



**EAST TENNESSEE STATE
UNIVERSITY**

COMMUNICATIONS DESIGN STANDARD

VERSION 3.3, POLICY 500.2 - JULY 2024

**East Tennessee State University
Facilities - Capital Planning**



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SECTION 1 - GENERAL INFORMATION

Associate Vice President

Laura Bailey
(423)439-7900

Director

Chuck Milam
(423)439-7762

Construction Manager

Eddie Phillips
(423)439-6167

Design and Construction Coordinator

Heather Raymond
(423)439-7787

Design Coordinator

Rebecca Amirfaiz
(423)439-7751

Communications Infrastructure Engineer

Andy Salley, RCDD, CDT
(423)439-7763

Senior Design and Construction Coordinator

David Hollifield
(423)439-7736

Additional information on ETSU Facilities Management policies, procedures and projects can be found at:

<http://www.etsu.edu/facilities/> Both Designers and Contractors should familiarize themselves with these and other governing policies for all work at ETSU.

Facilities Management

PO Box 70653
Wilbur H. Bond Building
1380 Jack Vest Drive
Johnson City, TN 37614
(423)439-7900

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SECTION 2 - DOCUMENT INTENT

The ETSU *Communications Design Standard (CDS)* is a design tool for use by architects, engineers, interior designers, planners and their agents (all hereafter referred to as Designers), to help ensure the successful delivery of ETSU capital projects and renovations as applicable. See ETSU Facilities Policy 500.2 available on the ETSU Facilities website.

The CDS policy is for the design and specification of communications pathway and spaces inside and outside all facilities, reflecting the *minimum* acceptable requirements to support ETSU Information Technology Services. The CDS is not project-specific and therefore is intended to be simultaneously used with ETSU-ITS's *Cabling Installation Standard* that can be obtained from ITS.

NOTE: All other communications-related items and materials (racks/cabinets, cabling, components, video cameras, electronic door access related to ITS, wireless, emergency phones, multimedia classroom technology, audio/video systems, approved manufacturers, manufacturer or system warranties and part numbers, all active equipment and other items and methods of installation or fabrication) are specified by ETSU-ITS and can be specifically found in the ETSU-ITS policy or directly from their group. It is the responsibility of the Designer to coordinate and clarify any reference to such materials and methods in this CDS policy with ETSU during the design process. For further information regarding anything in their policy you can contact ITS at (423)439-4648 or itshelp@etsu.edu

This CDS document is standardized on the TIA Commercial Building Telecommunications Standards series and has adopted applicable portions of the BICSI *Telecommunications Distribution Methods Manual (TDMM)* and the BICSI *Customer-Owned Outside Plant Design Manual (CO-OSP)* as the basis for telecommunications space and distribution design at ETSU. The CDS is the guide to the application of these standards, to the unique circumstances present in ETSU facilities and projects.

For copies of the TIA Series documents visit <https://store accuristech.com>

For copies of the BICSI series of TDMM and CO-OSP manuals visit <https://www.bicsi.org>

For references to units of measure, abbreviations, terms and definitions please refer to BICSI's ICT Terminology Handbook available at <https://www.bicsi.org> or download [here](#).

REVISION HISTORY

Note: Although the goal is to review/revise this document biennially, changes in codes and standards can dictate that a revision is necessary with lesser or greater frequency. It is the responsibility of the user to ensure that the latest revision is being used.

<u>Edition</u>	<u>Date of Issue</u>
1.0 (original edition)	October 19, 2016
2.0	September 11, 2017
3.0	October 20, 2019
3.1	June 30, 2020
3.2 (minor erratum update)	March 11, 2022
3.3	July 1, 2024

SECTION 3 - DESIGN IMPLEMENTATION / DESIGNER RESPONSIBILITIES AND DELIVERABLES

Designers should use the CDS to incorporate the information provided herein, into Construction Documents for both renovations and Capital Projects. In coordinated effort with designers, ETSU Facilities reviews and provides comment on design documents at every design phase (typically programming and space planning, all phases of Schematic Design, Design Development, and all phases of Construction Documents). At each and every stage of design the designer must submit all drawings and sections of the project manual (in both printed and PDF forms) for correction/comment by ETSU. All documents must be reviewed with ETSU for final owner-acceptance before releasing for SFMO review and bidding and/or construction.

Design Documents – Guidelines for Designers

The design elements expected in each phase are listed below and should be considered as required deliverables. The designer must clearly indicate what is new construction and what is not when working in renovated facilities. Please use the following sections as a deliverable's checklist for all design phases:

1. The Designer is responsible for conducting a pre-design site survey investigating and documenting all existing site and building conditions pertaining to communications. This must include but not be limited to items such as existing topography, soil conditions, conduit and pathway systems, cable, cable termination types/sizes, existing systems equipment locations, etc., which potentially impact the new installation or require relocation/demolition. The designer must also investigate if provisions need to be made in the design for Selective Demolition of cabling, pathways or systems as some systems may need to remain fully functional during work.
2. All drawings must be correctly scaled and indicated as such. All floorplans must show a key plan when the building or site is too large to fit on a single sheet as well as corresponding match lines and north arrow(s).
3. The Designer must coordinate equipment needs (where applicable) with ETSU-ITS during design to help determine electrical loads, emergency power, UPS sizing and mechanical loads as needed if required. The Designer must coordinate the electrical and mechanical loads with their engineers as early in the design process as possible.
4. The DEMARC is a Service Provider's main point of demarcation (AKA: Extended DMARC, NID, MPOE) and therefore is owned by the LEC or Service Provider (Brightspeed/Charter/Comcast etc.) and establishes a physical point where the service provider's responsibilities for service and maintenance end. The Designer must coordinate all designs and specifications with the SP including terminating spaces, power requirements, lighting, bonding/grounding, conduits (quantity, size and depth) to meet all LEC or SP requirements. This responsibility of the designer must also be carried out through the end of construction, in coordination with the Contractor, and must include all coordination and turn-up services oversight and responsibility, as well as the design and coordination of existing SP equipment and pathway demolition, removal and/or relocation where applicable.
5. The designer must investigate the requirement of DAS or related systems for all facilities as required by the AHJ. These systems may include all Emergency Services as well as private networks and services as applicable.
6. Throughout the design process, the designer should review and compare any changes in space usage, sizes, or technology requirements of all building areas to see if an increase in size or quantity of communication rooms or conduit is needed. Consult ETSU for additional needs as design stages progress and/or if these conditions apply.

Programming through Schematic Design (SD) Phase

1. The designer must plan and show adequate equipment rooms of all types (including MDF, A/V and TR's). This may include multiple buildings and floors, and multiple communication rooms on a floor. NOTE: Where practical, ETSU prefers to combine all data and A/V equipment in one comm room, making the required room size much larger than for separated data and A/V.
2. All Communication room types must be sized and placed as specified in this document, considering floor sizes, designated usage of areas, cabling distance limitations, and equipment to be served. Overall floor plans must be produced showing all proposed Communications spaces.
3. Communication rooms must be vertically aligned (stacked) with at least two common walls, preferably more, and be placed centrally enough to ensure that all horizontal permanent cabling links it will serve does not exceed 295 ft. (90m) from terminated port to terminated port. Note: Telecommunication rooms are for ETSU-ITS equipment only. Any other non-ETSU or specialty vendor equipment, wiring, associated cabling and active components must have dedicated spaces designed for their use and function unless approved in writing by ETSU-ITS.

4. A/V equipment rooms, if dedicated, must be sized appropriately per standard and placed as close as possible (preferably immediately adjacent) to the classrooms and auditoriums they will serve. Consult with ETSU-ITS's Special Projects department for multimedia and A/V room particulars. This includes but is not limited to space variances/clearances, electrical, grounding, HVAC, data, specialty cabling, technology furnishings, lecterns, equipment cabinets and all other related needs.

Design Development (DD) Phase

The 100% Design Development (DD) package must contain all items included in the 100% Schematic Design package and also include at minimum the following:

1. Overall scaled floor plans showing proposed telecommunications space locations (TR/MDF/etc.) and dimensions. Doors of all spaces must swing out into common areas and not into the rooms themselves.
2. Preliminary Riser Diagrams (line diagrams) for riser conduits, grounding/bonding and any OSP pathway routes.
3. A draft copy (or outline specification as required by AIA at 100% DD) of all specification sections related to the communications infrastructure.
4. NOTE: The designer must submit all floorplans and site plans to ETSU-ITS at the beginning of DDP for an initial Wireless Access Point and Camera Survey to be performed, where ITS will choose locations for outlets. These surveys must be returned to the designer and included in CD phases, with a final review by ETSU-ITS prior to CD Phase.

Construction Document (CD) Phase

If any communications related design items have an “unknown” final location due to pre-construction conditions or are related to equipment to be installed post-construction, the Designer must use a leader note or clouded callout notation directing that “Location to be determined. Verify with ETSU prior to rough-in or installation”. The beginning of CDP must include at minimum the following sections and must be accurate in both the ‘T’ series drawings and in the project manual in division 27 as applicable:

- Communications drawing pages be included on the cover sheet with a ‘T’ sheet index and description
- Complete Symbol Legend
- Notes and Keynotes as applicable on ‘T’ and ‘E’ sheets
- Inside and Outside plant Pathways, Spaces and Cabling
- Enlarged and detailed communications room plans with dimensions
- Permanent and correct room numbers for all building areas.
- Cable tray and major communications cabling pathways drawn to scale
- Sleeves and conduits (including vertical and horizontal penetrations) drawn to scale
- Pull boxes (interior and exterior)
- Bonding/grounding details and riser
- Communications floorplans (including outlet symbols for all voice, data, networked all-in-one machines, Wi-Fi, audio, video, multimedia, and outlets for electrical metering, building automation, HVAC controls and monitoring, FACP, DAS systems, vending and soda machines, washer/dryers, etc., nurse call, electronic locks, elevator phones, cameras and any other outlets)
- Areas clearly indicated for demolition, removal, reuse or “no-work”
- Complete cabling schedules including labeling and to-from locations
- Complete enlarged telecommunication room(s) plan layouts
NOTE: It is critical that the designer show exact rack footprint scale and dimension, wall space allocations for all equipment (electronic lock/access units, camera power supplies, OSP cabling surge protection enclosures, and any other wall mounted equipment)
- Space identified for Service Provider and Vendor equipment including pathways
- Fire stopping details and penetration locations
- Floor box, Poke-through and Multimedia box details and instructions
- Communication outlet and faceplate detail with ETSU-ITS labeling scheme. Note that communications faceplates must match electrical faceplates (color and material type) in each room unless noted otherwise.
- All typical details related to the scope of work

Enlarged Telecommunication Space Plans (properly scaled) must include:

- Equipment Rack locations, numbering sequence, and working clearances with dimensions shown.
- Bonding Bus Bar location.
- Cable Tray size and locations.
- Elevations which must include rack and cabinet locations, wall field layouts, and other Communications Equipment which will need wall space including but not limited to building automation, electronic lock/access systems, splitters and amplifiers, etc. NOTE: If space allows on plan-views, equipment wall elevations may not be required.

Equipment Rack Elevations which must include reserved RMUs for:

- Correct amount of Optical Fiber Housings and bulkhead panels.
- Correct amount of Copper Patch Panels.
- Correct amount of Horizontal and Vertical Cable Management.
- Correct amount of Network Switch Equipment (placeholder only – NIC).
- Other Communications Equipment (IC/NIC) which will need rack space.

