

# 27 Telecommunications Systems

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## GENERAL

Information Technology (IT) is the responsible unit for low-voltage installations at the University of Kansas (KU). This responsibility includes but is not limited to any and all University of Kansas property and structures including hand-holes, maintenance holes, pull-boxes, pedestals and enclosures as well as inside and outside plant installations.

Designers for projects relating directly or indirectly to areas listed above shall verify that all applicable portions of these standards are incorporated into the project's design, drawings, specifications and final construction. Requests for variances from these standards shall be submitted in writing to the DCM Project Manager, using the KU Standards Variance Request Form found in Appendix A1.1, for review and written approval or rejection as indicated on the form.

### ***Related Documents & Requirements***

Refer to the following project and/or University specifications for requirements that also apply to work of this section.

- General Requirements**
- Sitework:** Site Utility systems
- Special Construction:** CCTV Cameras, Security Systems
- Conveying Systems:** Elevator phones
- Electrical:** Raceways and boxes

The specifications contained herein are the minimum acceptable standard for voice, data, video, and other general telecommunications distribution systems at the University of Kansas. These specifications may be modified by the University's Information Technology department, (IT), a Division of Information Services, as necessary to accommodate special design or functional requirements of any particular space.

It is recommended that coordination between telecommunications designers and KU IT begin early. KU IT welcomes any questions or concerns that may arise, and would be happy to comment on preliminary sketches for locations of equipment, etc. AutoCAD submittals of any stage shall comply with the University of Kansas Department of Design and Construction Management (DCM) standards.

Any outages in service shall be carefully coordinated with KU IT as early in the design and construction processes as possible.

Telecommunications standards are dynamic in nature and continually change as technology evolves telecommunications and networking industry standards are modified. Designers shall coordinate with KU IT to ensure the latest standards are being used. Contractors shall coordinate with KU IT to ensure the proper specifications are being used prior to ordering products or beginning work.

The contractor shall purchase, install, test, and document all communications cabling, connectivity and support hardware as specified herein. Active telecommunications network equipment (electronics) will typically be supplied and installed by KU IT but may be specified for installation

by a contractor in accordance with specifications from KU IT. Designer shall verify requirements for each specific project with KU IT during the design phase.

These standards are not to be used as final specification or bid documents. They are intended to be a starting point in a process of collaboration between the architect/designer, DCM, the occupant, and KU IT throughout the project design process.

### ***Codes, Standards and Best Practices***

KU's communications systems follow the codes and standards set forth by standard-making bodies, including but not limited to current editions of the NEC, NESC, NFPA, ANSI/TIA/EIA Telecommunications Infrastructure Standards, FCC, IEEE and BICSI'S Telecommunications Distribution Methods Manual and Customer Owned Outside Plant Manual.

When a discrepancy arises between the above mentioned standards and the standards contained in this document, it shall be brought to the attention of KU IT immediately for resolution. Typically the more stringent of the two guidelines will be implemented.

### ***Bid Documents***

It is expected, that as a result of the collaboration between KU IT and the designer/consultant, a quality bid package be provided containing commonly accepted and standard language of the industry, such as what is included in the Division 27 standard specifications prepared by the Construction Specifications Institute (MasterFormat) and the American Institute of Architects (MasterSpec).

## **DEFINITIONS**

### ***Entrance Facility (EF)***

A room where the main telecommunications service enters a building from the outside; where the demarcation between the inter-building and intra-building cabling systems occurs.

### ***Equipment Room (ER)***

A room that provides space and maintains a suitable operating environment for large communications equipment. Equipment Rooms tend to serve an entire building as compared to a Telecommunications Room that serves a single floor. This space may be co-located with the Entrance Facility and/or Telecommunications Room, provided the room is sized for all functions.

### ***Telecommunications Room (TR)***

A room where the connection between the horizontal cabling and the building backbone cabling occurs. This room also contains the electronic equipment that transitions between the data, voice and video building backbone and the end user's telecommunications equipment. This space may be co-located with the Entrance Facility and/or Equipment Room, provided the room is sized for all functions.

### ***Backbone (Riser) Cabling***

The cabling that connects multiple Telecommunications Rooms to each other, to the Equipment Room and/or to the Entrance Facility.

### ***Horizontal Cabling***

The cabling between the Telecommunications Room and the Work Area that carries voice, data and video signals.

### ***Communications Outlet***

Any point of connectivity for voice/data/CATV at the user end (i.e. work area, desk, etc.).

### ***Communications Pathways***

Conduits, cable trays or other supports with the sole purpose of carrying communications cabling. Communications pathways shall not be used by other low-voltage systems, including but not limited to: fire alarm, security systems, and or building automation wiring or air/vacuum tubes.

### ***Outside Plant (OSP) Cabling***

Communications cabling and terminations primarily located outside the building footprint including, but not limited to copper and optical cabling, splicing and terminations, lightning and electrical protection, and work related to their construction.

### ***Outside Plant (OSP) Pathways***

Communications pathways primarily located outside the building footprint including but not limited to conduits, maintenance holes, handholes and work related to their construction.

## REQUIREMENTS

### ***Communications Rooms Minimum Requirements***

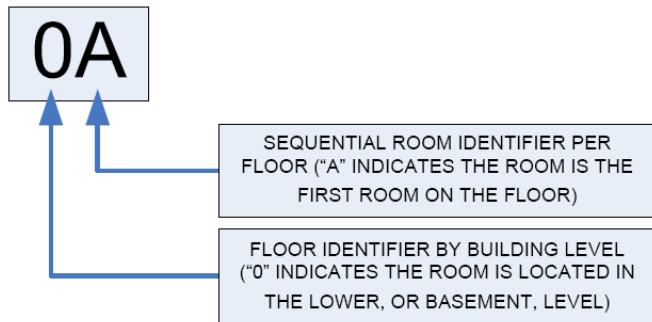
The following minimum requirements apply to all university Communications Rooms (i.e. EFs, ERs and TRs):

#### **Telecommunications**

Communications Rooms shall be secured and dedicated to this purpose with no other building services sharing the space.

Communication Rooms (for new and remodel projects) must comply with both PCI (Payment Card Industry) and LPA (Legislative Post Audit) requirements. Telecom Consultants and Contractors shall verify compliance with KU IT during design phase.

The room identifier shall be coordinated with KU IT and shall follow the diagram below:



**Communications Room Identifier**

#### *Pathway Entrances:*

The location, number, and size of communications pathways into Communications Rooms shall be coordinated with KU IT during the design phase of the project. No communications pathway shall have a fill that is greater than 40%.

Conduits and sleeves shall extend 2" above floor level or 2" beyond the face of the wall for intra-building conduits. For most buildings, (2) 4" conduits (or other approved equivalent pathway) between the EF, ER, and TRs will be a minimum requirement. However, some buildings may require more.

#### *Equipment Rack(s):*

A 7', 19" Ortronics Mighty MO 3 equipment rack shall be provided for housing fiber optic terminations and electronics. The rack shall be mounted to the floor and grounded. Coordinate the location of the rack with KU IT during design.

Conduit, receptacles and bolts attached to the rack shall be painted to match the color of the rack, with the exception of grounding conductors and connections. Scrape the paint of the rack off at the grounding connection location to ensure a good bond to steel.

*Cable Management Tray:*

Cable tray shall be provided around the perimeter of the room at 8' A.F.F. Cable tray shall also be installed between two walls, centered over the top of the equipment rack(s). Secure tray over equipment racks and support the cable tray as recommended by manufacturer. Deburr sharp edges of cable tray; provide spillways where cables transition out or in. Ground cable tray to Telecommunications Grounding System. Final size and location of tray will be determined by design and shall be coordinated with KU IT.

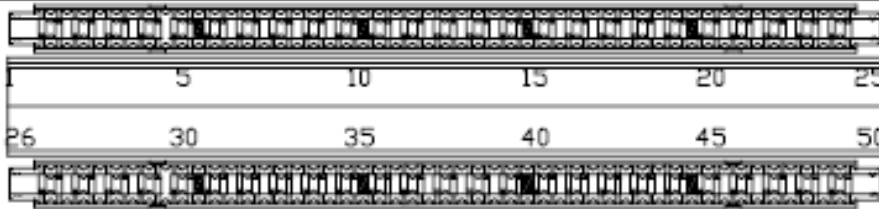
*Cable Management:*

Cables shall not be bundled along the horizontal path but be laid in their natural manner in cable management. Where required for dressing, support or routing within a communications room, cables may be loosely bundled using Velcro cable wraps; plastic tie wraps are prohibited.

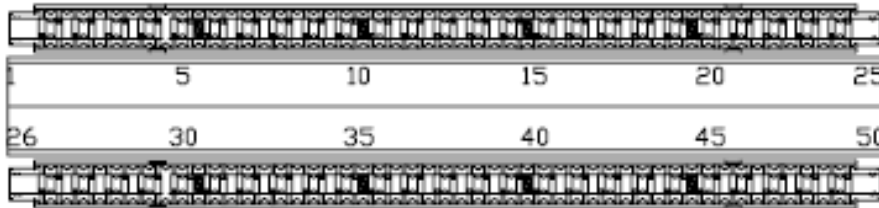
All cables, whether on the backboard or in the rack shall have cable management devices installed. Cable management devices that come with the termination devices or racks shall be used as required for a neat and workmanlike installation. Rack mounted Vertical and horizontal finger ducts shall be manufactured by Ortronics (OR-60400437 - Finger Duct with Cover, 4" x 4" x 7', black or OR-60400438 - Finger Duct with Cover, 2" x 4" x 7', black). GigaBIX Management Rings (Belden part number AX101478) shall be used between NORDX blocks.

