. Work Included: Provide all labor, materials, tools, and services required to perform all work and services for installation of all telephone/data cabling and components as shown and indicated on the drawings, and/or herein specified, with the intent that the installation shall be completed as specified.

B. Standards: All work shall comply with ISU Telecommunications and Networking standards, the NEC (current edition), TIA/EIA, and all applicable state, federal and local codes. In addition wiring installation shall comply with manufacturer’s specifications, standard practices, and recommendations.

C. Electrical/Communication Contractor Qualifications: Contractor shall have a minimum of two years experience in the installation of telephone station wiring and category 6 data station wiring. Contractor must be familiar with category 6 testing procedures as specified later in this document.

D. Submittals: Provide verification of wiring manufacturer’s certification as an approved category 6 wire installer and/or documentation pertaining to recent similar installations by the contractor including customer names, addresses, and telephone numbers. In addition provide product data relating to telephone/data jacks, cover plates, and telephone/data cable. Provide as-built drawings in accurate, clear, legible, and reproducible form for use by the owner. As-built drawings should include outlet locations identified by symbol as to type of outlet and by number corresponding to permanent wiring tags plainly visible on the outlet faceplate and attached to each wire at the wiring closet.

2.0 Products
A. Horizontal station wiring: The telephone and data station cables shall be: blue, plenum rated, UL listed as Type CMP meeting NEC Section 800: and meet category 6 cable performance requirements as listed in UL’s Cable Certification Program. Belden Data Twist 600e (7852A Blue) is the University standard and is required. All terminations must comply with manufacturer’s specifications.

B. Station jacks: Station jacks and faceplates are to be provided by the contractor and installed in metal single or double gang outlet boxes. All outlet components are Ivory colored, manufactured by Krone, are the University standard, and are required. Consult drawings for outlet location and type of installation.
   1. Telephone and Data station jacks are to be Krone modular inserts (6830-1-830-02), Ivory, 8 conductor, RJ45 jacks using the T568B standard.
   2. Krone flush-mount Ivory faceplates are required. The most commonly used faceplate is the single gang Krone 4-Port (6644-1-154-02) faceplate that will accept four snap-in termination modules. The four port faceplate is used for most administrative installations where University standard telephone only, telephone/single data, or telephone/dual data wiring standards are specified. Other Krone faceplates for special applications are also allowed by prior approval from the University.
   3. In situations where the faceplate is not fully populated the unused space in the faceplate will require a Krone Ivory blank insert (6645-1-160-02).

C. Closet Termination Products: At the IDF/BDF or data cabinet all conductors of each station wire will be terminated.
   1. Telephone and Data station wiring will be terminated on Krone Ultim8 eight conductor high band blocks (6468-2-060-06). Each block will accept two four pair category 6 station wires. The preferred termination of the high band blocks requires a Krone mounting bracket (6655-2-450-21/2) and a Krone frame (6652-2-100-00) which will mount onto a standard 19” data rack. Krone Type 105 label strips (6462-2-096-00) are also required. They do not come with the high band blocks. Krone Type 105 label holders (6630-2-004-05) are to be inserted in the top slot of each mounting bracket. This item must be ordered separately as well. The contractor must provide these products in all new construction and major rehabilitation projects. In situations where new wiring is being added to existing termination points the contractor will provide the Krone high band blocks and labels, the owner will supply the Krone mounting hardware.

D. Miscellaneous items: All concealed telephone/data wiring to be loosely bundled with Velcro wraps and supported per manufacturer’s recommendations. Bundled cable may not lie on suspended ceilings. Contractor to provide and install all miscellaneous materials necessary for a complete installation.
E. No substitutions of material or processes may be done by Contractor without prior written approval from the Owner. Consistency of material types will be required. Mix and match of equivalent materials will not be acceptable.

3.0 Execution

A. Provide complete telephone/data, telephone only, or data only outlets including all wiring and outlet components. All category 6 data cables will be terminated at both ends and tested from station jack to end of cable.