Riser Diagrams which must include:

- Pathway Riser – show conduits and sleeves required to connect telecommunications spaces. Provide information on conduit/sleeve size and quantities.
- Cabling Riser – show copper, optical fiber, and coaxial backbone cabling required to connect telecommunications spaces. Provide detail on cable types, strand/pair counts, cable quantities and to-and-from room names and numbers.
- Grounding/Bonding Riser Diagram – show TMGB location, TGB locations with room numbers and TBB cabling connections. Provide information on Telecommunications Bonding Backbone conductor(s) size and quantities, Bonding Equalizer size and quantities, and Bonding Conductor for Telecommunications conductor size detailing tie to power system per NEC.

Details which must include:

- Labeling details for copper patch panels and optical panels.
- Rack counts and layouts.
- Approved rated wall/floor penetration assemblies and details.
- Other typical details as required to further clarify drawings.

Complete cable schedules which must include:

- Horizontal cable and connection identifiers, TR room numbers, work area room number, rack number, patch panel number, port number, etc. per ETSU-ITS standard.
- Backbone cable and connection identifiers including, enclosures, pair and strand numbers with color coding, bulkhead identifiers, etc.

Specifications – Section of the Project Manual to include, as applicable, with all subsections:

- 27 00 00 Communications
 - 27 05 00 Common Work Results for Communications
 - 27 05 05 Selective Demolition for Communications
 - 27 05 26 Grounding and Bonding for Communications Systems
 - 27 05 28 Pathways for Communications Systems
 - 27 05 29 Hangars and Supports for Communications Systems
 - 27 05 33 Conduits and Backboxes for Communications Systems
 - 27 05 36 Cable Trays for Communications Systems
 - 27 06 00 Schedules for Communications Cabling
 - 27 08 00 Commissioning of Communications
 - 27 10 00 Structured Cabling
 - 27 11 00 Communications Equipment Room Fittings
 - 27 11 13 Communications Entrance Protection
 - 27 11 16 Communications Cabinets, Racks, Frames, and Enclosures
 - 27 11 19 Communications Termination Blocks and Patch Panels

27 11 23	Communications Cable Management and Ladder Rack
27 13 00	Communications Backbone Cabling
27 15 00	Communications Horizontal Cabling
27 53 19	Internal Cellular, Paging, and Antenna Systems

Note: Other sections of the Project Manual may also apply (section 01, 26, etc.) The designer must include all applicable sections outside of division 27 as they apply, based on CSI MasterFormat best practices. See also:

- 02 41 19 for selective demolition of existing systems
- 07 84 00 for firestopping
- 07 92 00 for joint sealants
- 08 31 00 for access doors and panels
- 31 23 33 Trenching, Backfilling and Compaction (as applicable to 27 00 00 work)

Outside Plant (OSP) Telecommunications and Site Plan Drawings

For projects which include existing, to-be-demolished, and new outside plant cabling or infrastructure, provide drawing(s) showing a scaled telecommunications distribution site plan. These drawings must include the following:

- Maintenance hole, vault or hand hole locations labeled with their identifiers
- Complete duct bank and/or conduit routing, details, and elevations
- Conduit sizes, quantities, and arrangements
- Inner duct placement, properties, quantities, installation and routing
- Cabling service loop locations and details
- Duct bank cross sections – for each type as quantities or sizes change
- Hand hole and pull box details
- Outside plant copper and fiber communications cabling, including pair counts, fiber type and strand counts
- Locations of buildings, roads, curb and gutter, utility poles/lighting, existing underground utilities and other obstructions
- Details noting the contractor’s responsibility for locating utilities prior to any work (TN 811)
- Notes to direct the contractor to contact ETSU for observation and approval prior to any and all backfill or soil restoration.

These sheets should also identify coordination arrangements where conflicts with site work for other disciplines could possibly arise, in particular indicating the separation distances between telecommunications and power or water. The sequencing of site work also should be shown, if applicable.

The site plan must show the cabling pathways from the service providers and must indicate the requirements for owner-provided maintenance holes or hand holes and pathway to the point of demarcation.

Quality Control / Quality Assurance and Construction Administration

RCDD-of-Record Recommendations:

ETSU strongly encourages the Designer employ or utilize a BICSI Registered Communications Distribution Designer (RCDD) for all phases of design and administration including:

- Designer support for code and standard
- Drawing and Specifications – D27 of the Project Manual
- Quality Control / Quality Assurance
- Site observations and associated documentation to ensure work complies with design
- Regular involvement and contributions/direction in construction progress meetings
- Cabling test result review and associated document compliance
- Construction administration and support through warranty compliance as applicable

SECTION 4 - CODES, STANDARDS AND AUTHORITIES HAVING JURISDICTION

Designs based on this document must apply the editions of the codes and standards indicated unless directed otherwise by the authority having jurisdiction (a Non-ETSU municipal government code enforcement official, THEC and/or The State Building Commission including the Office of the State Architect, SFMO or any appointees of such). NOTE: This is not the complete list of all applicable codes, standards, and policies that apply to design and construction at ETSU. Contact ETSU Facilities for a complete list. Some applicable standards may be subject to scope and/or budget.

Tennessee Department of Commerce and Insurance

- State Fire Marshal's Office – Codes, History and Enforcement
NOTE: This includes all current adopted rules of CHAPTER 0780-0202 "Codes and Standards" (building codes, electrical codes, etc.)

Building Industry Consulting Service International (BICSI)

- Telecommunications Distribution Methods Manual – Latest Edition
- Outside Plant Design Reference Manual – Latest Edition

ETSU-ITS Cabling Installation Standard 4.0

Construction Specifications Institute – MasterFormat and PageFormat latest editions

Tennessee State Building Commission (SBC) - All OSA Policies and Procedures

Tennessee Higher Education Commission (THEC)

Federal Trade Commission - INFORM Consumers Act

Telecommunications Industry Association (TIA) and related Standards

- TIA-5017, Telecommunications Physical Network Security Standard
- TIA-568.0-E, Generic Telecommunications Cabling for Customer Premise
- TIA-568.1-E, Commercial Building Telecommunications Infrastructure Standard
 - E-1, Addendum 1 - Balanced Single Twisted-pair Cabling; Cabling Requirements for Wireless Access Points Standard
- TIA-568.2-D, Balanced Twisted-Pair Telecommunication Cabling and Components Standard
 - D-1, Balun Requirements for Category 8 Testing
 - D-2, Addendum 2 – Power Delivery over Balanced Twisted-Pair Cabling
- TIA-568.3-E, Optical Fiber Cabling Components Standard
- TIA-568.4-E, Broadband Coaxial Cabling and Components Standard
- TIA-568.5, Balanced Single Twisted-pair Telecommunications Cabling and Components Std
- TIA-569-F, Telecommunications Pathways and Spaces
- TIA-606-D, Administration Standard for Telecommunications Infrastructure
- TIA-607-E, Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- TIA 758-B, Customer Owned Outside Plant Telecommunications Cabling Standard
- TIA 862-C, Structured Cabling Infrastructure Standard for Intelligent Building Systems
- TIA 1179-B, Healthcare Facility Telecommunications Infrastructure Standard
- TSB-162-B, Telecommunications Cabling Standards for Wireless Access Points
- TSB-5018, Structured Cabling Infrastructure Guidelines to Support Distributed Antenna Systems

American National Standards Institute (ANSI) collaborative standards

- ANSI/BICSI 006-2020, Distributed Antenna System (DAS) Design and Implementation Best Practices
- ANSI/BICSI 008-2024, Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices
- ANSI/TIA 4966-A (w/addendum 1) Telecommunications Infrastructure Standard for Educational Facilities

SECTION 5 - TELECOMMUNICATION ROOMS

5.0 Overview: It can be assumed by the Designer that a Distributor Room (DR per TIA-569-E) and a Telecommunications Room (TR per BICSI TDMM) are the same thing and serve the same purpose. The Telecommunications Room or ‘TR’ has been adopted in this document to allow for its parallel use with the ETSU-ITS guidelines document using the same room name.

5.1 Size: TR’s vary greatly in size depending on their function and size of the floor space they serve for the life of the building. Sizing guidelines are based on services to users at one user per work area, one work area being 100 ft². At least one TR per floor is required. Additional space may be required depending on ETSU’s needs. The Designer must consult with ETSU during the programming phase so that all space requirements are met.

- The TR must be sized to meet known requirements such as the function of the room, the number of equipment racks and cabinets needed, and the number of equipment outlets that it will serve.
- Sizing must include projected future as well as present requirements, including A/V cabinets.
- A TR containing Distributor B with no A/V cabinets (the absolute smallest size TR allowable at ETSU) should be sized at a minimum of 100 ft² as 10’x10’.
- In larger buildings, the size of the distributor room containing Distributer C should be increased in increments of 1 m² (10 ft²) for every increase of 10,000 m² (100,000 ft²) in gross building area.

If the area to be served is...	Then the interior dimensions of the TR must be at least...
5000 ft ² or less	10’-0” x 10”-0” (additional sqft needed if room contains AV equip)
>5000 ft ² to 8000 ft ²	10’-0” x 12”-0” (additional sqft needed if room contains AV equip)
>8000 ft ² to 10,000 ft ²	10’-0” x 15”-0” (additional sqft needed if room contains AV equip)

NOTE: Room sizing may need to be larger if areas served are not standard office environments (1 user per 100 ft²). Special sizing is required if serving classrooms, meeting rooms, auditoriums, health and medical care areas, and other purpose-built construction. Consult ETSU during design. Additional telecommunications rooms (one for each area up to 1000 m² (10,000 ft²)) should be provided when: a) the floor area to be served exceeds 1000 m² (10,000 ft²); or b) the horizontal distribution distance to the work area exceeds 90 m (295 ft). See section D of the Programming Design phase in this document.

If the building is smaller than...	It may be served by...
5000 ft ²	Shallow rooms
1000 ft ²	Wall cabinets Self-contained cabinets Enclosed cabinets

NOTE: Installation of active equipment in shallow or walk-in rooms is not recommended because many types of equipment require environmental controls and a depth of at least 1 meter. See Chapter 4 of BICSI’s TDMM.

5.2 Location: If utilized, an Equipment Room and its location (service entrance that includes demarcation from one or more service providers) must be as close as practicable to the point where the electrical facilities enter the building. This room must be completed early in the construction phase, so the copper, fiber and broadband feeder cables to the room can be installed. The room must be dedicated to Telecommunications Service Providers and house backbone connectivity connections to service the building.

Telecommunication Room (TR) locations should be located to best serve the occupants of the building and/or floor and not in close proximity to sources of EMI/RFI, transformers, X-ray, etc. TR’s must be sized and placed as specified in this document, taking into consideration floor sizes, the possible need for more than one TR per floor, areas and equipment to be served including specialty equipment and construction as well as future room enlargement. TR’s must be vertically aligned (stacked) with at least two common walls, preferably more, and be placed centrally enough to ensure that all horizontal permanent cabling links for it will serve are as short as possible and never exceed 295 ft. (90m) from terminated port to terminated port for general non-AV data. Cabling in TR’s must be bundled per BICSI N2-17. TR’s must not be designed to share space with any

other service such as custodial, proprietary equipment, general or specialty storage, etc. TR's also cannot be designed or placed in such a location that they are used as "pass-through" areas in order to gain access to adjacent electrical, mechanical, or other rooms, or vice-versa. All TR's should be accessed only through dedicated and secured doors in hallway or common areas. Equipment not directly for use by TR's (sprinkler piping, HVAC, electrical must not be located in or pass through or above a TR. Telecommunications rooms must not be located below water or potential flood level and must be free of water or drain piping not directly required to support the room.