*NORDX Block Labeling*

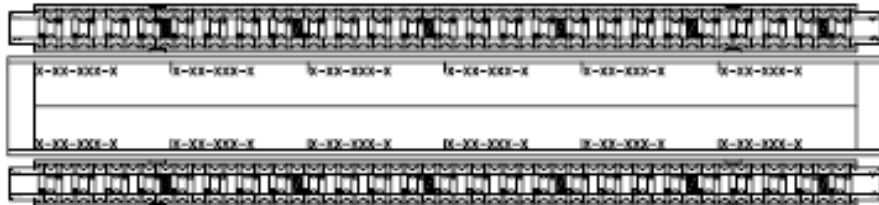
See the following diagram for NORDX block labeling and termination information.



Feeder, 25 Pair NORDX GigaBIX Label  
Green Background (NORDX Label)  
Verify Cable number w/ NTS



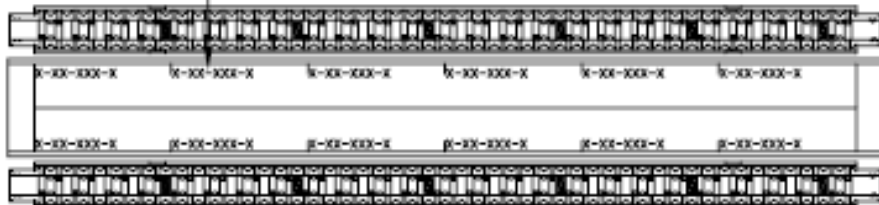
Riser, 25 Pair NORDX GigaBIX Label  
White Background (NORDX Label)  
Verify Cable number w/ NTS



Horizontal 6 Part NORDX GigaBIX Label  
Blue Background (NORDX Label)

Device  
i.e., Cisco 29XX  
Switch

C2950-2 ← Switch Port



Data Distribution Field  
6 Part NORDX GigaBIX Label  
Purple Background (NORDX Label)

*CATV Equipment:*

CATV equipment shall be coordinated with KU IT on a per-project basis.

Preferred CATV equipment includes:

Directional Tap: Taikan Series 55

Wall Mount Amplifier: PCT-MDA-42-RTA

Rack Mount Amplifier: RMDA-86A-30 5200-83 860 MHz, 30 dB Push-Pull Amp with  
Active Return Path

Fiber Optic Mini-Node: PCT part number PCT-MFN-FAS

Equalizers/Attenuators:

VMI-CEQ8V 9377A-xx Plug-in Equalizer, 860 MHz, Values 0-20 dB

VMI-AT 9320-xx Plug-in Attenuator, 1000 MHz, Values 0-18 dB

## **Architectural**

*Ceiling and height of room:*

Communications Rooms shall be open to structure with a minimum structure height of 9'-6".  
False or recessed ceilings are not allowed.

*Door:*

Communications Rooms shall have a fully opening, lockable door, which is at least 36" wide and 80" in height. The door shall be keyed to match KU IT's AB1 lock.

*Walls:*

Brick and gypsum board walls shall be painted or sealed to minimize dust. Each wall, except the wall which contains the entrance door, shall be lined with 3/4" A-C Grade, fire-retardant-treated plywood with the (A) side of the plywood installed facing out. Prior to equipment installation, plywood shall be painted with two coats of white, fire retardant low-gloss paint. At least one of the legible grade stamps on each sheet of plywood shall be masked or covered prior to painting for KU IT verification.

The plywood shall reach from corner to corner and be installed a maximum of 6" AFF. The plywood shall be anchored securely to wall substrate with a minimum of five (5) equally spaced fasteners along each vertical edge and down the centerline of each sheet of plywood. Fasteners shall be of the appropriate type for each substrate. Blocking or additional studs are to be provided in framed walls to receive plywood backup panel fasteners.

## **Electrical**

*Lighting:*

Minimum lighting shall be the equivalent of 540 lux (50 foot-candles) measured 3 feet AFF.

*Power:*

The standard electrical outlet is a four-plex outlet. The circuit shall be a dedicated circuit, surge protected, with no shared neutral.

On each wall, except the wall containing the door, one A/C 20-amp electrical fourplex outlet shall be installed, evenly spaced, at standard height. Note: Project plans may specify the need for additional electrical outlets to be installed, depending on the location of the electrical equipment.

A four-plex electrical outlet shall be installed in the bottom of the equipment rack to support rack-mounted UPSs. UPSs are typically provided by the University. The final size and type of UPS may affect the electrical receptacle required. The telecom consultant shall coordinate this with KU IT early in the design phase.

### **Mechanical**

Communications Rooms shall not have any plumbing or HVAC piping or ductwork within the room's interior space, interior walls, routing horizontally on the floor directly above the room, or within the floor slab.

Additionally, sufficient room shall be left surrounding the Communications Room for cable management tray access.

#### *HVAC:*

Communications Rooms shall have HVAC to control temperature and humidity. Temperature under load shall remain between 64 and 75 degrees Fahrenheit. The specific BTU's of heating and cooling to be provided will be specific to each building. Humidity shall be controlled at 50% +/- 15%. Electronics loads shall be verified with KU IT.

#### *Smoke and Fire Detection:*

Communications Rooms shall have a smoke/fire sensor that is part of the overall building fire alarm system.

### **Entrance Facility (EF)**

#### **Telecommunications**

##### *Pathway Entrances:*

For inter-building conduit entrances (OSP/entrance), conduits and sleeves shall extend 4" above floor level or 4" out from wall face for a "through-wall" penetration. For most buildings, (2) 4" conduits shall be installed from the nearest maintenance hole or handhole to the EF, one of the 4" conduits shall be a Carlon 4-way MultiGard conduit or approved equivalent. The final number shall be determined during the design phase of the project.

##### *Phasing:*

The EF shall be completed early as possible during construction.

##### *Grounding:*

Telecommunications Grounding shall follow ANSI J-STD-607-A and the Grounding section of these standards. A Harger (minimum) 12" long x 4" wide x 1/2" thick Telecommunications Main Grounding Busbar (TMGB) shall be provided in the EF and shall be labeled "TMGB" with mechanically produced text. The TMGB shall be pre-drilled copper with holes for use with standard-sized lugs. The TMGB shall be located at the lower left corner of the plywood backboard; 18" A.F.F. KU IT will determine which wall to place the TMGB.

##### *Equipment Rack(s):*

Minimum Communications Room requirements apply.

*Cable Management Tray:*

Minimum Communications Room requirements apply.

*UTP Copper Termination Field:*

NORDX 300 pair GigaBIX blocks shall be wall mounted in the EF to support riser and feeder cables. Location and size of the copper termination field shall be coordinated with KU IT. Building entrance protection shall also be coordinated with KU IT.

See Entrance and Outside Plant section for information concerning building entrance protection.

*Cable Management:*

Minimum Communications Room requirements apply.

*CATV Equipment*

Minimum Communications Room requirements apply.

## **Architectural**

*Location:*

The Entrance Facility shall be located to provide easy access to OSP and entrance conduits. Termination of entrance cables in the EF shall be within 50' of entering the building to reduce the requirement for rigid or intermediate conduit.

*Size:*

The Entrance Facility shall be sized as follows:

- When serving buildings with less than 5,000 square feet, dimensions shall be a minimum of 4' x 5'.
- When serving buildings greater than 5,000 square feet, dimensions shall be a minimum of 6' x 8'.

When the EF is also used as an ER and/or TR, the room shall be sized to accommodate the type and number of the services being supplied to the building. The size of the room shall be coordinated with KU IT as early as possible during the design phase.

*Ceiling and height of room:*

Minimum Communications Room requirements apply.

*Door:*

Minimum Communications Room requirements apply.

*Flooring:*

Floors shall be vinyl composition tile and all exposed concrete shall be sealed to minimize dust. Floors shall be designed to support a minimum of 4.8 kPA (100 lb/ft<sup>2</sup>).

*Walls:*

Minimum Communications Room requirements apply.

## **Electrical**

### *Lighting:*

Minimum Communications Room requirements apply.

## **Mechanical**

### *HVAC:*

Minimum Communications Room requirements apply.

### *Plumbing/Piping:*

Minimum Communications Room requirements apply.

### *Smoke and Fire Detection:*

Minimum Communications Room requirements apply.

## **Equipment Room (ER)**

## **Telecommunications**

### *Pathway Entrances:*

Minimum Communications Room requirements apply.

### *Grounding:*

Telecommunications Grounding shall follow ANSI J-STD-607-A and the Grounding section of these standards. A Harger (minimum) 12" long x 2" wide x 1/2" thick Telecommunications Grounding Busbar (TGB) shall be provided in the ER and shall be labeled "TGB" with mechanically produced text. The TGB shall be pre-drilled copper with holes for use with standard-sized lugs. The TGB shall be located at the lower left corner of the plywood backboard; 18" A.F.F.

### *Equipment Rack(s):*

Minimum Communications Room requirements apply.

### *Cable Management Tray:*

Minimum Communications Room requirements apply.