B. General installation guidelines/Contractor responsibilities.
   1. Workmanship and neat appearance shall be as important as the electrical and mechanical efficiency of the system. All installation work shall be done in a neat, high quality manner and in conformity with local and federal codes.
   2. All cables, wire, and equipment shall be held firmly in place. Fastenings and supports shall be adequate to support loads.
   3. All cable, wires, and equipment shall be installed per manufacturer’s guidelines.
   4. Cables and wires shall be installed free of kinks. A kink is defined as a violation of the manufacturer’s minimum bend radius specification. Cables and wires shall be placed with sufficient bending radius so as not to kink or damage the cable such that it may cause deterioration to the transmission characteristics of the cable.
   5. All wiring shall be color coded per industry and ISU standards. Cable terminations shall be terminated in order per industry and or ISU standard color code.
   6. All jacks and cables shall be labeled with mechanically printed permanent labels that are the same on both ends and are legible. The Universities labeling standard is detailed in this document. Clarification of the labeling standard and next available C# for data installations will be provided by the ISU Telecommunications and Networking Structured Wiring division.
   7. All category 6 data cables shall be tested and documented. Cable faults must be cleared. No cable shall have greater than 0% bad cable pairs. If 0% bad cable pairs are exceeded in one cable sheath, the Contractor shall replace cable at their expense.
   8. The contractor is responsible for documenting as-built information.
   9. Provide all project documentation, test results, as-built information and so-forth to ISU at completion of project or as directed. Individual station wire test results must be received in the proper format prior to outlet activation by ISU Telecommunications and Networking.

C. Station Wire Installation
   1. Install station cables from the designated BDF/IDF wiring closet to the information outlet (jack) location indicated on the drawings.
2. No exposed station wiring outside of the wiring closet will be permitted.
3. Wall/Floor penetrations shall require metal sleeves and sealing with fire-stopping compound.
4. Open topped cable tray is the preferred horizontal distribution method for telephone/data station wiring. Cable trays should be installed in all new buildings and in areas undergoing major renovations. Traditional aluminum cable tray is preferred. Wire basket type cable tray will be allowed if flat solid panels are installed in the bottom. Conduit is required from the outlet box to the nearest cable tray, or from the outlet box to an accessible ceiling space, or from the outlet box to the wiring closet if the pathway is inaccessible. Minimum conduit size per outlet is 1”. Conduit is to be installed with a maximum of two-90 degree bends between outlets or junction boxes; conduit runs of more than 90 feet will require a pull box at 90’ maximum intervals. On projects where cable tray has not been specified the contractor should coordinate with ISU to determine the best path for station runs. Routing generally shall follow a main backbone highway with station drops branching off as needed.
5. At the station jack (user end) all four pairs of each Belden Data Twist 600e data station wire will be terminated on Krone Keystone RJ45 category 6 Ivory modules (Krone# 6830-1-830-02). The data station wire will have all four pairs terminated following the color coded terminals on the RJ45 module using option B. All four pairs of the data station wire terminate on the jack using TIA/EIA T568B and University standards.
6. Telephone and Data applications may require blank inserts (Krone#6645-1-160-02) in unused faceplate positions. Proper alignment of the module in the outlet faceplate puts the strain relief notch for the telephone and data line cords toward the bottom. The telephone and data jack modules will snap into the outlet faceplate starting in the upper left knockout, then the upper right knockout, then the lower left knockout, and finally the lower right knockout. At the BDF/IDF closet the category 6 station wiring will be terminated on Krone high band blocks following the color coding on the blocks and all other manufacturer specifications and recommendations. The exception being routing station wiring through the factory hole provided for that purpose in the back of the Krone pans. The wire should be routed from the top or bottom but not through the hole. Ample slack must be left in the cable. Generally the cable will serve from above and be neatly dressed in the rack with slack looping to just above the floor and up to the termination blocks. Cables that feed from the bottom will follow the same pattern in reverse. The goal being that the entire Krone bracket can be adjusted up and down in the data rack to accommodate future modifications.
7. Splicing of any station cabling is prohibited.
8. A nylon pull-string shall be installed in all main distribution conduits to facilitate future wiring additions.