5.3 Doors/Windows: Doors must open into an interior common area (no classrooms or utility rooms, etc.). Doors must be solid core at least 36" wide and 84" in height and be fully opening (180-degrees if permissible by code). Doors must have a lock and be keyed to ETSU's ITS current lock standard. Doors must be hinged to open out into assessable area (hallway) and not into the communications room. Doors must be designed with sweeps (no doorsills or raised thresholds). Windows or vents of any type are not permitted.

5.4 Electrical: If emergency power is available, all branch circuits and their receptacles as well as at least one lighting circuit must be tied into emergency power. If receptacles are utilized on emergency power, those receptacles must be red in color with stamped permanent labeling indicating they are on emergency power and have the ID of the branch circuit/breaker clearly indicated.

An electrical panelboard must be designed inside the TR that serves all circuits within the TR. Along all walls there must be one 120Vac/20A electrical quad outlet NEMA 20R every 6'-0" minimum. These should be below the communications backboard. On the lower-rear toe-plate of all 2-post racks and the top interior corner of all A/V cabinets, must be at least one 120VAC/20A quad outlet (vertical). This outlet must be on a dedicated circuit. See Detail 8 in the appendices section of this document for elevation and dimensions. Consult with ETSU-ITS on installed elevation of rack receptacle.

5.5 Grounding/Bonding: Provide an approved building bonding cable (TBC), with bus bar, to the room. Locate the bus bar as directed by ETSU. Refer to Grounding section of this standard and chapter 9 of the BICSI TDMM for more information.

5.6 Interior Finishes and Flooring: Floors must be of vinyl composition tile or sealed concrete. All exposed concrete, brick and gypsum board walls must be painted or sealed. Note that antistatic floor tiles are preferred to standard VCT if budget allows. They should be utilized with a manufacturer-designed grounding and bonding system. ESD floors must meet the requirements of ANSI/ESD S and must be light in color. In addition, all floor-mounted racks must have a permanent rack base insulator kit at their base. Floor loading must be sufficient to bear all the installed loads in the building and a structural engineer consulted to do the design.

5.7 Ceiling: In new construction, no false or acoustical ceilings are permitted in TR's or ER's. Walls of TR's must extend to roof deck or bottom of floor above, effectively sealing the TR. Where extending the walls to deck is not possible, ceiling heights must be 9' AFF minimum - 10' AFF maximum and must be solid gypsum, are required with or without fireproofing, and may or may not extend to the roof deck depending on the needed design. No exposed spray-on fireproofing is permitted unless required by the AHJ. Horizontal conduits/sleeves entering the TR must do so at a point below the ceiling and above the ladder rack/cable tray within the TR.

5.8 HVAC: The mechanical system should maintain and continuous and dedicated environmental control. If emergency power is available, the Designer should consider connecting it to the mechanical system that serves the TR. The system should maintain a positive pressure with a minimum of one air change per hour for typical equipment. More stringent requirements may apply. The Designer is responsible for the system to dissipate the heat generated by all known active devices and satisfy code requirements. The temperature and humidity level should be maintained as recommended by the manufacturer of the equipment present at end of construction and ASHRAE 62.1-2013 and 90.1-2010. Note: See ANSI/TIA-569-E for ASHRAE class requirements from B through C as applicable, section 6.2. ETSU has standardized the wall-mounted, ductless split system style of HVAC as the default system standard for all TRs. The wall location chosen must not inhibit the installation or use of cabling pathways into the room. Recommended temperature should be maintained between 64 deg F and 81 deg F with a maximum relative humidity of 60% per TIA-569-E, 6.1. (Minimum dew point of 42 deg F, maximum dew point of 59 deg F). Regardless of the HVAC system type installed, systems serving a TR must be provided with a manufacturer-provided auto restart function for the compressor and other systems to endure that the unit comes back on fully functional automatically after power has been restored after failure. The total power load should be converted to heat load units and coordinated with

the mechanical engineer: $\text{Power (W)} \times 3.412 = \text{BTU [calorie]/hr}$. The designer shall determine the heat load (BTU [calorie]/hour) of all equipment installed within the space. If heat loads are not available for individual pieces of equipment, the designer will need to determine the true power load of all equipment installed within the space.

5.9 Lighting: LED Lighting must be a minimum of 500 lux in the horizontal plane and 200 lux in the vertical plane, measured 3 ft. above the finished floor in the middle of all aisles (or front and rear of cabinets and racks). Switches should be located at entry door. Coordinate lighting layout to maximum light reaches front and rear of equipment racks, not directly above. If emergency power is available, at least one fixture must be included in EP circuit. Lighting must be on a dedicated circuit. Emergency lighting is recommended.

5.10 Cable pathways entering the ER/TR: The number and type of telecommunications circuits that will be brought into the building must determine the number and size of inter-building conduits entering this room. The minimum number and size of conduits to a building from outside is four (4) 4" conduits, with two of the conduits having two (2) detectable MaxCell Edge innerducts each with their own color I.D. All innerducts must be installed by means of manufacturer-approved swivels as directed. All additional service entrance conduits must terminate in the service entrance room or as directed by ETSU or the SP. All conduits entering from the floor must extend to a minimum of 4" AFF UNO. Consult ETSU for the size, quantity and locations of all other pathways and sleeves in the ER/TR. See "Detail 5" of this manual for horizontal penetration requirements.

5.11 Plumbing: The room must not have any water pipes within its interior space, routing horizontally on the floor directly above the room, or within the floor slab below the room. See section 8 for fire protection.

5.12 Backboard Panels: At least two adjoining walls of each TR must have 3/4" thick A/C Grade plywood installed on them. All plywood must be painted with two coats of fire-retardant paint or additive to specifications (see ETSU-ITS) and must be 4'x8' sheets mounted vertically with the bottom of the plywood mounted 6" from finished floor with the best side toward the room. Plywood shall be completely painted prior to the installation of any equipment. Plywood must be permanently fastened to the wall by means of wall anchors, using galvanized, zinc plated, or stainless-steel hardware with a flat head. Finished installation shall have flush appearance with countersunk screwheads to prevent splitting. Drywall screws are not acceptable.

5.13 Access and Security: ETSU-ITS calls for the physical protection of all components inside each telecommunications room. Contact ITS directly for their current policy on locking hardware/access.

5.14 Equipment and Cabling Racks: Rack layouts and installation must be designed in accordance with 'Detail 5' and 'Detail 8' of this document. See the ETSU-ITS guidelines for more specific requirements depending on equipment rack and ladder-rack style cable tray types. Racks and cabinets must meet EIA/ECA-310-E standard and should maintain a minimum 3' clearance on front and rear of equipment. See TIA-569-E 6.3.9.3 for more acceptable clearances and information.

5.15 Fire Protection: Fire protection must be provided, at minimum, as code requires. Consult ETSU during design to see if additional protection is desired. See section 8 of this document. If the TR/ER has been selected to have sprinkled fire suppression, then a floor drain should be designed to expedite water leaving the room as well as protective cages (head guards) to be installed over all sprinkler heads. The minimum clearance below sprinkler heads and clean agent nozzles shall be no less than 18" for fixed objects.

5.16 Signage: All signage should meet ETSU Facilities requirements. Signage should be compliant with PFIS, E911, and device labeling standards. Consult ETSU Facilities for more details.

Audio/Video Equipment Rooms

5.17 General: Dedicated A/V and specialized technology rooms should be designed and placed in accordance with ETSU-ITS's Special Projects manager. In general, these rooms are sized and have similar power, HVAC, lighting, bonding and other needs as Telecommunication Rooms. A/V rooms should be placed as close as possible to the classroom or group of classrooms they serve, to limit cable lengths issues associated with high-performance A/V. Consult ETSU Facilities and ITS when designing these rooms and locations to ensure all requirements are met.

SECTION 6 - OUTSIDE PLANT CONDUIT, PATHWAYS AND SPACES

6.0 Backfill, Encasement and Separation: Prior to backfill and concealment, all OSP installations must be observed and approved by ETSU. The designers must add this note to all site and OSP drawings and include it in any pre-construction directives. See 'Detail 3' and 'Detail 4' of this document. Consider concrete encasement of conduit when minimum depth cannot be attained, conduits pass under roads, sidewalks, driveways, or when bend point may be subject to shifting or movement. Also special or sensitive circuits (Public Safety, Life Safety) may have particular encasement needs. Consult with ETSU prior to design. When communications conduit and cabling require separation from other utilizes, maintain a minimum of; 1) 12" of well tamped earth from power, 2) 3" from electrical power when encased in concrete and 3) 2'-0" from steam lines.

NOTE: If sufficient earth is removed so that the known or previously unknown and unexposed buried communications cable, pathway or duct bank becomes exposed, it is the responsibility of the excavator (contractor) to properly install new approved detectable warning tape above the conduit or cable media for the entire distance it is exposed, regardless if any communications items are in the scope of work or not. The contractor must contact ETSU Facilities and ETSU-ITS for site approval prior to installation of detectable warning tape and prior to backfilling.

6.1 Identification: Provide identifying metalized (detectable and conductive) minimum 6" wide warning tape above all OSP conduit. Warning tape must be placed 12" maximum below finished soil grade and run continuous and center above conduit sections. See note in section above. All conduits must be labeled inside maintenance holes, hand holes and Telecommunications Rooms.

6.2 Paving, Surfacing and non-Paved Restoration: Follow guidelines set by contract documents and consult ETSU Facilities. All OSP pull boxes must be flush with grade on all sides to allow for mowing, etc.

6.3 Conduit: Communications conduit and fittings must be made of polyvinylchloride, PVC schedule 40 pipe for most applications. Schedule 80 must be utilized for passing under parking lots or drive areas, streets, and other load bearing applications. Solvent weld fittings are to be used and joints must be watertight. All conduits must be provided with a sequentially marked pulling tape in English or metric markings with a minimum of 1200 lbs. pulling tension. Conduit must be thoroughly cleaned after placement. During construction and after the conduit is completed, the ends of the conduits must be sealed as specified in this document. No conduit section must exceed 100' in distance without a handhole or pullbox. The pull box must be in a fully accessible area away from vehicle and designed pedestrian traffic. Each conduit section including those containing innerduct must have a minimum 3/8" nylon pull rope (mule tape) rated at a minimum 200lb. tensile strength.

6.4 Conduit Formation: Where practical, conduit formations using single-bore conduit should be arranged so that orderly cable racking can be accomplished within the maintenance hole or handhold and that minimum changes are made in the formation as it enters the maintenance hole. Main conduit formations must enter the end walls of a maintenance hole as shown on Detail 4 of the appendices section of this document. In OSP applications there must be a minimum of four (4) 4" conduits from pullbox-to-pullbox or pullbox-to-building. Conduits must enter and exit pullboxes in a straight (aligned) formation, entering and exiting at opposite sides of the box. Conduits entering buildings must be sloped down and away from buildings to create a substantial drain slope. Conduits, regardless of whether they are empty or contain cabling, must be free of debris and water at all times and must be sealed with approved pliable seal at all openings.

6.5 Bends: The contractor must use the longest radius bends possible. All bends must be long, sweeping bends with a radius not less than 10 times the internal diameter of conduits. NOTE: 90-degree bends are not approved in any circumstance. Factory manufactured bends are to be utilized (non-heated). No more than two bends are permitted in a length of conduit without a pullbox. Pull boxes must not be utilized in lieu of a conduit bend.

6.6 Terminating Conduit: (Reaming). All ends of conduit must be reamed and all protruding ends should be fitted with bushings at ends.