### *UTP Copper Termination Field:*

NORDX 300 pair GigaBIX blocks shall be wall mounted in the ER to support riser cables. Location and size of the copper termination field shall be coordinated with KU IT.

### *Cable Management:*

Minimum Communications Room requirements apply.

### *CATV Equipment*

Minimum Communications Room requirements apply.

## Architectural

### *Location:*

The ER location shall ensure that backbone cabling pathways are easily accessible. Accessibility for delivery of equipment shall also be kept in mind. The ER shall be located away from EMI, machinery causing vibration, piping, drains, clean outs, and shall not be located in the basement or lowest level of a facility. The ER shall not be located under or adjacent to restrooms or other areas with flooding possibilities.

If the ER is separate from the EF, it shall be located directly above the EF.

### *Size:*

The following Equipment Room sizing guidelines shall be used; however final size may be modified during design in coordination with KU IT, based on current and future equipment located in the space.

- When serving an area of less than 1,000 square feet, dimensions shall be a minimum of 3' x 4'.
- When serving an area between 1,000 and 5,000 square feet, dimensions shall be a minimum of 6' x 6'.
- When serving an area between 5,000 and 8,000 square feet, dimensions shall be a minimum of 6' x 10'.
- When serving an area between 8,000 and 10,000 square feet, dimensions shall be a minimum of 8' x 10'.
- When serving an area between 10,000 and 20,000 square feet, dimensions shall be a minimum of 10' x 15'.
- When serving an area between 20,000 and 30,000 square feet, dimensions shall be a minimum of 15' x 15'.
- When serving an area between 30,000 and 40,000 square feet, dimensions shall be a minimum of 17' x 17'.
- When serving an area between 40,000 and 50,000 square feet, dimensions shall be a minimum of 19' x 19'.

When the ER is also used as an EF and/or TR, the room shall be sized to accommodate the type and number of the services being supplied to the building and the equipment being housed. The size of the room shall be coordinated with KU IT as early as possible during the design phase.

### *Ceiling and height of room:*

Minimum Communications Room requirements apply.

### *Door:*

Minimum Communications Room requirements apply.

### *Flooring:*

Floors shall be vinyl composition tile and all exposed concrete to minimize dust. Floors shall be designed to support a minimum of 4.8 kPA (100 lb/ft<sup>2</sup>).

### *Walls:*

Minimum Communications Room requirements apply.

## **Electrical**

### *Lighting:*

Minimum Communications Room requirements apply.

### *Power:*

Minimum Communications Room requirements apply.

## **Mechanical**

### *HVAC:*

Minimum Communications Room requirements apply.

### *Plumbing/Piping:*

Minimum Communications Room requirements apply.

### *Smoke and Fire Detection:*

Minimum Communications Room requirements apply.

## **Telecommunications Room (TR)**

### **Telecommunications**

#### *Pathway Entrances:*

Minimum Communications Room requirements apply.

#### *Grounding:*

Telecommunications Grounding shall follow ANSI J-STD-607-A and the Grounding section of these standards. A Harger (minimum) 12" long x 2" wide x 1/2" thick Telecommunications Grounding Busbar (TGB) shall be provided in the ER and shall be labeled "TGB-X" with mechanically produced text (where X corresponds with the Communications Room Identifier). The TGB shall be pre-drilled copper with holes for use with standard-sized lugs. The TGB shall be located at the lower left corner of the plywood backboard; 18" A.F.F. KU IT will determine which wall to place the TGB.

#### *Equipment Rack(s):*

Minimum Communications Room requirements apply.

#### *Cable Management Tray:*

Minimum Communications Room requirements apply.

#### *UTP Copper Termination Field:*

NORDX 300 pair GigaBIX blocks shall be wall mounted in the TR to support riser cables. NORDX 72 port GigaBIX blocks shall be wall mounted in the TR to support horizontal cables. Location and size of the copper termination field shall be coordinated with KU IT.

The connection between the horizontal cabling termination field and the network electronics in the equipment rack shall be completed with NORDX IBDN Category 6 Patch Cords, 8P8C (T568B). Jacket color shall be purple (Pantone 291C). Belden part number NXGX-RSOPR-BPR, Anixter

part number AC300XXX (XXX varies as to what length is ordered). The part number specified shall be cut in half to create two patch cords with one connectorized and one blunt end.

#### *CATV Equipment*

Minimum Communications Room requirements apply.

#### *Cable Management:*

Minimum Communications Room requirements apply.

### **Architectural**

#### *Location:*

The TR location shall ensure that backbone and horizontal cabling pathways are easily accessible. The TR shall be located away from EMI, machinery causing vibration, piping, drains, clean outs, and shall not be located in the basement or lowest level of a facility. The TR shall not be located under or adjacent to restrooms or other areas with flooding possibilities.

TRs shall align vertically on each floor of the facility. If TRs are not aligned vertically, then they shall have a readily available means to easily access the TRs on the adjacent floors via conduit sleeves. The location of the TR shall be as close as possible to the center of the floor it is intended to serve, to minimize the horizontal cable lengths. The distance between a TR and the farthest possible Work Area Outlet in the area it is serving shall not exceed 295', measured as the cabling would travel through the communications pathways.

#### *Size:*

The Telecommunications Room shall be sized as follows:

- When serving an area with less than 5,000 square feet, dimensions shall be a minimum of 10' x 7'.
- When serving an area between 5,000 and 8,000 square feet, dimensions shall be a minimum of 10' x 9'.
- When serving an area between 8,000 and 10,000 square feet, dimensions shall be a minimum of 10' x 11'.

For small buildings where total useable floor space is 5,000 square feet or less, the Telecommunications Room may be sized as follows:

- When serving an area between 1,000 and 5,000 square feet, dimensions shall be a minimum of 4'-6" x 4'-6".
- When serving an area of less than 1,000 square feet, The Telecommunications Room may consist of a Rittal wall mount enclosure.
  - Size of enclosure shall be determined during design phase in coordination with KU IT. Size of enclosure shall accommodate existing and future equipment to be located in the space.
  - A typical enclosure used is a Rittal 60"x36"x16", part number 1097.330.
  - Rittal accessories shall also be provided for the specific enclosure used, but may typically be as follows:
    - Mounting Brackets: Rittal part number 1594.000
    - Grounding Strap: Rittal part number 2568.000
    - Locking Handle: Rittal part number 2450.000 with Insert: 2467.000
    - Fan and Vent Units: Rittal part number 3323.117 and 3323.207
    - Fan Cord: Rittal part number 9962.136

- Enclosure cutouts shall be made according to Rittal templates.
- Ground bar shall be provided within the cabinet
- Cabinet shall be grounded utilizing ground straps
- A duplex power receptacle shall be provided within the cabinet

When the TR is also used as an EF and/or ER, the room shall be sized to accommodate the type and number of the services being supplied to the building and the equipment being housed. The size of the room shall be coordinated with KU IT as early as possible during the design phase.

*Ceiling and height of room:*

Minimum Communications Room requirements apply.

*Door:*

Minimum Communications Room requirements apply.

*Flooring:*

Floors shall be vinyl composition tile and all exposed concrete to minimize dust. Floors shall be designed to support a minimum of 2.4 kPA (50 lb'/ft<sup>2</sup>).

*Walls:*

Minimum Communications Room requirements apply.

## **Electrical**

*Lighting:*

Minimum Communications Room requirements apply.

*Power:*

Minimum Communications Room requirements apply.

## **Mechanical**

*HVAC:*

Minimum Communications Room requirements apply.

*Plumbing/Piping:*

Minimum Communications Room requirements apply.

*Smoke and Fire Detection:*

Minimum Communications Room requirements apply.

## ***Backbone/Riser Communications Cabling***

A twisted pair copper cable for voice, a fiber optic cable for data and a coaxial cable for CATV shall be installed from the EF to the ER and each TR. All backbone/riser cabling shall be rated for the space in which it is installed (typically riser rated, however cable passing through a plenum shall be plenum rated).

## UTP Copper

### *Technical Specifications*

Backbone/Riser twisted-pair cabling shall be reinforced for protection against environmental damage. The sheath shall consist of a corrugated aluminum shield, which is adhesively bonded to an outer jacket of PVC plastic to form an aluminum-polyvinyl-chloride sheath.

Riser cable shall be used in riser shafts, without conduit, where a fire retardant sheath is necessary to meet NEC low-flame requirements. The riser cable must have a category rating of CMR or higher according to Article 800 of the 2005 NEC. A minimum of one 100 pair category 3 ARMM riser cable shall be installed from the EF to each TR.

The backbone/riser cable shall meet the following criteria:

Gauge: 24 AWG

Pair Size: 25 to 1800

Maximum Average DC Resistance: 26.5 ohms/1000ft

Maximum Average Mutual Capacitance: 16 nf/1000ft (at 1 kHz)

Impedance: 100 ohms +/- 15% (at 1.0 - 16 MHz)

Maximum Attenuation:

2.6 at .064 MHz (dB/1,000 ft.)
3.6 at .256 MHz (dB/1,000 ft.)
5.0 at .512 MHz (dB/1,000 ft.)
6.3 at .772 MHz (dB/1,000 ft.)
7.2 at 1.0 MHz (dB/1,000 ft.)
14.8 at 4.0 MHz (dB/1,000 ft.)
21.4 at 8.0 MHz (dB/1,000 ft.)
24.4 at 10.0 MHz (dB/1,000 ft.)
32.0 at 16.0 MHz (dB/1,000 ft.)