D. Station Wire Removal
1. In situations where new station wiring is replacing existing wiring and the existing wiring will no longer be used or designated as spare the contractor must remove the abandoned wiring end to end.

E. Grounding
   1. One copper No. 6AWG insulated ground wire and a copper ground bus bar shall be installed in each new main distribution and riser closet. This ground bar shall be attached to a suitable building ground point by the contractor and shall be installed in compliance with current NEC and BICSI requirements.
   2. All data racks and cabinets, telephone protectors, cable trays or other transport pathways within these new closets shall be bonded to this common ground bar by the contractor with 6AWG insulated copper wire.

F. Testing of cabling system
   1. All category 6 telephone and data station cabling shall be auto-tested end to end from the station jack to the termination in the BDF/IDF room. Any defects found while testing shall be repaired, and if cable cannot be repaired it shall be replaced at the Contractor’s expense.
   2. The category 6 data cable shall have a full range category 6 certification test performed using a quality tester that will identify system faults and verify that the installed data wiring meets assigned standards and requirements. Signed and dated 81/2” X 11” legible paper print outs of the test results including the location and complete jack number must be submitted to ISU prior to outlet activation (by ISU) or final acceptance.

G. Labeling
   1. The University has adapted a unique labeling standard. Each telephone and data jack requires an individual ‘C#’ label for each jack and wire. The “C#’s must be provided by the ISU Telecommunications and Networking Structured Wiring division.
   2. Each information outlet faceplate and each telephone and data wire shall be labeled following University standards. The labels shall be made of waterproof material and be mechanically printed with permanent black ink. The labels must be legible with the same identification numbering corresponding to both ends. Each information outlet faceplate has removable covers that hide the mounting screws. They are located above and below each pair of module knockouts. The approved adhesive backed label should be placed on the outside of the top removable cover to identify the top two jacks and on the outside of the bottom removable cover to identify the lower jacks. Telephone and Data wiring at the BDF/IDF closet should be labeled with mechanically printed labels both on the wire and on the Krone high band blocks using the Krone Type 105 label strips (6462-2-096-00). Labeling products must be approved by ISU Telecommunications and Networking prior to use.
3. The standard ISU Telecommunications and Networking outlet label format consists of:

Bldg#-Room#-Floor#-Closet#-Jack#

Building # = The University’s official building number, usually three digits.
Room # = Room number where outlet is installed.
Floor # = Is the floor that the terminal closet is located on.
Closet # = Designates which closet on the floor that the outlet is served from.
Jack # = The individual outlet number used to identify the wire on both ends, this number will always start with a ‘C’. There will only be one “C1” per building.

H. Documentation
1. Contractor shall provide in writing, electronically (ACAD), and on a clearly marked floor plan the outlet numbers and corresponding locations to ISU.
2. Contractor shall provide the printed results of the category 6 data certification auto-tests on legible individual 8 ½” X 11” paper sheets. The results must be identified by location and complete jack number. They must be signed and dated by the tester. The test results must be submitted to ISU prior to outlet activation.
27 35 23 Emergency Telephone Kiosk

1.0 General
A. Industries Jaro, Inc- Model Number J070 telephone kiosk with bronze finish. 84”H x 16 ½” dia. Lighted “EMERGENCY” panel to be included. Panel to be blue with white letters.

B. GAI-TRONICS- Standard Emergency Telephone, Model Number 293AL-001, Cast Aluminum.

C. GAI-TRONICS- Strobe with Dual Constant-On Lamps, Model Number 530FB.

D. See Appendix B1.