6.7 Depth: The top of all OSP communications conduit must be buried at least 2'-0" below the surface of the ground. See 'Detail 3' in the appendices of this document.

6.8 Innerduct: All OSP conduit shall contain innerduct. All innerduct placed inside OSP conduit must be MaxCell Edge color-coded detectable 3-cell innerduct. When initial cabling is installed in an empty innerduct, the middle (center) cell must be occupied first. All OSP conduit (including those encasing innerduct) must have a pull rope installed as well. (See part 3.4 of this section). Each innerduct is to have different color ID markings and must be installed per the manufacturer's instructions including the use of manufacturer approved swivels. No kinked or twisted innerduct will be accepted. Pull tapes must remain free floating throughout the installation. Consult ETSU-ITS on the requirement for inside plant innerduct (MaxCell Premise) for interior riser pathways.

6.9 Handholes/Pullboxes: HH/PB's are to be open bottom with a minimum dimension of 30"x48" with cover permanently labeled "COMMUNICATIONS" by the manufacturer. All covers must have a pull slot with center pin for opening and setting. No conduit section between HH/PB's must exceed 100'. When the designer is considering tying a new conduit into an existing HH/PB, the designer must consult with ETSU first to see if the existing HH/PB should be replaced with a larger one. When conduits enter a HH/PB they should be designed to do so no lower than 2'-0" below finished grade. Conduits must enter and exit HH/PB's in a straight (aligned) formation. All covers must be flush with grade to allow for grounds equipment, mowing, mobility, etc.

New HH/PB locations must be in a fully accessible area away from vehicle and designed pedestrian traffic (streets, sidewalks, etc.). Existing HH/PB locations that are to remain unaltered but because of new construction it has been determined will be exposed to occasional lightweight vehicular and pedestrian traffic, must be converted to rated HH/PB's that exceed a maximum rating for expected traffic for that location per ANSI/SCTE 77 standards and tiers. For HH/PB locations designed to be in deliberate traffic including heavy vehicles (earth moving, construction, emergency and first responder vehicles) they must meet, at a minimum, AASHTO H20 standards for all materials. All cabling and conduit openings must be clearly and permanently labeled at each HH/PB. When cabling is to be installed at each HH/PB, a minimum 25' service loop in each cable must be installed and appropriately secured to the side of the HH/PB where directed by ETSU-ITS. See ANSI/SCTE 77 2017, Section 7 for design and test loading requirements for all enclosure types. Only Tier 22 and AASHTO H-20 are approved for use at ETSU as specified in this section. For the designers general information however, ANSI/SCTE 77 establishes six types of traffic for load ratings:

1. **Light Duty:** Pedestrian traffic only.
Example: grassy areas in residential properties that are located away from vehicular traffic.
2. **TIER 5:** Sidewalk applications with a safety factor for occasional non-deliberate vehicular traffic.
Example: Residential sidewalk that is not crossed by a driveway.
3. **TIER 8:** Sidewalk applications with a safety factor for non-deliberate vehicular traffic.
Example: Most public sidewalks
Example: Within parking curbs of parking lots where it is highly unlikely to be run over.
4. **TIER 15:** Driveway, parking lot, and off-roadway applications subject to occasional non-deliberate heavy vehicular traffic.
Example: Sidewalks in residential or public areas where heavy vehicle traffic is unlikely, but may occur.
5. **TIER 22:** Driveway, parking lot, and off-roadway applications subject to occasional non-deliberate heavy vehicular traffic.
Example: Non-paved median between a divided highway or non-paved shoulder area.
6. **AASHTO H-20:** Deliberate vehicular traffic applications.
Example: Within streets, highways and paved shoulders along highways.

NOTE: Prior to backfill and concealment, all OSP installations must be observed and approved by ETSU. The designers must add this note to all site and OSP drawings and include it in any pre-construction directives. See 'Detail '3' and Detail '4' of this document.

Additional information on Outside Plant conduit, cabling, conduit bodies and boxes

6.10 Any and all existing HH/PB locations that are inside or within an area of construction and laydown or parking area or within 100' of an area must be protected from damage or contact from materials, spills/overflow/runoff, manpower, machinery, vehicles or equipment. It is the contractor's responsibility to identify, protect and secure these locations using approved means prior to any mobilization, material delivery or construction work of any kind. Protection installed or constructed must be approved by ETSU. Contact ETSU Facilities for more information. Protection of OSP boxes consists of flat steel road plates that cover a minimum of 120% of the OSP box exposed surface area (rim/lid), as well as metal grade or survey stakes installed in-ground near each OSP box corner. Construction fencing and caution tape shall surround the box and be secured to stakes on all sides. See 'Detail 9' of this document for more information.

6.11 Where OSP conduit and cabling transitions into existing building walls/facades/architectural members, the use of Conduit Bodies must be designed and utilized. These bodies have removable or hinged weatherproof covers to allow access to the cable for pulling purposes only. It is used to give access to cabling or allow change in direction of the conduit pathway system. Note that it is critical to meet the minimum bend radius requirements for cabling. These type conduit bodies (a/k/a "Smart" conduit bodies such as from Madison Electric Products) have built-in internal radius members that ensure that the cabling placed inside meets the industry-standard bend radius. Only these type conduit bodies are to be used in the design and construction of these type pathways. NOTE: See Detail 13 in the Appendices section of this document for more detail.

6.12 For system conduits, pull boxes, routing, termination, risers, horizontal runs, sizing, etc., follow industry standard requirements. Raceway definitions must comply with NEC definitions. There must be a maximum conduit fill ratio of 40 percent to be accommodated for when sizing conduit.

6.13 Conduit runs must be equipped with a pullbox (inside), or maintenance hole (outside), after two 90-degree bends or an accumulation of 120 degrees of total pathway deviations from a straight line between each point of access. For conduit diameters 53 mm [2 in.] or less, minimum bend radius must be six times the internal diameter of conduit. For conduit diameters exceeding 53 mm [2 in.], conduit bend radius must be 10 times internal diameter of conduit. For conduit enclosing optical fiber cabling minimum conduit bend radius must be 10 times internal diameter of conduit.

6.14 All designs should provide and allow for a separate cable distribution system including dedicated continuous conduits for critical, life, emergency, safety and protection systems (i.e. emergency phones, emergency voice communications from elevator cars, parking lots, stairwells, FACP's, etc.

NOTE: No conduit bodies, enclosures, cabinets, pull boxes or other transitional spaces used or designed for access to pull cabling thru shall be used to house any active equipment, primary grounding, surge protection or other components not directly related to the support and routing of the cabling itself. Any other terminations, surge protection, active components, power receptacles, means of grounding etc. must utilize separate and appropriately sized enclosures or conduit bodies for this purpose. These will be permitted to have connections thru approved conduits between enclosures and housings for means of connection. Contact ETSU for more information and refer to Detail 10 in the Appendices section of this document. No exposed Class 2 cabling (LV/comm/etc.) of any kind is permitted at ETSU. No aerial or direct buried communications cabling of any kind is permitted at ETSU. All OSP cabling infrastructure must be installed in conduit pathways by approved means.

SECTION 7 - INSIDE PLANT CABLE TRAY, CONDUIT, SUPPORTS AND OTHER ITEMS

J-hooks

7.0 Open-top cable supports are approved for use where needed as horizontal free-wire pathways to provide support for cabling from outlets to the cable tray in accessible areas. J-hooks for horizontal cabling must be installed on maximum 5' centers, in regular intervals, allowing for no more than 12" of cable sag. A minimum clearance of 8" must be maintained wherever possible above j-hooks and cable tray. Cables must be bundled in TR's per BICSI N2-17 and never exceeding 24 4-pair BTP cables per bundle. J-hooks and supports must comply with the uses and material types as directed in the ETSU-ITS guidelines. This includes cable quantities where applicable. All cabling supports and pathways must be secured from movement per NEC 300.11. Note: See ETSU-ITS installation standards for maximum allowable fill for all J-hook and cable types. Designs that will provide infrastructure for A/V cabling in addition to typical data cabling must have a two-level cable tray system installed or single-layer tray with continuous divider plate installed. Consult ETSU for more details. Electrical bonding is required for all Cable Tray types in all areas. Electrical bonding for J-hooks is not required per NEC 250.86 exception 2, but may be required by manufacturer for warranty or by ETSU. Check for details.

Consolidation Points

7.1 Consolidation points should have appropriate security, such as key locking, tool removable covers, or other means of security. Furniture or spaces used to house consolidation points must have sufficient space to allow for anticipated horizontal cable slack storage, strain relief and terminations. Suspended ceiling spaces and floors may be used, provided the space is accessible without moving building fixtures, equipment, heavy furniture or disturbing building occupants. Consolidation points in plenum-rated spaces must conform to applicable codes.

Cable Tray

7.2 Wire-basket styled cable tray is for use outside all TR's to serve all building work areas only. All cable tray installed inside TR's must be ladder rack style and sized according to ETSU. All cable tray types must be either two-layer divided for separate data and A/V cabling, or single-layer divided by a continuous metal adjustable barrier to separate cabling types.

7.3 Wire basket type tray for backbone and horizontal cabling shall be sized appropriately (allow 25% growth) and have a 2" minimum depth. Tray's shall be located a minimum of 3" above ceiling tile and have a minimum of 12" of unobstructed access above tray. When designing the layout of the tray, the designer should ensure that other building components (e.g., lighting fixtures, structural supports, air ducts) do not restrict access to the tray. Wire basket must be cut using cutting tool for wire basket and not typical bolt cutters. All basket cable tray should be installed with either a two-level system for separation of AV and general ITS 'data' cabling, or a single layer cable tray with a metallic center divider. A metallic center divider is mandatory for all single layer tray installations. Consult ETSU for more info.

Horizontal Conduits

7.4 Horizontal conduits for ETSU communications outlets (voice/data/video/Wi-Fi/cameras/displays/floor boxes and poke-through assemblies/standard A-V outlets, etc.) must be 1" diameter EMT. See detail 2 of this document of related specifics and conduit rough-in requirements including box sizes and methods of construction. No more than six, four-pair cables may be in a single one-inch conduit.

- All conduits serving a work area outlet shall serve no more than one outlet/j-box per conduit run. The design and installation of daisy-chaining more than one conduit box on a single conduit path is prohibited unless approved otherwise by ETSU Facilities prior to installation, and is done in accordance with TIA-569-E, section 9.9.2.5.
- Conduit entries at pull boxes must be arranged so that cables passing through the box enter and exit at opposite sides of the box. ETSU requires conduit elbows (sweeps) that maintain cable bend radii for changes of direction.
- Surface metal raceways are not acceptable and must not be approved for wire or cable on the outside walls. In interstitial spaces and above solid ceilings (inaccessible areas), route conduit serving work area outlets and other type outlets to the nearest cable tray, cabinet, or rack as applicable.
- Conduit from work area outlet to above accessible ceiling interior diameter must be a minimum of one inch and be terminated to a 3-inch deep, 4-inch square box. See Detail 2 in the appendices section of this document.
- No section of conduit must be longer than 30m (100 feet) between pull points (boxes). Conduits should not be more than 250 feet from the serving comm room to the work area served.

- No section of conduit must contain more than two 90-degree bends, or equivalent, between pull points (e.g., outlet boxes, pull boxes, distributor rooms). If there is a reverse (U shaped) bend in the section, a pull box must be installed. For conduits with an internal diameter of 2 inches or less, the inside radius of a bend in conduit must be at least 6 times the internal diameter. For conduits with an internal diameter of more than 2 inches, the inside radius of a bend in conduit must be at least 10 times the internal diameter. Bends must not contain any kinks or other discontinuities that may have a detrimental effect of the cable sheath during cable pulling.
- Conduit fittings must not be used in place of pull boxes.