Sheath: Aluminum-Polyvinyl-Chloride

Shield: Corrugated Aluminum

Color Code: Standard PIC 25/50 pair binders

### *Installation*

The installation of twisted pair copper backbone/riser communications cables shall conform to manufacturer recommendations and the following installation criteria.

Minimum installation clearances for cabling shall be as follows:

- 5 inch separation from power lines carrying 2KVA or less
- 12 inch separation from power lines carrying from 2 to 5KVA
- 36 inch separation from power lines carrying more than 5KVA
- 5 inch separation from all fluorescent lights and other sources of electromagnetic interference (EMI) such as electric motors, HVAC equipment, arc welders, intercoms, etc.

Both ends of backbone/riser cables shall be terminated on NORDX GigaBIX 300 pair termination blocks. A specific cable pair count will be distributed to each communications room. A binder count will appear in only one communications room.

Appropriate bonding of the metallic cable shield is required throughout the physical cable plant with the shield being grounded whenever the outside jacket is opened.

Minimum Bending Radius shall not exceed manufacturer's specifications, typically not less than 12 times O.D. for shielded cables. Maximum Pulling Tensions shall not exceed manufactures specifications.

If the outer sheath is nicked or damaged, it must be reported to KU IT and the resolution for the repair must be approved by KU IT. Resolution could be a tape wrap or cable replacement, depending on the degree of damage.

*Labeling:*

Riser cables shall be labeled with their cable ID and pair count as determined by KU IT. Labeling shall be completed using mechanically produced text at the termination block, when entering or exiting a pull box, and within 6" of their entrance into a communications room. Labels for backbone/riser cables shall be printed on white paper.

NORDX riser cable termination blocks shall have manufacturer provided white labels with every first and fifth pair labeled, text to be mechanically produced. See *Labeling* under Communications Room Telecommunications requirements.

All cables shall have either strap-on or snap-on (wrap-around) labels. Verify with KU IT prior to placement of the label type and information printed.

*Testing:*

The following tests shall be completed on all twisted pair copper backbone/riser cables:

- Continuity on all pairs, (test for opens).
- Crosses and shorts, on all pairs.
- Loss at 1004hz, on all pairs.
- Noise metallic and noise to ground, sampling can be used.
- Insulation resistance, sampling may be used.

The contractor shall provide a test record report in electronic format to KU IT within one week of testing completion.

The maximum allowable defects copper cable pairs shall be in accordance with the following table:

<b>Cable size (pair)</b>	<b>Allowed Defects (pair)</b>
4 - 100 pr	0
100 - 600 pr	0
600 - 900 pr	0
900 – above	less than 0.002%

If outer sheath damage is the cause of the bad pairs, the entire cable shall be removed and replaced at the contractor's expense.

**Fiber Optics**

*Technical Specifications*

A minimum of one (1) 12 strand multimode and one (1) 12 strand single-mode shall be installed from the EF to each TR.

Plenum Rated part numbers:

Corning 12 strand multimode: 12K88-33150-29

Corning 12 strand singlemode: 12E88-31131-29

Riser Rated part numbers:

Corning 12 strand multimode: 12K81-33150-24

Corning 12 strand singlemode: 12E81-31131-24

### *Installation*

The installation of fiber optic riser/backbone communications cables shall conform manufacturer recommendations and to the following installation criteria.

The fiber optic riser cables shall be terminated at each end in a Corning Closet Connector Housing unit. The number of fibers installed will determine the required number of Corning Closet Connector Housing units.

The multimode and single mode fibers shall be terminated in separate Closet Connector Housing units.

Multimode fibers shall be terminated utilizing Corning ST pigtailed and splice housings. If the use of pigtailed is not feasible, then Lucent ST connectors, part number 105143911 shall be used.

Singlemode fibers shall be terminated utilizing Corning ST pigtailed and splice housings. If the use of pigtailed is not feasible, then Lucent ST connectors, part number 106812258 shall be used.

There shall be 15' of cable slack looped in each Connector Housing unit to facilitate future re-terminations.

The minimum bending Radius shall not exceed manufacturer's recommendations, typically 20 times diameter of cable when under tension and 10 times the diameter of cable when not under tension. The cable manufactures rated maximum tensile rating shall not be exceeded during installation.

### *Labeling:*

Riser cables shall be labeled with their cable ID and strand count as determined by KU IT.

Labeling shall be completed using mechanically produced text at the termination panel, when entering or exiting a pull box, and within 6" of their entrance into a communications room. Labels for backbone/riser cables shall be printed on white paper.

Fiber termination panels shall have manufacturer provided labels with mechanically produced text.

All cables shall have either strap-on or snap-on (wrap-around) labels. All cables shall have either strap-on or snap-on (wrap-around) labels. Verify with KU IT prior to printing information and placing label.

### *Testing:*

The following tests shall be completed on all fiber optic backbone/riser cables:

- End to end dB loss, both directions, at 850 and 1300 for multimode and 1310 and 1550 nanometers for single mode.
- Distance in feet for actual cable length
- Distance in Kilometers for actual cable length
- Number of splices in each fiber

The contractor shall provide a test record report in electronic format to KU IT within one week of testing completion.

The maximum allowable attenuation (db/km) for multimode fiber is 3.5 at 850nm and 1.0 at 1300nm. The maximum allowable attenuation (db/km) for single mode fiber is 0.4 at 1310nm and 0.3 at 1550nm.

The maximum allowable loss for splices is .3dB.

The maximum allowable loss for connectors is .75dB per connector pair.

## **Coax**

### *Technical Specifications*

A minimum of one (1) coax broadband riser rated cable, Commscope part number P-3 500JCAR, shall be installed from the EF to the first TR. One (1) broadband riser rated cable, Commscope part number P-3 500JCAR, shall be installed between each TR.

### *Install*

The installation of coax riser/backbone communications cables shall conform manufacturer recommendations and to the following installation criteria.

For each coax cable, 15' of cable slack shall be left at each end for terminating.

### *Label*

Riser cables shall be labeled with their cable ID as determined by KU IT. Labeling shall be completed using mechanically produced text at the termination point, when entering or exiting a pull box, and within 6" of their entrance into a communications room. Labels for backbone/riser cables shall be printed on white paper.

All cables shall have either strap-on or snap-on (wrap-around) labels. Verify with KU IT prior to printing information and placing label.

### *Testing:*

The following tests shall be completed on all coaxial backbone/riser cables:

- Continuity

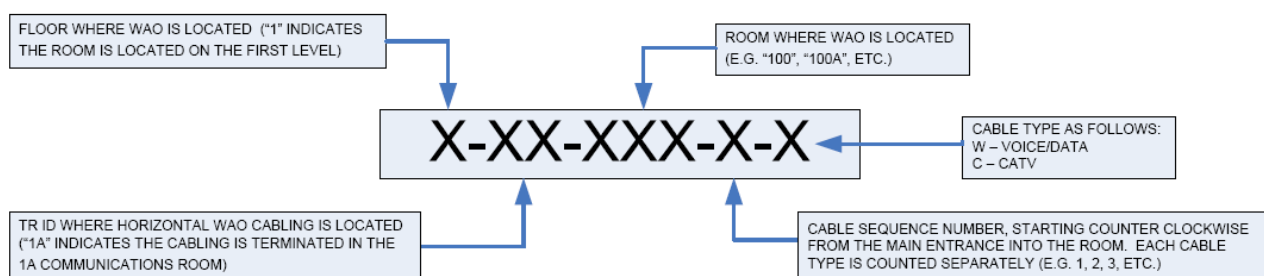
The contractor shall provide a test record report in electronic format to KU IT within one week of testing completion.

## Horizontal Communications Cabling

Horizontal cabling is largely dependant on work area outlet requirements. As early as possible in the design phase, the engineer/consultant shall closely coordinate work area requirements with the building occupants and KU IT to ensure that the needs of the occupant are being met and that they are in accordance with University standards.

### General Labeling:

Horizontal cables shall be labeled with a cabling identifier coordinated with KU IT, and shall follow the diagram below. Labels shall be located at the work area outlet (WAO) end of the cable, 1" from the termination. Labels shall also be located within 6" of their entrance into the TR and within 6" of their terminations inside the TR. All cables shall have either strap-on or snap-on (wrap-around) labels.



**Horizontal Cabling and WAO Identifier**

## UTP Copper

### Technical Specifications

Typically, a minimum of two (2) horizontal cables shall be provided to each work area outlet. All horizontal cabling shall be plenum rated.

Horizontal data and voice cables shall be yellow unshielded twisted-pair (UTP), each cable consisting of four twisted pairs of 24 AWG solid conductors type CMP, Category 5E, plenum rated. Cable shall be Berk-Tek LANMark 350.

### Install

The installation of horizontal communications cables shall conform manufacturer recommendations and to the following installation criteria.

Minimum installation clearances for cabling shall be as follows:

- 5 inch separation from power lines carrying 2KVA or less
- 12 inch separation from power lines carrying from 2 to 5KVA
- 36 inch separation from power lines carrying more than 5KVA
- 5 inch separation from all fluourescent lights and other sources of electromagnetic interference (EMI) such as electric motors, HVAC equipment, arc welders, intercoms, etc.