7.5 Pull Boxes for Horizontal Cabling

- Pull boxes should be readily accessible and not placed in a fixed false ceiling space unless immediately above a suitably marked access panel.
- A pull box must be placed in a conduit run where: a. The length is over 100 feet, b. there are more than two 90-degree bends or equivalent, or c. There is a reverse (U-shaped) bend in the run.
- Pull boxes must be placed in a straight section of conduit and not used in lieu of a bend. The corresponding conduit ends should be aligned with each other.
- Where a pull box is required with conduits smaller than 1 ¼", an outlet box may be used as a pull box. Where a pull box is used with conduits, it must be sized, at minimum, per table 7 of ANSI/TIA-569-E section 9.9. Pullbox length should be 16 times the conduit end face. Consult ETSU prior to sizing.

Table 7 – Pull box sizing

Metric designator (trade size)	Width mm (in)	Length mm (in)	Depth mm (in)	Width increase for additional conduit mm (in)
27 (1)	102 (4)	406 (16)	76 (3)	51 (2)
35 (1-¼)	152 (6)	508 (20)	76 (3)	76 (3)
41 (1-½)	203 (8)	686 (27)	102 (4)	102 (4)
53 (2)	203 (8)	914 (36)	102 (4)	127 (5)
63 (2-½)	254 (10)	1067 (42)	127 (5)	152 (6)
78 (3)	305 (12)	1219 (48)	127 (5)	152 (6)
91 (3-½)	305 (12)	1372 (54)	152 (6)	152 (6)
103 (4)	381 (15)	1524 (60)	203 (8)	203 (8)

SECTION 8 - FIRE STOPPING

8.0 All rated sleeves and penetrations needed for delivery of communications cabling must meet, at minimum, the following requirements:

- Where rated walls, floors, roofs, ceilings and/or any other members are cut/penetrated to install cabling, pathways, or related components, the contractor must provide and install all materials necessary to re-establish or exceed the original fire-rating of that structure (specified requirements), to the satisfaction of the authority having jurisdiction (SFMO or code official).
- Premanufactured firestop assemblies are permitted as long as they have been pre-approved (reviewed and stamped as approved) by the SFMO prior to installation.
- The designer must determine the extent of rated partitions and non-rated assemblies (i.e. walls, partitions, floors or ceilings) to maintain pressurization of environmental air (e.g. O.R., isolation rooms, negatively pressurized spaces, positively pressurized spaces) or acoustical areas providing sound attenuation or acoustical ceiling located in the path of cabling and specify appropriate re-enterable raceway system seals or acoustical pathway devices at those locations. Hardening caulks, sealants and cementitious materials must not be specified for telecommunications and special systems cabling.

8.1 It is recommended that:

1. All rated penetrations must have a computer-generated decal applied within 12 inches from the center of each penetration showing contractors name, address, phone, hour type and rating, and signed/dated by installer, and be clearly visible from floor level.
2. The decal must be minimum 5"x7" in size, and it must be photographed in place by the contractor immediately upon installation. See Chapter 8 (page 8-51) of the BICSI TDMM for more information.

NOTE: Although it is permissible for cabling insulating jackets and outer sheathes to be in direct contact with approved firestop compounds, the application of non-approved materials and coatings are not allowed at any time. This includes the direct (intentional or unintentional) application of paint to exposed cabling, etc.

SECTION 9 – FURNITURE, FIXTURES AND EQUIPMENT (FF&E)

9.0 See ETSU's Design Guidelines regarding communications infrastructure and furniture/equipment. No furnishings or equipment of any kind (including modular furniture systems) should be designed that block, cover, or impede full view and access to new or existing electrical and communication receptacles in walls or floors. All receptacles shall be unobstructed and labeling shall be in clear view for accessibility, future adds/changes, and E-911 compliance. NOTE: See Section 11 of this document for more labeling requirements.

9.1 Any furnishings designed to be installed against walls shall have either: 1) Fully open area below work surfaces (privacy panels) exposing the adjoining wall a minimum of 2'-0" AFF – preferably no privacy panels or backing against walls, or 2) a full sliding panel system below work surface height to allow for full view and accessibility to all power and communications outlets on wall.

Note: This requirement is necessary regardless of whether permanent wall has existing outlets or not, to allow for future growth and accessibility.

9.2 For all acoustical ceilings, no power receptacles are permitted above ceilings per NEC for the continuous use of equipment or devices. All power receptacles for equipment shall be installed in-grid or below ceiling in accordance with NFPA-70 and TIA 569. Any in-grid outlets and devices must be designed specifically for that purpose, and installed in a manner using approved independent supports that do not use or rely on ceiling grid wires or ceiling grid T-bars or ceiling supports of any kind. All approved supports must be secured per code to permanent architectural or structural components. Consult ETSU for more details. Low voltage outlets (data) are permitted above ceilings provided they are permanently accessible, labeled, and installed in accordance with ETSU-ITS standards.

SECTION 10 - BONDING AND GROUNDING

10.0 The information in this section does not replace any applicable laws, codes or standards. All design for bonding and grounding must meet or exceed those defined by the AHJ. TIA-607-E Table 9.1 below provides a cross reference between older and newer terms and acronyms for certain materials in this section. Note that newer terms are preferred but these are interchangeable:

Previous term	New term
Grounding equalizer (GE)	Backbone bonding conductor (BBC)
Telecommunications main grounding busbar (TMGB)	Primary bonding busbar (PBB)
Rack grounding busbar (RGB)	Rack bonding busbar (RBB)
Telecommunications grounding busbar (TGB)	Secondary bonding busbar (SBB)
Bonding conductor for telecommunications (BCT)	Telecommunications bonding conductor (TBC)

10.1 Locate TMGB/PBB in the facility utility entrance, as close as practical to the primary or secondary protectors and near the electrical panel to which it will be bonded.

10.2 TMGB/PBB must be sized according to the anticipated number of bonded connections. The busbar must be a pre-drilled copper busbar with holes for use with standard sized lugs (two-lug design), be minimum .25 inches thick by 4 inches wide and length as specified.

10.3 Building steel within 1.8 m [6 feet] of the communications grounding system should be bonded into the system. The Bonding Conductor for telecommunications (BCT/TBC), connecting the TMGB/PBB to the IBT, must be sized at least one (1) size larger than TBC. Where practical, TBC length should be less than 9 m [30 feet].

10.4 Per TIA 607-E Standard, individual projects requiring larger conductor sizes or greater clamp density must take precedent over these guidelines. Each individual racks and cabinet must bond to the TGB with a conductor size of #6 AWG or larger. Serial connections (or "daisy-chaining") between racks, cabinets, enclosures, etc. will not be accepted. Bonding couplers connecting sections of cable tray are permitted.

Bonding within Racks and Cabinets

10.5 Racks and cabinets must have bonding busbars installed along one rail to provide effective bonding of rack / cabinet mounted equipment.

10.6 Larger equipment (chassis switches) with integral bonding terminals must be bonded to the vertical busbar with equipment bonding conductor attached to those terminals and bonded to the rack-mounted busbars.

10.7 Smaller equipment (servers, switches) not having integral grounding must be bonded from the rack bonding busbar to a bonding lug connected to an accessible equipment chassis metal screw (ensure the chassis paint is removed where the lug connects to ensure a good connection).

Note: See Detail 6 in the appendices section of this document. In existing facilities where an adequate electric bonding system is already in place, the a TGB/SBB and TBC system is permitted to be properly bonded to it if it is inspected/observed for compliance by the Engineer or AHJ. All methods of the system must conform with Chapter 9 of the BICSI TDMM and ANSI/BICSI-N3-2020 for installation, testing and inspection (telecommunications bonding only).

SECTION 11 - CABLE TESTING, COMMISSIONING AND DOCUMENTATION

11.0 See General Cabling Information and Performance Tables at the end of Section 11. Refer to ETSU-ITS Cabling Installation Standard for more information on wire and cable.

11.1 All test equipment must be in compliance with the manufacturer's factory-authorized calibration and have the latest firmware/software testing parameters and standards downloaded and installed, preferably within the last calendar year. This must include documentation from the manufacturer or authorized center indicating calibration within the manufacturer's recommended date and/or date interval.

11.2 Any test equipment makes and models used for the purpose of certification in obtaining a warranty must be approved by the manufacturer that is issuing the warranty. Testing must commence only after all materials are 1) permanently and correctly installed, 2) permanently adjusted and 3) and accurately labeled. Testing must commence only in a clean environment, free of moisture, dirt, dust and debris.

11.3 Labeling of all components must be accurate and officially final to be accepted. Labeling of devices, faceplates, bulkheads and other items will only be accepted by ETSU that reflect final and accurate room numbering in compliance with the University's numbering system for the facility and the Tennessee Board of Regents Physical Facilities Inventory and Survey (PFIS). It is the user's responsibility to obtain acceptance prior to any final labeling application.

Optical Fiber Cable Testing

11.4 One-cord reference method is preferred for both Multimode and Single-mode links. Consult ETSU prior to testing MPO/Array links. All optical fiber methods and procedures must follow TIA-568.3-E and include at minimum:

- Test instruments that comply with Annex E.3
- Test measurements and methods as specified in Annex E.4 and E.5

OPTICAL FIBER TESTING METHODS

Optical Fiber Type	Testing Method per TIA-568.3-E (annex 'E')
Single-mode OSP	Tier 1 <u>and</u> Tier 2 testing required: <ul style="list-style-type: none">- Tier 1: Attenuation measurement for permanent link measured with optical loss test set (OLTS) LSPM using methods specified by TIA-526-7-A, method A.1 and TIA-568.3-E, annex 'E'.- Tier 2: Additional attenuation measurement with optical time domain reflectometer (OTDR) using methods specified by TIA-526-7-A, method B and TIA-568.3-E, annex 'E'.
Single-mode ISP and Indoor-Outdoor	Tier 1 testing required (Tier 2 optional unless specified by ETSU): <ul style="list-style-type: none">- Tier 1: Attenuation measurement for permanent link measured with optical loss test set (OLTS) LSPM using methods specified by TIA-526-7-A, method A.1 and TIA-568.3-E, annex 'E'.
Multimode ISP and Indoor-Outdoor	Tier 1 testing required (Tier 2 optional unless specified by ETSU): <ul style="list-style-type: none">- Tier 1: Attenuation measurement for permanent link measured with optical loss test set (OLTS) LSPM using methods specified by TIA-526-14-C, method B and TIA-568.3-E, annex 'E'.

OPTICAL FIBER AND CONNECTOR ATTENUATION TABLE

Optical Fiber or Connection Type	Wavelength (nm)	Maximum Attenuation (dB/km)	Performance
OM1 – Multimode (grandfathered)* 62.5um per TIA 492AAAA	850 1300	3.5 1.5	Minimum bandwidth of 200 and 500 megahertz over 1 kilometer (MHz-km) at 850 and 1300 nm, respectively.
OM2 – Multimode (grandfathered)* 50um per TIA 492AAAB	850 1300	3.5 1.5	Minimum bandwidth of 500 and 500 MHz-km at 850 and 1300 nm, respectively.
OM3 – Multimode 850nm Laser-Optimized 50um per TIA 492AAAC	850 1300	3.0 1.5	Minimum bandwidth of 2000 and 500 MHz-km at 850 and 1300 nm, respectively.
OM4 – Multimode 850nm Laser-Optimized 50um per TIA 492AAD	850 1300	3.0 1.5	Minimum bandwidth of 4700 and 500 MHz-km at 850 and 1300 nm, respectively.
OM5 – Multimode Wideband Laser-Optimized 50um per TIA 492AAAE	850 953 1300	3.0 2.3 1.5	Minimum bandwidth of 4700 and 500 MHz-km
OS1 – Single-mode (grandfathered)* Inside Plant per TIA 492CAAA	1310 1550	1.0 1.0	
OS1 – Single-mode (grandfathered)* Indoor-Outdoor per TIA 492CAAA	1310 1550	0.5 0.5	
OS1 – Single-mode (grandfathered)* Outside Plant per TIA 492CAAA	1310 1550	0.5 0.5	
OS1a – Single-mode Inside Plant per TIA 492CAAB	1310 1383 1550	1.0 1.0 1.0	Specified for 1310 and 1550 nm. At 1383 nm (water peak), attenuation is reduced to 1dB.
OS2 – Single-mode Outside Plant per TIA 492CAAB	1310 1383 1550	0.4 0.4 0.4	Low water-peak, suitable for course wavelength division multiplexing specified for 1310, 1383 and 1550 nm.
CONNECTOR LOSS (per mated pair)	n/a	0.75	
SPLICE (each)**	n/a	0.3	

*Per TIA-568.3-E, Annex B – Fibers and cable types within this annex (noted above) are grandfathered and are not to be used for new installations. These cable types shall only be installed at the request of ETSU-ITS as replacement media for legacy systems.

**Optical fiber splices must be measured in accordance with TIA-455-78-C for field testing.

Use of Test Cords

11.5 Per TIA-568.3-D 7.3.4, there is a recommendation (but not requirement) for the use of reference-grade terminations on test cords to reduce uncertainty and improve the reproducibility of measurements. Reference-grade terminations result in lower loss than standard-grade terminations. The table below provides the test cord loss allowance for two different termination combinations:

Mated termination combination	Multimode (dB/connection)	Single-mode (dB/connection)
Reference-grade to Standard-grade	0.3	0.5
Standard-grade to Standard-grade	0.75	0.75

Supportable Distances and Channel Attenuation (Link Loss Budgets)

11.6 Per TIA-568.3-E, link attenuation (link loss budget) is calculated as:

Link attenuation = cable attenuation + connector attenuation + splice attenuation

Cable attenuation (dB) = Attenuation coefficient (dB/km) x length (km or percent of km as applicable)

NOTE: The contractor must ensure the proper usage of optical fiber patch cords during testing, having the correct core-to-cladding offset on connected fiber. (i.e. 50µm-to-50µm, not 50µm-to-62.5µm for multimode where specified, etc.) Test results must show calculated loss budget for each fiber length and type. The use of mode-conditioned launch cables and fiber mandrels must be employed where applicable. All color coding must comply with TIA-598-D Optical Fiber Color Coding. See more test results requirements at end of next section.

Copper Cable Testing (Balanced Twisted-Pair)

Category 5e/6/6A Cabling

11.7 Each communications 8P8C outlet/jack must be tested for performance, conductor integrity, and termination sequence. Testing must be performed over the 'Permanent Link' between modular jacks in the work areas, and modular ports on the patch panels.

11.8 Provide connectorized testing of each outlet under ANSI/TIA 568.2-D Section 6 specifications for each cabling category, using approved and calibrated test equipment. Every wire and connector pin for each cable from an outlet to the patch panel or distribution frame must be tested for the following at the specified frequencies as applicable. Some tests are optional as noted unless specified by ETSU.

- Wire Map
- Length
- Insertion Loss (Attenuation)
- NEXT Loss, pair-to-pair
- FEXT Loss, Pair-to-pair
- PSNEXT Loss
- ELFEXT Loss, pair-to-pair
- PSELFEXT Loss
- Return Loss
- Propagation Delay
- Delay Skew
- PSAACRF
- DC Loop Resistance
- DC Resistance Unbalance within a pair (CAT6A)
- DC Resistance Unbalance between pairs (CAT6A)
- TCL/ELTCTL (if required by manufacturer for warranty, informational only or CAT6A)
- ACRF, AFEXT, ANEXT, PSAFEXT, PSAACRF, PSANEXT, PSAACRF (CAT6A)

11.9 Per ANSI/TIA-1152, any *fail* or *fail** must result in an overall failure. In order to achieve an overall pass condition, all individual results must be *pass* or *pass**. Follow the manufacturer's warranty submittals and submit a copy of all results (including UTP/STP/ScTP, CATV, and Optical Fiber) to ETSU before final certification. Test results must be provided in the following Sections, Format and Order*:

Section 1: Cover sheet clearly indicating project name / number and date of testing. Include name and signature of qualified technician(s) that performed the testing.

Section 2: Summary sheet with a single table indicating all ID's in alphanumeric order, total cable quantity and a pass or fail result for each.

Section 3: Individual sheets for each individual twisted pair cable or optical fiber strand pair in order showing all applicable test results per TIA standards, including plotted graphical data.

*Test results submitted in any other format will be rejected.

11.10 Balanced twisted-pair cable test results must be submitted in their original format from tester (*.filetype) as well as PDF format for Sections 1 through 3 above. Twisted-pair testing limits must conform to TIA-568.2-D for the permanent link.

11.11 Coaxial cable test results must comply with TIA-568.4-D. Provide test results on a document (PDF spreadsheet) indicating all stated measurements in sections 6 through 8 of TIA-568.4-D.

11.12 Optical fiber test results must be submitted in the format as specified in TIA-568.3-E, Annex E.6 and shall include all seven items for Tier 1 test results and all nine items for Tier 2 test results.

General Cabling Information and Performance Tables

11.13 In addition to the general requirements stated in the ETSU-ITS cable installation standard, the requirements below shall apply to all communications cabling provided to or installed for ETSU in all facilities:

- Purchasers, specifiers, and installers of communication cables placed in risers or plenums during building construction or upgrade must be aware that cables that do not meet safety requirements present a significant risk of hastening the spread of fire. This represents an unacceptable risk — and avoidable hazard — to building occupants and owners. If a cable bears no certification mark but is marketed and advertised as meeting applicable codes and standards specifications (e.g. Category XX or CM, CMR, CMP fire safety rating), then the cable may be correctly described as “NON-COMPLIANT” and is unacceptable for use.
- Copper-clad cable for communication cabling is not permitted in any application or area. See NEC 800.179 and 568-C.2 sect 5.3
- If a cable or product falsely bears a name or brand that is descriptive of the product that was not produced by that manufacturer, then the cable may be described as “COUNTERFEIT” and is unacceptable for use.
- If a cable bears an unauthorized certification mark (e.g. UL or ETL), then the cable is counterfeit as to the mark. The cable may be described as “BEARING COUNTERFEIT CERTIFICATION” or “COUNTERFEIT MARK” and is unacceptable for use.
- Any cable that does not have third-party certification is not in compliance with the NEC and therefore is illegal to install and unacceptable for use.
- NOTE: Underwriters Laboratories provides a unique holographic label for each manufacturer and cable that has been tested by them. The installer is expected to confirm the E number and cable legitimacy prior to procurement or installation. This can be done on UL’s website or mobile app.

Classification and Performance Tables

Cabling Standard*		Maximum Frequency	Supported Network Standards**					
TIA	ISO		10BASE-T	100BASE-TX	1000BASE-T	2.5GBASE-T 5GBASE-T	10GBASE-T	25/40GBASE-T
Cat 5		100 MHz	X	X				
Cat 5e	Class D	100 MHz	X	X	X	(limitations)		
Cat 6	Class E	250 MHz	X	X	X	X	(35 m max)	
Cat6A	Class E _A	500 MHz	X	X	X	X	X	
Cat 8	Class I, II	2000 MHz	X	X	X	X	X	(30 m max)
*TIA and ISO standards are not necessarily wholly equivalent								
**Support for 100-meter channels unless otherwise indicated								

SECTION 12 - SUBMITTAL REQUIREMENTS / SHOP DRAWINGS

12.0 All submittals must be provided to ETSU in their entirety (including re-submittals) in both printed and PDF formats. Note: See “Designers Submittals Checklist” in this document.

12.1 The following submittals are due in the Pre-or-Early Construction Phase:

Communication and related submittals are required to be provided to ETSU for all materials to be provided/installed/fabricated. All submittals must be approved by both the designer (sealed as “approved”) and ETSU prior to acquisition, installation or construction:

- Provide cover sheet showing project number, name, and description. Include table of contents with all product names, manufacturer, and specific product number identified.
- Materials and their manufacturer(s) part numbers must be clearly called out for each item using a black or red arrow or circle. No highlighted submittals will be accepted.
- Labeling samples of faceplates/enclosures/patch panels/OSP items showing compliance with ETSU-ITS requirements.
- Contractor must provide shop drawings (scaled plan and elevation drawings) of the proposed layout and construction of all components in all telecommunications rooms indicating locations of busbars, racks, enclosures, sleeves, ladder rack, service loops, wall mounted equipment, etc. These proposed layouts must be approved by the Designer and ETSU prior to construction.

12.2 The following items are due at Substantial Completion:

Record Drawings (as-built drawings)

- Provide scaled drawings indicating actual location of the TR’s, data outlet locations, Wi-Fi outlets, camera outlets, floor boxes and poke-through assemblies, and any above-ceiling terminations and service loops. Also to be included are all communications outlets and other points of termination including all outlet labeling and identification. Provide scaled CAD drawings for all drawing sheets (both native .dwg and .rvt) as well as PDF drawings of floorplans, risers, OSP, site and all other drawings to reflect as-constructed conditions, including conduit to-and-from data.
- A copy of the application for manufacturer warranty as submitted to the manufacturer – contact ETSU-ITS for specific requirements in their policy.

12.3 Submittals for product or manufacturer substitutions must be submitted to ETSU ITS for approval prior to construction or installation. The submittals must include full specifications and warranties and verified with a recognized independent testing laboratory such as UL or ETL. All substitutions must be approved by the Designer and ETSU in writing. A full mock-up is required for face plate and patch panel labeling prior to work.

SECTION 13 – SAMPLE SUBMITTALS CHECKLIST

Required Submittals Checklist

(Sample list based on ETSU-ITS typical items – Others not listed may apply)

Reminder: all manufacturer submittals/cutsheets must have arrows clearly indicating each individual chosen part number for approval. Submittals not in compliance with this will be rejected and required to be resubmitted.