Installation and physical protection of horizontal cabling is a critical element for the cable to deliver its rated bandwidth. A "kink", "pinch", incorrect bend radius, or stretching of the cable by exceeding the 25 pound maximum pulling tension during installation will damage the cable to the point that it will not meet specifications.

Any cable damaged during the procurement, construction or post-construction processes shall be replaced in its entirety, at the contractor's expense.

When terminating horizontal UTP cabling, no more than one-half inch of horizontal UTP copper cables shall be untwisted.

Cable runs from the TR to the work area outlet shall not exceed 295 feet, measuring as the cabling would travel through the communications pathway. Horizontal cables shall not be spliced.

At the work area outlet end, located in the outlet box or above the ceiling, a minimum of 12" of cabling slack shall be provided (after termination) to facilitate future re-terminations.

Horizontal UTP copper cables shall be terminated in the TR on a 72-port NORDX GigaBIX block. In the TR cable management tray, horizontal cables shall have 10' of slack (after termination). Cable shall be routed and managed in a neat bundle using Velcro tie wraps.

No open or exposed wiring or conduits will be permitted below finished ceilings. Ivory colored surface raceway, Wiremold 2100 with a 2144-2 box may be used in places where "fishing" of walls is not possible. No substitution of raceway is allowed.

*Labeling:*

On the 72-port GigaBIX block containing the horizontal cabling terminations, each cable termination will be labeled on the block with the jack ID. Labels shall be printed on blue (Pantone 291C) paper. See *Labeling* under Communications Room Telecommunications requirements.

*Testing:*

UTP Horizontal cable testing shall conform to ANSI/TIA/EIA-568-B.1 standard and all addendums and shall be accomplished using a level IIe or higher field tester. The following tests shall be completed and results submitted to KU IT:

- Wire map
- Length
- Insertion Loss
- Pair-to-pair NEXT
- PSNEXT loss
- Pair-to-pair PSELFEXT
- Cable return loss
- Propagation delay
- Delay skew

The contractor shall provide a test record report for each horizontal link in electronic format to KU IT within one week of testing completion.

Where any portion of the system does not meet the specifications, the deviation shall be corrected and the test shall be repeated at no charge to the University.

All category 5e cable shall be certified to 100 MHz.

The contractor shall replace, at no charge to the University, any cable that tests defective, is not installed in a neat and workmanlike manner, is kinked, exceeds bend radius, has stretched jackets or has been secured with tie-wraps that have been over-tightened.

The contractor shall correct at no charge to the University, any cable that has more than 1" of jacket removed at the termination points.

## **Coax**

### *Technical Specifications*

Horizontal coaxial cabling shall be RG6, plenum rated, with a white jacket, Commscope part number 2279V.

### *Installation*

The installation of horizontal communications cables shall conform to manufacturer recommendations. Coaxial cable termination at the TR shall be coordinated with KU IT, as CATV equipment is reviewed on a case-by-case basis.

The work area outlet cable end shall have a minimum of 12 inches of excess cable. At the TR end of the cable there shall be 24 inches of excess cable plus the length needed to reach the designated equipment (typically a tap or splitter). Cable shall be routed so the 24" of slack is managed in a neat bundle.

### *Label*

Horizontal cables shall be labeled with their cable ID, as determined by KU IT. Labels shall be located at the work area outlet, 1" from the termination. Labels shall also be located within 6" of their entrance into the TR and within 6" of termination in the TR. All cables shall have either strap-on or snap-on (wrap-around) labels.

The horizontal cable labeling shall be coordinated with KU IT and will contain the floor number, TR ID, room number of room the jack is located in, the sequence number of the cable (start with 1 and number sequentially going clockwise in the room for each cable type) and the cable type.

### *Testing:*

The following tests shall be completed on all coaxial horizontal cables:

- Continuity

The contractor shall provide a test record report in electronic format to KU IT within one week of testing completion.

## **Conference Rooms:**

A single RG6 coax cable shall be installed to each conference room, for termination in the standard work area outlet box.

## COMMUNICATIONS OUTLET

### General

The Telecommunications Designer shall provide a WAO identifier on the construction drawings for each cable pulled. These identifiers are provided to minimize confusion in the field and to aid KU IT in provisioning work. The Telecommunications Designer shall also provide activation information for each cable pulled to KU IT with the submittal of Construction Documents (i.e. Identify locations of voice, data and CATV that the occupant needs to be activated upon completion of the project). See “Horizontal Cabling and WAO Identifier diagram below.

Connectivity to each work area outlet (WAO) outlet will need to be carefully coordinated with the building occupants and KU IT.

Typically, the minimum connectivity provided to each occupied room will be (1) voice and (1) data connection.

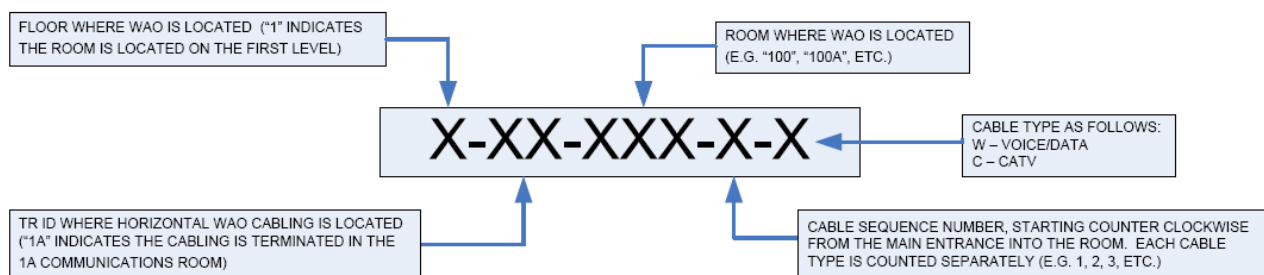
The work area outlet box shall be a RACO steel double gang box, 4” X 4” X 2¼” deep with 2-gang plaster rings.

Two work area outlet boxes shall be installed for every 100 square feet of office space unless otherwise noted.

Conference rooms shall have two work area outlet boxes installed.

For horizontal cabling conduit runs, the minimum conduit size shall be one inch in diameter.

A label printed with the outlet identifier, as coordinated with KU IT and identified in the diagram below, shall be placed on the faceplate of each work area outlet. Labels shall have mechanically produced text and shall be printed on white paper.



**Horizontal Cabling and WAO Identifier**

### Information Outlet Termination:

Horizontal cabling shall be terminated at the work area end using Ortronics Series II modules in an Ortronics faceplate. Part numbers shall be verified with KU IT.

Horizontal UTP cabling termination shall follow the 568B-wiring standard.

Horizontal coaxial cables shall terminate in an "F" barrel connector, utilizing T&B Snap-N-Seal connectors.

When uniformity with electrical receptacles is desired, Ortronics TracJacks and "106" type frames may be used. The required part numbers shall be verified by KU IT.

### **Telecommunications Wall Phone Outlet:**

A telecommunications wall phone is defined as a voice connection for a guest or "courtesy" phone.

These outlets shall be located at 54" A.F.F. and shall contain a single voice connection.

The telecommunication wall phone outlet box shall be a RACO steel double gang, 4" X 4" X 2¼" box with a steel drawn plaster ring secured to the double-gang outlet box prior to the installation of finish material. The appropriate raised single-gang steel drawn plaster ring, i.e. 5/8", shall be installed so that the outer surface of the plaster ring will be flush with the outer surface of the surrounding sheet rock or finish material.

The surface mount wall phone jack shall be Leviton part number 40226-S, with a UPC 07847710506 stainless steel phone wall plate.

For wall phone outlet cabling conduit runs, the minimum conduit size shall be one inch in diameter.

### **Public Phones:**

A public phone is defined as elevator, payphones or other emergency phones in common areas.

A single voice connection shall be provided. Public phone conduit shall be a minimum of one inch EMT conduit "home-run" back to the TR, (not stubbed out to communications pathways like information outlet cabling).

### **BACS & Fire Alarm:**

BACS and Fire Alarm connectivity will need to be closely coordinated with KU IT, the Fire Protection Engineer and the University of Kansas' Facilities Operations Departments. Typically (1) 6 strand multimode cable is provided to the university fire alarm panel that is connected to the University fire alarm fiber optic ring.

A single data connection is provided to each BACS panel back to the TR. BACS and Fire Alarm conduit shall be a minimum of one inch EMT conduit "home-run" back to the TR, (not stubbed out to communications pathways like information outlet cabling).

A data connection shall be provided to the gas and power meter. This shall be coordinated with the electrical and mechanical engineering team.

Additionally, the Telecom Designer will need to verify with DCM and the Engineering Team whether the building they are working on is going to be added to the University's Mass Emergency Notification System which would require the Telecom Designer to incorporate a dry copper pair connection into the design.

## ***Inside Plant (ISP) Communications Pathways***

### **General**

Clear and accessible pathways for telecommunications cabling shall be provided. These pathways provide physical connection between the EF, ERs, TRs and rooms containing telecommunications outlets. Typically, these pathways shall be located in common hallways to allow easy access with the least disturbance to offices and classrooms. When hallway locations for pathways are not feasible, the Design Team shall coordinate with KU IT to locate them in the least obtrusive location possible.