COMMUNICATIONS CABLING

- Balanced twisted-pair horizontal cable (6/6A)
- Balanced twisted-pair backbone cable
- Fiber Optic OSP backbone multimode cable
- Fiber Optic OSP backbone singlemode cable
- Fiber Optic ISP backbone multimode cable
- Fiber Optic ISP backbone singlemode cable
- ISP/OSP backbone cable ID label tags
- Copper OSP cable
- Innerduct (detectable/color coded)

OUTLETS AND CONNECTORS

- Office work area Faceplate (match approved electrical color)
- Classroom Faceplate (match approved electrical color)
- Student Room Faceplate (match approved electrical color)
- Modular Furniture Faceplate (match approved electrical color)
- Blank Faceplate inserts
- Wi-Fi/WAP surface outlet box
- Modular jacks (6/6A)
- Outlet Cut-In Brackets

PATCHPANELS, HOUSINGS AND BULKHEADS

- Unloaded Patch Panels for horizontal cable (6/6A)
- Unloaded Patch Panels for backbone cable
- 110 Blocks w/clips
- Fiber Optic Wall Mount Housing
- Fiber Optic Rack Mount enclosure
- Twisted-pair OSP Building Entrance Terminals
- Twisted-pair OSP Surge Protection Modules
- Fiber Optic fan-out kits
- Fiber Optic Connectors or Pigtails
- Fiber Optic Bulkheads

EQUIPMENT RACKS AND ACCESSORIES

- Equipment Racks
- Equipment Cabinets
- Rack Base Insulator Kit
- Horizontal Wire Management
- Vertical Wire Management
- Rear Cable Strain Relief Bar
- Cable Tray, (for TR/AV rooms)
- Cable Tray, (for corridors and common areas)
- Cable Tray bonding Strap Kit
- J-Hooks/Independent supports
- Primary Bonding Busbar (TMGB/PBB)
- Secondary Bonding Busbar (TGB/SBB)
- Rack Bonding Busbar (RGB/RBB)

MISCELLANEOUS ITEMS

- Manufacturer 'Certified Installer' Certificate
- Outlet and Patch Panel Labeling Scheme and mock-up
- BICSI RCDD Certificate
- Test Equipment/OTDR Mfr & Calibration statement
- Firestop Materials and Sleeve Kits
- Fire Retardant Paint and/or additive
- Detectable OSP Warning Tape
- OSP Handhole/Vault/Pull Box
- Splice Enclosure
- Conduit Duct Seal
- Smart Conduit Body LB Assembly
- Floor In-slab Box Assembly w/components
- Floor Poke-through Assembly w/components
- Copy of Warranty application (post-construction)

SECTION 14 - APPENDICES INDEX

(Design and Construction Details on the following pages)

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NOTE: DESIGNERS MAY CHOOSE TO USE THEIR OWN SYMBOL LIBRARY AS LONG AS THE INTENT AND REPRESENTATION IS CLEAR. ALL SYMBOLS AND LEGENDS MUST BE APPROVED BY ETSU PRIOR TO PUBLISHING FOR USE.

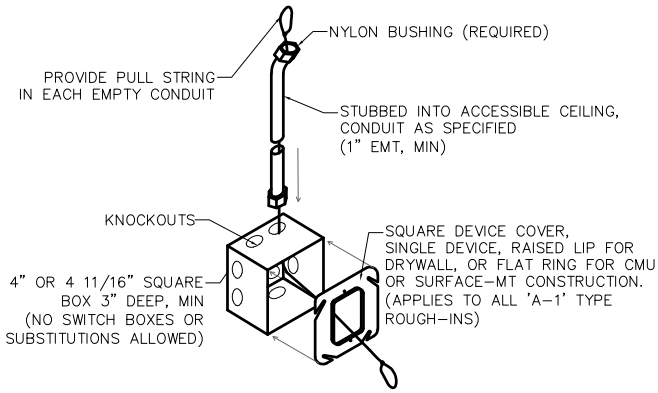


SYMBOL LEGEND

DEVICE SYMBOL	DESCRIPTIVE TEXT
	COMMUNICATIONS WALL OUTLET AT 18" AFF, UNO. FOR ADDITIONAL INFORMATION, REFER TO DRAWINGS, SPECIFICATIONS AND/OR DETAILS. W = WALL PHONE AT 48" UNO E = EXISTING D - TO BE DEMOLISHED SEE DETAIL 2 FOR PATHWAY TYPES
	COMMUNICATIONS WORK AREA ROUGH-IN, BOX AT 18" AFF, UNO SEE DETAIL 2
	COMMUNICATIONS FLOOR OUTLET (RECESSED)
	COMMUNICATIONS FLOOR OUTLET ROUGH-IN (RECESSED)
	COMMUNICATIONS OUTLET - CEILING MOUNTED.
	COMMUNICATIONS OUTLET BOX ROUGH-IN - CEILING MOUNTED.
	FURNITURE SYSTEM COMMUNICATIONS OUTLET - MOUNTED PER MANUFACTURER'S REQUIREMENTS, UNO.
	WIRELESS ACCESS POINT OUTLET = WIRELESS ACCESS POINT AND PATCHCORD (PROVIDED BY OTHERS) = COMMUNICATIONS OUTLET FOR W.A.P. INSTALL AT LOCATION SPECIFIED
	TELEVISION OUTLET / DIGITAL SIGNAGE OUTLET
	MULTIMEDIA OUTLET
	MULTIMEDIA FLOORBOX - POKE THRU FROM CEILING BELOW
	MULTIMEDIA FLOORBOX - CAST IN SLAB
	CARD READER
	SURFACE MOUNT RACEWAY - REFER TO DRAWINGS FOR REQUIREMENTS
	VERTICAL SERVICE POLE 'PVD' = POWER/VOICE/DATA 'VD' = VOICE/DATA
	VIDEO CAMERA, MOUNTING HEIGHT AS SPECIFIED
	1" EMT COMMUNICATIONS CONDUIT FROM WALL OUTLET BOX STUBBED TO ACCESSABLE CEILING SPACE (UNO). EXTEND CONDUIT TO CABLE TRAY OR J-HOOK PATHWAY AS SPECIFIED. PROVIDE 4" SQUARE BOX WITH SINGLE-GANG DEVICE RING, UNO. PROVIDE BUSHING ON OPEN END OF CONDUIT. (SEE DETAIL 2)
	1" EMT COMMUNICATIONS CONDUIT FROM WALL OUTLET BOX HOMERUN CONTINUOUS TO LOCATION SPECIFIED. PROVIDE 4" SQUARE BOX WITH SINGLE-GANG DEVICE RING, UNO. PROVIDE BUSHING ON OPEN END OF CONDUIT. (SEE DETAIL 2)

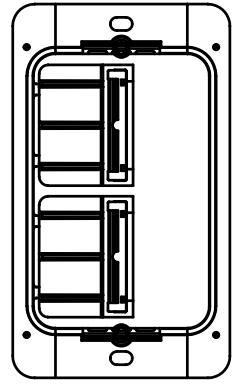
NOTE: NOT ALL ABBREVIATIONS, SYMBOLS, DETAILS, OUTLET TYPES, DESIGNS AND DIAGRAMS ARE NECESSARILY USED WITHIN THIS PROJECT OR SET OF DOCUMENTS. SEE DRAWINGS AND SPECIFICATIONS FOR DETAILS ON OUTLETS AND CABLE MEDIA TYPES.

DEVICE SYMBOL	DESCRIPTIVE TEXT
	TELECOMMUNICATIONS BACKBOARD
	TELECOMMUNICATIONS ROOM
	ELECTRICAL ROOM
	COMMUNICATIONS MAINTENANCE HOLE / PULLBOX
	TMGB / TGB GROUNDBAR
	VERTICAL SLEEVE PENETRATION
	HORIZONTAL SLEEVE PENETRATION
	CABLE TRAY
	EQUIPMENT RACK (FRONT VIEW) WITH VERTICAL CABLE MANAGEMENT
	EQUIPMENT RACK (TOP VIEW) WITH VERTICAL CABLE MANAGEMENT
	HORIZONTAL CABLE MANAGEMENT
	PATCH PANEL (SIZE AS INDICATED)
	POWER STRIP (RACK MOUNT)
	110 TERMINATION BLOCK (300pr)
	110 TERMINATION BLOCK (100pr)
	RADIUS DROP SUPPORT



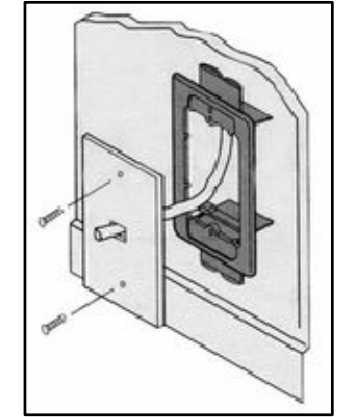
**COMMUNICATIONS CONDUIT ROUGH-IN (TYPE 'A-1')
IN-WALL (SEE NOTE AT RIGHT)**

NOT TO SCALE



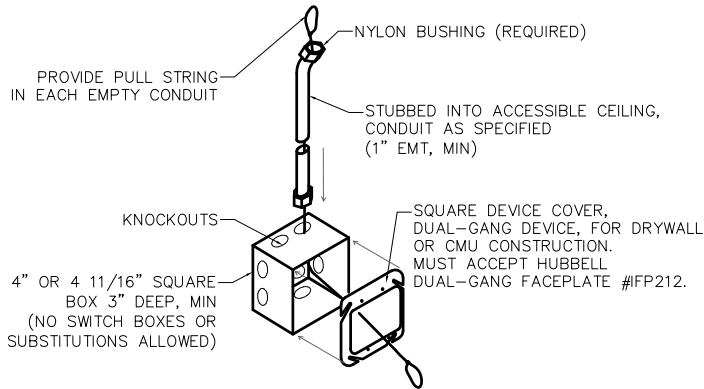
**nVENT / CADDY LOW-VOLTAGE MOUNTING PLATE
(MP SERIES - ONE THROUGH FOUR GANG)**

NOT TO SCALE



**nVENT / CADDY LOW-VOLTAGE MOUNTING PLATE
(MP SERIES - ONE THROUGH FOUR GANG)**

NOT TO SCALE

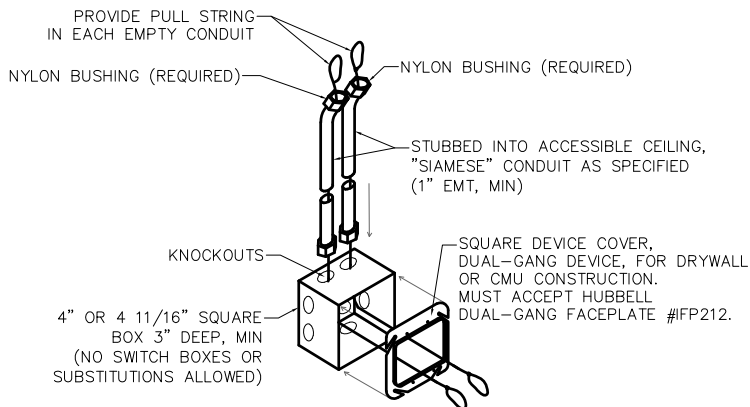


**COMMUNICATIONS CONDUIT ROUGH-IN (TYPE 'A-2')
IN-WALL (SEE NOTE AT RIGHT)**

NOT TO SCALE

NOTE: TYPE 'C' CUT-IN MOUNTING BRACKETS AND MOUNTING PLATES ARE APPROVED FOR CLASS 2 WIRING ONLY AND ON EXISTING CONSTRUCTION (RENOVATIONS) ONLY. ALL ROUGH-IN'S AND CUT-IN'S ON THIS PAGE SHALL HAVE PULL STRINGS INSTALLED, ONE STRING PER GANG. (GREENLEE 430 OR APPROVED EQUAL).

1" CONDUITS SERVING A WORK AREA OUTLET INCLUDING TYPES 'A-1' AND 'A-2' SERIES SHALL SERVE NO MORE THAN ONE OUTLET/J-BOX PER 1" CONDUIT. THE DESIGN AND INSTALLATION OF DAISY-CHAINING MULTIPLE COMMUNICATIONS BOXES ON A SINGLE CONDUIT PATH IS PROHIBITED UNLESS APPROVED OTHERWISE BY ETSU FACILITIES PRIOR TO INSTALLATION, AND IS DONE IN ACCORDANCE WITH TIA-569-E SECTION 9.9.2.5.