The Architect and design team shall ensure a clear and accessible pathway for telecommunications cabling has been provided. Any pathway that is not accessible or does not provide a clear and workable pathway shall be removed and relocated.

There are several methods available for providing a pathway for supporting telecommunications cables. The architectural design of each building is unique and requires an analysis of which method(s) are best suited for that building.

Communications Pathways shall be installed in accordance with any applicable electrical code and manufacturer recommendations.

Communications pathways shall not be attached, secured to, or be supported by, any portion of the ceiling or ceiling grid system, including the “T” bar ceiling tile support rails or the “T” bar support rail wires. The use of “batwing” support is not allowed.

Communications pathways shall not interfere with ceiling tile installation or removal.

The load bearing capacity of communications pathways shall exceed the combined load of the physical pathway and the additional imposed load of the cables installed at 100% fill.

Toggle bolts or similar fasteners shall not be used to secure communications pathways to field areas of sheetrock or other finish material.

Communications Pathways shall be dedicated for use only by KU IT. No other cabling shall travel in any part of the communications pathways.

All pathways are to be designed with a maximum of 40% cabling fill. Communications Pathway sizing and final locations shall be verified with KU IT.

Cabling shall not be unsupported for a distance greater than 4’.

### **Conduit**

Conduits used to carry telecom cabling are a part of the “communications pathway”. Communications conduit requirements depart from that of “normal” electrical power distribution. Communications conduit sizing does not follow NEC in terms of the maximum number of conductors allowed per unit volume. Due to the need for facilitating frequent additions, moves and

changes to the telecommunication systems, communications conduits are generously sized, with a maximum cable filling of 40%.

Conduits shall be EMT, unless otherwise noted.

Sharp edges of conduits shall be deburred prior to cabling installation. Grounding bushings shall be provided at the ends of communications conduits.

Conduit waterfalls (spillways) shall be provided at ends of conduits where cabling transitions over six inches in elevation.

The horizontal communications outlet conduit shall connect from the outlet box to the nearest cable tray or consolidated communications pathway. The conduit shall terminate within one foot of the nearest communications pathway.

Conduit designated or installed with the probability of fiber optic cabling traveling in it will be carefully coordinated with the fiber optic manufacturer's cabling bend radius maximums, in addition to the horizontal copper cabling requirements.

Conduit runs for horizontal cabling shall not exceed 260 feet in length.

The minimum bend radii for conduits shall be as follows:

- If the internal diameter of the conduit is less than 2" then the bending radii shall be a minimum of 6 times the internal diameter.
- If the internal diameter of conduit is 2" or greater then the bending radii shall be a minimum of 10 times the internal diameter.

A pull box shall be installed after every 180-degree change in direction or elevation or every 150 feet.

Pull boxes shall be located in readily accessible locations. The installation of pull boxes in the conduit run shall be placed in line with the conduit so that cabling can be pulled through the pull box without incurring damage to the cable. No turns or bends of the conduit run are allowed within pull boxes.

All pull boxes shall be labeled with mechanically produced text "KU IT".

A nylon pull cord shall be installed in each empty conduit and run with a 200 pound pulling tension.

Conduits in laboratories shall be extended to the nearest hallway or corridor.

LB type fittings shall not to be used.

PVC conduit or PVC sleeves shall not be used within the footprint of the building.

Flexible conduit is not recommended as a telecommunications pathway, however if carefully coordinated with KU IT, flexible conduit may be used under special circumstances. When used, the next higher trade size must be installed. Example: If a 1" EMT conduit cannot be used and a flexible conduit must be used, then the flexible conduit must be 1-1/4" in size.

## **Cable Tray**

Cable tray provided shall be Cablofil EZ-Tray.

Cable tray size(s) will be determined during the design phase of the project, and shall be verified with KU IT.

Support of cable tray shall be at intervals in accordance with the manufacturer's instructions, or 5', whichever is more stringent.

Communications cabling shall only be placed within the basket area (inside) of the cable tray. No conductors of any kind, or any other materials or systems shall be secured to, attached to, or be supported on the outside surface of the cable tray.

If project plans specify the vertical installation of cable tray, the inside of the basket area of the tray shall be installed facing outward, away from the face of the wall.

Where cable tray is to be installed horizontally, the inside of the basket area shall face in an upward direction.

Cable trays shall be installed level. Exception: Elevation transitions between cable tray sections.

## **J-Hooks**

J-hooks provided shall be B-Line Systems model BCH21, BCH32, or BCH64 or Erico Fastening Products "CableCat" system model Cat21 or Cat32.

J-hooks may be used to provide cabling support between the horizontal conduit and communications pathway. The maximum 40% cabling fill shall be followed, but cable count inside a J-hook shall not exceed 25.

J-hook pathways shall be securely fastened to building structural components at no greater than 4 foot on-center. In most circumstances, J-hooks will be secured to above ceiling CMU's, poured concrete ceilings/walls or sheetrock covered metal wall studs. If a wall stud is not available at the required maximum spacing distance, a closer spacing of J-hooks securely fastened to building structural components shall be installed in the area affected. Extra J-hooks shall be installed to properly cross hallways and to make turns or a change in direction.

## ***Entrance and Outside Plant (OSP) Communications Cabling***

The number and type of entrance or outside plant (OSP) cables (for voice, data, and video) that will be brought into each specific building will be determined by KU IT and will help establish the number and size of entrance conduits coming into the EF.

A ground wire shall be installed at the location the cable enters the building. Reference 2002 NEC Articles 800-40 and 800-50.

## UTP Copper

### *Technical Specifications*

Twisted-pair cable used for outside cable plant purposes shall be reinforced for protection against environmental damage and shall be waterproof, ANMW (ASP) or PIC type cable, manufactured by Superior Essex.

Entrance/OSP twisted pair copper cabling shall meet the following criteria

Gauge: 24 AWG

Pair Size: 25 to 1800

Maximum Average DC Resistance: 27.3 ohms/1000ft

Maximum Average Mutual Capacitance: 15.7 nf/1000ft (above 1.0 MHz)

Impedance: 100 ohms (above 1.0 MHz)

Maximum Attenuation: 5.49 at 772 kHz and 6.25 at 1.0 MHz

Sheath: Polyethylene

Shield: 8 mil aluminum or equivalent

Color Code: Standard PIC 25/50 pr binders

### *Protection*

Twisted pair copper cabling shall have one end terminated at the building Entrance Facility on a Porta Systems Corp. Series 26 stub in and stub out. The entrance cable will then be terminated on NORDX GigaBIX 25 pair module(s). A specific cable pair count is distributed to each building. A binder count will appear in only one building communications room. Inter-building cables shall be protected at both ends, and there shall be no bridge tap (multiple) on any outside plant cable.

### *Installation*

The installation of twisted pair copper backbone/riser communications cables shall conform to manufacturer recommendations and the following installation criteria.

Outside plant or unlisted cabling shall not extend into a building more than 50 feet unless the cable is enclosed in rigid or intermediate metal conduit for the duration of its run.

Appropriate bonding of the metallic cable shield is required with the shield being grounded at the building entrance facility.

Minimum Bending Radius shall not exceed manufacturer's specifications, typically not less than 12 times outer diameter for shielded and 8 times outer diameter for unshielded cables. See also NEC Art 300-34.

Maximum Pulling Tension shall be in accordance with the following formula (not exceed 6500 lbs.):  $T_m = .008 \times n \times CM$

$T_m$  = Maximum Pulling Tension, lbs,  $n$  = no. of conductors,

$CM$  = circular mil area of each conductor

Maximum Permissible Pulling Length shall be in accordance with the following formula (measured in feet):  $L_m = T_m / C \cdot W$

$T_m$  = Maximum Pulling Tension, lbs

$W$  = Weight of Cable per ft., lbs.

$C$  = coefficient of friction (usually 0.5 - 0.9)

*Labeling*

OSP/entrance cables shall be labeled with their cable ID and pair count as determined by KU IT. Labeling shall be completed using mechanically produced text at the termination block, when entering or exiting a pull box, and within 6” of their entrance into a communications room. Cables shall also be labeled as they enter and exit a maintenance hole, handhole and where they enter/exit a building. At splices, a label with the cable ID and count will be placed where cables enter and exit a splice case. If the cable is run in a tunnel, the cable shall be labeled every 50’ with the cable ID and count.

All cables shall have either strap-on or snap-on (wrap-around) labels. Verify with KU IT prior to printing information and placing label.

NORDX OSP/entrance cable termination blocks shall have manufacturer provided green labels with every first and fifth pair labeled, text to be mechanically produced. See *Labeling* under Communications Room Telecommunications requirements.

All innerduct and cables shall have either strap-on or snap-on (wrap-around) labels. All cables shall have either strap-on or snap-on (wrap-around) labels. Verify with KU IT prior to printing information and placing label.

*Testing:*

The following tests shall be completed on all twisted pair copper entrance/OSP cables:

- Continuity on all pairs, (test for opens).
- Crosses and shorts, on all pairs.
- Loss at 1004hz, on all pairs.
- Noise metallic and noise to ground, sampling can be used.
- Insulation resistance, sampling may be used.

The contractor shall provide a test record report in electronic format to KU IT within one week of testing completion.

The maximum allowable defects copper cable pairs shall be in accordance with the following table:

<b>Cable size (pair)</b>	<b>Allowed Defects (pair)</b>
4 - 100 pr	0
100 - 600 pr	0
600 - 900 pr	0
900 – above	less than 0.002%

If outer sheath damage is the cause of the bad pairs, the entire cable shall be removed and replaced at the contractor’s expense.

*Splice Cases*

Copper splice cases shall be encapsulated, unless otherwise directed by KU IT.

## Fiber Optics

### *Tech Specs*

A minimum of one (1) Corning 12 strand multi-mode and one (1) Corning 24 strand single-mode fiber optic cables shall be installed into each EF.

Corning's double-jacket single-armor fiber optic cable shall be used, multimode part number 012KW5-T4150 D20 and single mode part number 024EW5-T4101 D20.

### *Installation*

The installation of fiber optic entrance/OSP communications cables shall conform manufacturer recommendations and to the following installation criteria.

The fiber optic riser cables shall be terminated at each end in a Corning Closet Connector Housing unit. The number of fibers installed will determine the required number of Corning Closet Connector Housing units.

The multimode and single mode fibers shall be terminated in separate Closet Connector Housing units.

Multimode fibers shall be terminated utilizing Corning ST pigtails and splice housing. If the use of pigtails is not feasible, then Lucent ST connectors, part number 105143911 shall be used.

Single mode fibers shall be terminated utilizing Corning ST pigtails and splice housing. If the use of pigtails is not feasible, then Lucent ST connectors, part number 106812258 shall be used.

There shall be 15' of cable slack looped in each Connector Housing unit to facilitate future re-terminations.

The minimum bending radius shall not exceed manufacturer's recommendations, typically 20 times diameter of cable when under tension and 10 times the diameter of cable when not under tension. The cable manufactures rated maximum tensile rating shall not be exceeded during installation.

### *Labeling:*

OSP/entrance cables shall be labeled with their cable ID and pair count as determined by KU IT. Labeling shall be completed using mechanically produced text at the termination block, when entering or exiting a pull box, and within 6" of their entrance into a communications room. Cables shall also be labeled as they enter and exit a maintenance hole, handhole and where they enter/exit a building. At splices, a label with the cable ID and count will be placed where cables enter and exit a splice case. If the cable is run in a tunnel, the cable shall be labeled every 50' with the cable ID and count.

Fiber termination panels shall have manufacturer provided labels with mechanically produced text.

All cables shall have either strap-on or snap-on (wrap-around) labels. Verify with KU IT prior to placement of the label type and information printed.

*Testing:*

The following tests shall be completed on all fiber optic entrance/OSP cables:

- End to end dB loss, both directions, at 850 and 1300 for multimode and 1310 and 1550 nanometers for single mode.
- Distance in feet for actual cable length
- Distance in Kilometers for actual cable length
- Number of splices in each fiber

The contractor shall provide a test record report in electronic format to KU IT within one week of testing completion.

The maximum allowable attenuation (db/km) for multimode fiber is 3.5 at 850nm and 1.0 at 1300nm. The maximum allowable attenuation (db/km) for single mode fiber is 0.4 at 1310nm and 0.3 at 1550nm. LEAF attenuation shall be 0.22 at 1550nm, .24 at 1625nm and 1.0 /km @ 1383.

The maximum allowable loss for splices is .3dB.

The maximum allowable loss for connectors is .75dB per connector pair.

## ***Entrance and OSP Pathways***

*Technical Specifications*

The communication entrance pathway into the EF shall consist of a minimum of (2) four inch conduits run from the nearest existing maintenance hole or handhole, to the EF of the new facility. One of the four inch conduits shall be a Carlon 4-way Multigard conduit.

Outdoor conduit runs for other communication purposes other than entrance cabling or OSP backbone cabling shall be a minimum of one-inch diameter.

Steam tunnels shall not be used for the routing of telecommunications cables or cable trays as tunnels facilitate sabotage possibilities, increase liability for worker safety, and the environmental conditions in the tunnels negatively affect the electrical characteristics of the cables and the life expectancy of the cables.

The Telecommunications Contractor and all sub-contractors shall coordinate the cable and conduit access facilities for telecommunication services with the University of Kansas and KU IT prior to the installation and acceptance of any completed project.

Electrical conduits and electrical branch circuit conductors, including grounding and grounded conductors required to enter KU IT space (i.e. room, cabinet, enclosure, hand-hole or maintenance-hole) shall do so separately from all telecommunications conduits, conduit bodies, sleeves and conductors, observing minimum separation distance requirements as identified in the most current edition of the National Electrical Code.

No electrical conductor of any kind shall be installed in the same conduit, sleeve, or raceway containing Telecommunications conduit or cabling. Exception: An approved composite cable associated with the integral operation of Telecommunications equipment as specified in the project drawings.

The use of “LB” connections and fittings is prohibited.

#### *Installation*

Communications conduits shall be buried at a minimum depth of 36" and shall terminate 4" after they penetrate the outside wall or floor of the EF.

A minimum distance of 12" shall be maintained between the telecommunications conduits and any electrical conduits.

OSP and entrance conduits shall not contain more than two 90-degree bends without a maintenance holes or handhole installed. Conduit shall be placed with a minimum of 1/4 inch per foot slope to allow proper water drainage from the ducts.

No run of conduit shall exceed 500 feet between maintenance holes or handholes. New maintenance holes shall contain permanent ladders, pull rings, racking hardware, grounding system, a sump pit, and a floor drainage system to drain water from them.

Maintenance holes shall be a minimum of 8' L X 6' W X 8' D (inner measurement) in size and shall contain a French drain to ensure minimal water retention in maintenance holes. Handholes shall be a minimum of 3' W X 5' L X 4' D (inner measurement).

New maintenance holes shall be provided with an appropriately sized LockDown-LockDry device manufactured by Barton Southern.

New handholes shall contain, pull rings, grounding system, a sump pit, and a floor drainage system to drain water. Handholes shall be installed with 12" of gravel below the handhole and 6" of gravel in the base of the handhole. Handhole lids shall be flush with the final elevation grade and shall be secured and labeled.

Maintenance hole and handhole penetrations shall be sealed with mechanical seals. 4-Way multi-gard conduits as well as the cable in a conduit shall also be sealed with mechanical seals.

Conduits shall have some type of sub-space partitioning such as Carlon Snap-Loc spacers.

Detectable “fiber optic or telecommunications” warning tape shall be placed 12” to 18” above conduits.

Conduits shall be encased in a concrete envelope not less than 2” thick, or as specified by the project plans when a minimum conduit depth of 36” cannot be attained, where conduits pass under roads, driveways, or railroad tracks, or where bend points might be subject to movement. Concrete for encasement shall have a minimum compressive strength of 2500psi.

All conduit installations for the specific use or future purpose of supporting telecommunication related activities shall have a durable pull wire provided such as a number 12 gauge steel wire or equivalent with a minimum of 200 lbs. pulling tension. The pull wire shall be installed in each conduit for future cable access.

All joints in conduits shall be made so the ends of the pipes come together in the center of the coupling.

Duct Plugs shall be used for all unused openings in conduit.

#### *Trenching and Backfill*

The Telecommunications Contractor (TC) shall observe all State, Local, and University policies and regulations for trenching and backfilling on University property.

The TC shall protect existing facilities, utilities (overhead and underground), sidewalks, and pavement. Contractor shall repair, at their cost, any damage done by them or any of their subcontractors.

The TC shall protect graded areas against erosion. Contractor must re-establish grade where settlement or washing occur at their own expense.

The TC shall not fill under footings. If excavation is deeper than necessary, fill with concrete of same strength as footing concrete. Coordinate with the building or project structural engineer.

Backfilling shall be compacted as follows:

- Under future and existing roadways, parking areas, walk paving, compact to 95% maximum dry density.
- For other embankments and fills not listed, compact to 90% of maximum dry density.
- Place layers horizontally and compact each layer to specified density prior to placing additional fill.
- The contractor may use on-site soils including fat clay and weathered shale as fill. All fill shall be reasonably free of roots, organic material, trash, frozen matter, and stones larger than three inches. Surplus or unsuitable material shall be hauled off-site.
- Dumping on University property is prohibited.
- If the Contractor finds any material that is unsuitable or cannot be compacted as specified, they shall replace it with suitable material at the contractor's expense.
- Flowable fill may be used in place of granular backfill and compaction.

When a joint-trench method is used for OSP conduit installation, a separation of six inches of concrete between telecommunications and other utilities, (i.e., power, gas, etc). shall be maintained.

## **Grounding**

### *General*

Careful coordination of communications grounding must occur with the building's electrical grounding system and specifications. All cabling systems and electronics distribution equipment shall be grounded for safety and electromagnetic interference.

Telecommunications Grounding Systems at the University of Kansas shall conform to the ANSI/TIA/EIA-607 grounding and bonding standard, and the following guidelines, whichever is more stringent. Sizing and connectivity of conductors shall be in accordance with the ANSI/TIA/EIA-607 grounding and bonding standard.

Each grounding plan shall be tested using a Two-Point Test Method, and the ohmic value shall be less than 0.1 ohm to be considered to have an adequate bonding between the two reference points. A copy of the test shall be provided to KU IT prior to any telecommunication services being activated.

Communications pathways, equipment racks, entrance protection, shielded cable, splice cases and any other equipment that is recommended to be grounded per this specification or the ANSI/TIA/EIA-607 shall be grounded appropriately.

*Bonding Conductor for Telecommunications (BCT)*

A green insulated copper ground wire (6 AWG minimum) shall be run from the building's Main Electrical Ground (MEG) to the Entrance Facility's TMGB with no splices or connections other than the designated end points, and no conduit bonds if run in metal conduit. This conductor shall be labeled "BCT" in mechanically printed text at any exposed location including at the connection to the MEG and at the TMGB.

*Telecommunications Bonding Backbone (TBB)*

A TBB is a green 6 AWG (minimum), insulated, copper Bonding Conductor (BC) that shall provide direct bonding between the TMGB and each TGB(s). When two or more TBBs are used within a multistory building, the TBBs shall be bonded together with a Grounding Equalizer (GE) at the top floor and every third floor in between. The TBB and GE shall be one continuous cable containing no splices. TGBs shall be connected to the TBB via a "tap" connection and the routing of the TBB shall be completed in as direct a manner as possible.

This conductor shall be labeled "TBB" in mechanically printed text at any exposed location including at the connection to the TMGB and at each TGB.

See Communications Room Requirements for Ground Bar requirements.

***Firestopping***

Firestopping is the process of installing UL listed fire-rated materials into penetrations of fire rated barriers to maintain the fire resistance rating of the barrier. Proper firestopping is critical in the construction of a building to ensure personal safety and to meet code requirements.

Firestopping shall be designed and installed in accordance with the NFPA and the following guidelines, whichever are more stringent. To facilitate the requirement to meet codes and to have a system that is easily maintainable, EZ-Path fire rated pathway shall be installed at all fire rated assembly penetrations for the telecommunications pathways throughout the building. Refer to the code footprint and or Architectural drawings to determine walls and floors that have a fire rating.

In addition, designers should note that separation walls in control zones (labs, etc.) often require fire and smoke protection. For these special penetrations, re-enterable fire caulk shall be provided after the telecommunications cabling has been pulled.

Firestops removed or modified during construction shall be replaced to their original fire rating. Firestopping shall not be installed where it is not required; with the exception of penetrations into

Entrance Facilities, Equipment Rooms and Telecommunications Rooms. At these locations, EZ-Path Firestop systems shall be installed regardless of the rating requirement.

The model and size of EZ-Path to be used will be determined by the cabling requirements of the building. Each firestop location shall be labeled using EZ-Path manufacturer provided labels, adhered to both sides of the wall, adjacent to the penetration. Labels shall be completed in accordance with STI Firestop recommendations. EZ-Path “waterfall” cable supports shall be provided for both sides of each EZ-Path installation.

The model and size of EZ-Path specified will be determined by the cabling requirements of the building or as indicated on the approved set of plans. As a general guideline, cable fill ratios for EZ-PATH products can be based on the EZ-Path Cable Fill Chart found on the STI Firestop EZ-Path website.

### ***Designer/Consultant Requirements***

Telecommunications Designers shall either be from the KU Pre-qualified Telecommunications Design Pool or shall be evaluated and pre-qualified by KU IT on a per-project basis. This is done to ensure that designers are capable and experienced in successfully designing the telecommunication systems according to KU IT and industry standards.

The Telecommunications 100% construction documents or “T” sheets shall be approved and stamped by a Registered Communications Distribution Designer (RCDD of Record) prior to submitting the drawings to DCM for review by KU IT.

The RCDD of record shall make weekly inspections of the job site whenever work is being performed that relates to the telecommunications system. These inspections are required to ensure the telecommunications system is being installed per the specifications and drawings and the craftsmanship is per industry standards. All discrepancies must be reported to the Telecommunications Contractor (TC), DCM Project Manager, and KU IT.

When the discrepancies noted have been corrected, the contractor shall request and schedule a re-inspection by the RCDD of Record. When the discrepancy has been resolved, approved, the RCDD of Record will then submit approval documentation to the TC, DCM Project Manager and KU IT.

When a project scope includes wireless, the locations for the Access Points need to be carefully coordinated with KU IT. Typically the Telecom Consultant will design the location for the telecommunications outlet for the wireless AP connection, and then KU IT will install the actual AP and Antenna during KU IT service provisioning. This will need to be verified with KU IT on a per-project basis.

The Telecommunications Designer shall provide a WAO identifier on the construction drawings for each cable pulled. These identifiers are provided to minimize confusion in the field and to aid KU IT in provisioning work. The Telecommunications Designer shall also provide activation information for each cable pulled to KU IT with the submittal of Construction Documents (i.e. Identify locations of voice, data and CATV that the occupant needs to be activated upon

completion of the project). Activation information can be on the drawings, incorporated into the WAO Identifiers or as a separate document, such as a spreadsheet.

### ***Contractor Requirements***

Telecommunications Contractors (TCs) shall either be from the KU Pre-qualified Telecommunications Installation Pool or shall be evaluated and pre-qualified by KU IT on a per-project basis. This is done to ensure that bidders are capable and experienced in successfully completing the telecommunication systems specified prior to bid opening. Bids from non-pre-qualified TCs will not be opened.

The Telecommunications Contractor evaluation includes, but is not limited to, the following requirements:

- Must be able to have an RCDD on staff and available on-site to inspect the installation, and to certify in writing that the installation meets all TIA and NEC standards and codes, and that the installation was done per the specifications and drawings.
- Provide a minimum of five (5) references for which the contractor has completed similar work (number of drops and cost) within the last five years.
- Must have a minimum of one of the following installer certifications: Systemax, Siemon, Leviton, Ortronics, Belden IBDN Certified System Vendor or a Belden IBDN Installation Qualified Contractor.
- The TC shall certify in writing and provide supporting documentation to support that the lead technician on the job site is BICSI Installer Level II Certified and has a minimum of five years of experience installing similar telecommunications structured cabling systems.

Additionally, the TC shall consistently demonstrate exceptional craftsmanship and professional integrity along with the items mentioned above to maintain their KU IT pre-qualified status. Failure to maintain the qualification requirements will result in removal from pre-qualification status.

If the scope of work requires outside cable plant installation (conduits and/or cabling), the contractor performing these tasks shall have five years of experience and provide five references for which the contractor has completed similar work within the last five years.

The contractor shall furnish and install all material required for a complete system, including the installation and termination of communication cables, communication outlets, and the termination of all cables in the EF, ER and TR.

If cables lack the proper slack, the contractor will replace the cable at no charge to the University.

A one-year materials and labor warranty shall be provided on all cable and hardware installed by the telecommunications contractor.

The contractor is prohibited from using any materials, replacement or new, which contains asbestos in any form.

The contractor shall warrant that all persons assigned to a project shall be employees of the contractor or subcontractor and shall be fully qualified to perform the work required. The contractor shall include a similar provision in any contract with any subcontractor selected to perform work under this contract.

The contractor is prohibited from using any paint product containing lead.

The contractor must remove, on a daily basis, all debris in associated work areas left as a result of the installation of the telecommunications systems.

Where communication equipment and related materials are installed in new, existing or renovated KU IT communications rooms or other effected spaces, remove all communication related construction debris, cable scrap and accumulated dust from the floor and from the surfaces of newly installed communication equipment and materials and rooms of the building.

Contractor shall supply all splicing and bonding and grounding hardware and material.

The TC shall comply with the manufacturer's applicable instructions and recommendations for installations, unless otherwise noted in this document.

The TC shall inspect each item of material or equipment immediately prior to installation and reject damaged and defective items.

The TC shall provide connection devices and methods for securing work properly as it is installed; true to line and level, and within recognized industry tolerances if not other wise indicated. Allowance for expansion, contraction, and building movements shall also be made. The TC shall provide uniform joint attachment widths and spacing in exposed areas of work for the best possible visual and operational effect. Refer questionable visual effect choices to KU IT for final decision.

The TC shall provide work during conditions of temperature, humidity, dust, exposure, forecasted weather, and status of project completion that will ensure the best possible results for each unit of work. Each unit of work shall be isolated from non-compatible work to prevent product, service, or material deterioration.

The TC shall coordinate enclosure (closing up) of work with required inspections and tests to avoid unnecessary uncovering or reopening work for inspections purposes. The TC shall arrange for inspection of work by University inspectors and shall give the inspectors all necessary assistance required.

Except as otherwise indicated for required approval, labels, and operational data, the TC shall not permanently attach or imprint markings on exposed surfaces of products which will be exposed to view either in occupied spaces or on exterior work.

*As-Built Drawings and Information:*

The Contractor shall prepare and submit record drawings, at an industry recognized scale. The Contractor shall submit three drawings on 3 mil thick diazo Mylar material and four copies on white paper with black print. Paper size shall be 24" x 36".

The Contractor shall also submit electronic copies on CD-ROM, in AutoCAD as directed by KU IT, DCM or Project Architect. Record drawings shall include the following:

- Copper feeder cable information: cable type, size, gauge, year installed, cable number, pair counts, distance(s) and splice location(s).

- Fiber feeder cable information: type cable, size, cable number, fiber count, distance(s), splice locations, and length of cable.
- EF, ER, TR information: Room identifier, quantity and type of protectors, quantity and type termination blocks, cable and pairs entering and/or leaving.
- Riser cable information: cable type, size, gauge, year installed, length, splice points, cable number, and pair count(s).

End - The University of Kansas Division 27 Design and Construction Guidelines -  
Changes from last version (dated 01/31/2008) are noted by an underline.

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