**COMMUNICATIONS CONDUIT ROUGH-IN (TYPE 'A-2S')
IN-WALL (SEE NOTE AT RIGHT)**

NOT TO SCALE



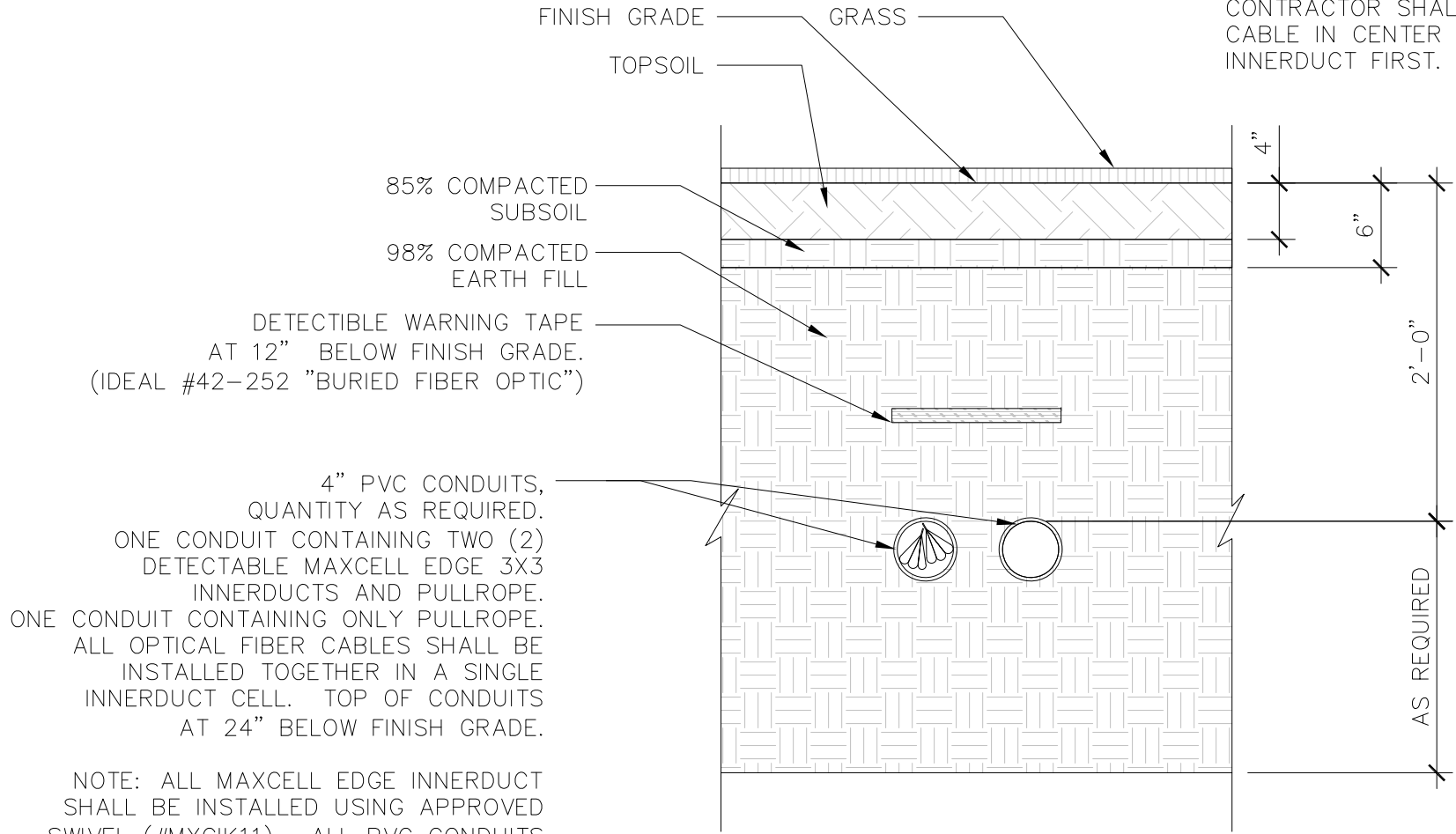
**TYPE 'C-1' SINGLE-GANG LV CUT-IN MOUNTING BRACKET
IN-WALL (ARLINGTON 'LV' SERIES)**

NOT TO SCALE



**TYPE 'C-2' DUAL-GANG LV CUT-IN MOUNTING BRACKET
IN-WALL (ARLINGTON 'LV' SERIES)**

NOTE:
IF CABLING IS TO BE INSTALLED
INSIDE INNERDUCT,
CONTRACTOR SHALL INSTALL
CABLE IN CENTER CELL OF
INNERDUCT FIRST.



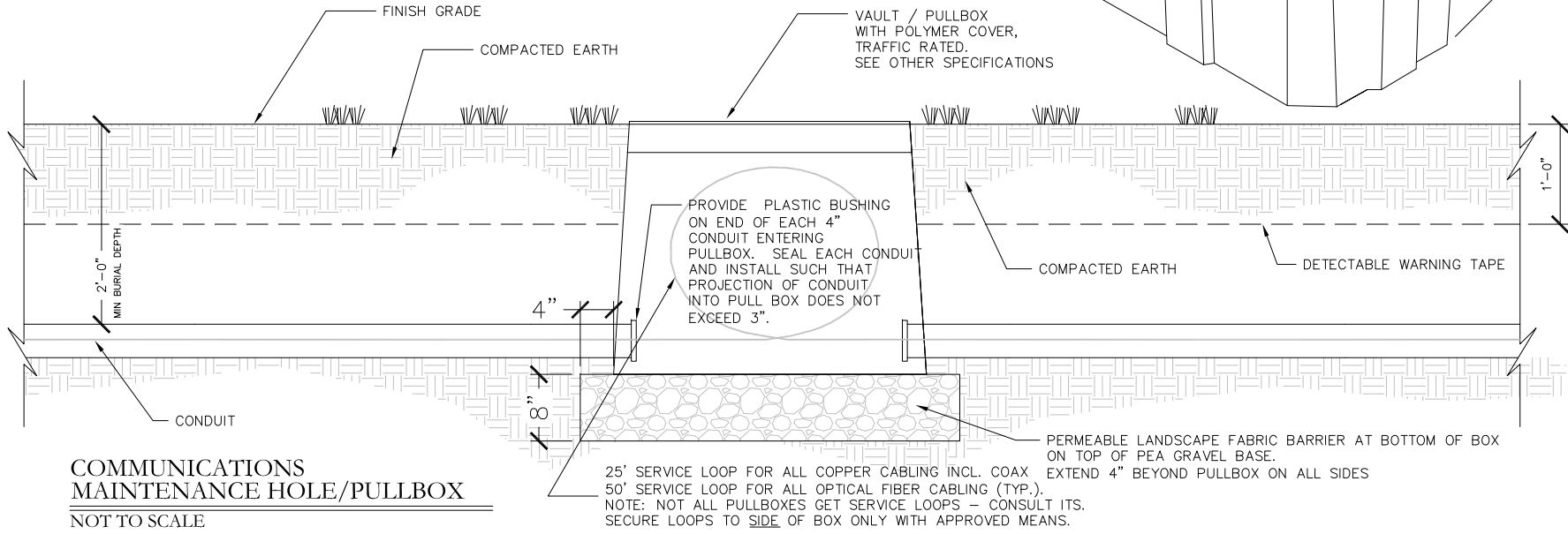
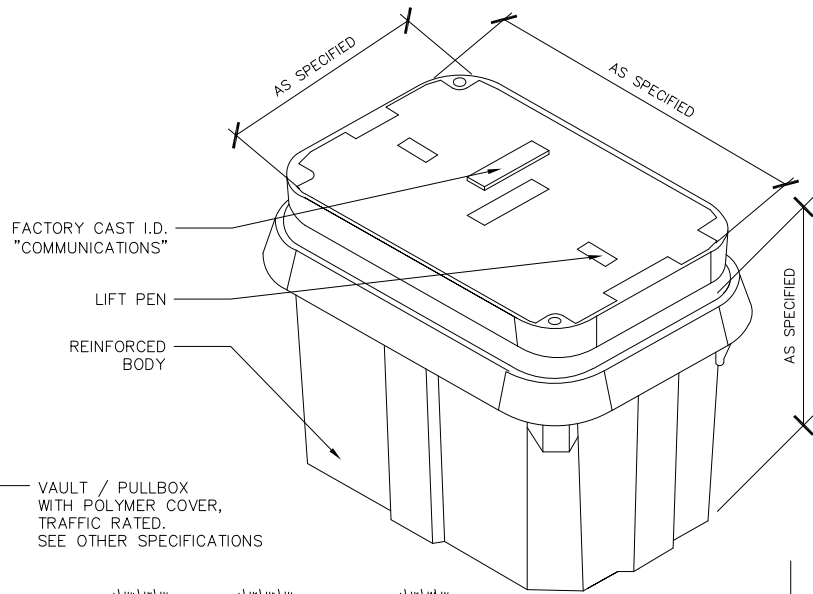
DETECTIBLE WARNING TAPE
AT 12" BELOW FINISH GRADE.
(IDEAL #42-252 "BURIED FIBER OPTIC")

4" PVC CONDUITS,
QUANTITY AS REQUIRED.
ONE CONDUIT CONTAINING TWO (2)
DETECTABLE MAXCELL EDGE 3X3
INNERDUCTS AND PULLROPE.
ONE CONDUIT CONTAINING ONLY PULLROPE.
ALL OPTICAL FIBER CABLES SHALL BE
INSTALLED TOGETHER IN A SINGLE
INNERDUCT CELL. TOP OF CONDUITS
AT 24" BELOW FINISH GRADE.

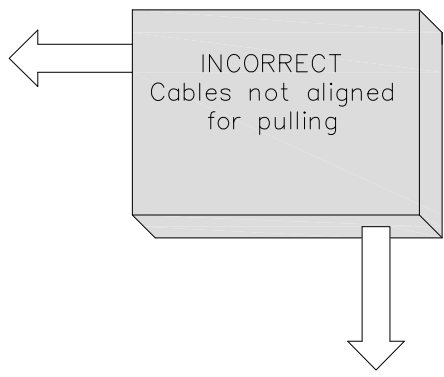
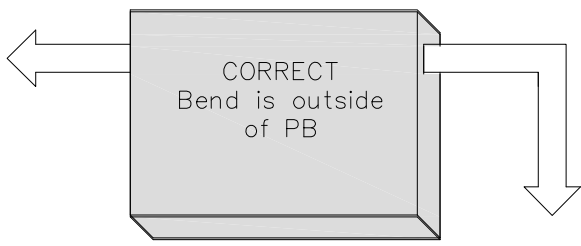
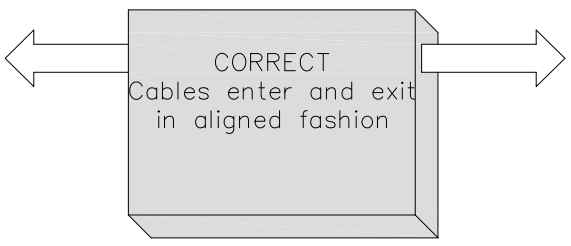
NOTE: ALL MAXCELL EDGE INNERDUCT
SHALL BE INSTALLED USING APPROVED
SWIVEL (#MXCIK11). ALL PVC CONDUITS
SHALL BE SCHEDULE 40 OR SCHEDULE 80
AS DIRECTED BY ETSU STANDARD
FOR EACH APPLICATION TYPE (GRASSY
AREAS, SIDEWALKS, ETC.).

**OSP CROSS SECTION COMMUNICATIONS
CONDUIT**
NTS

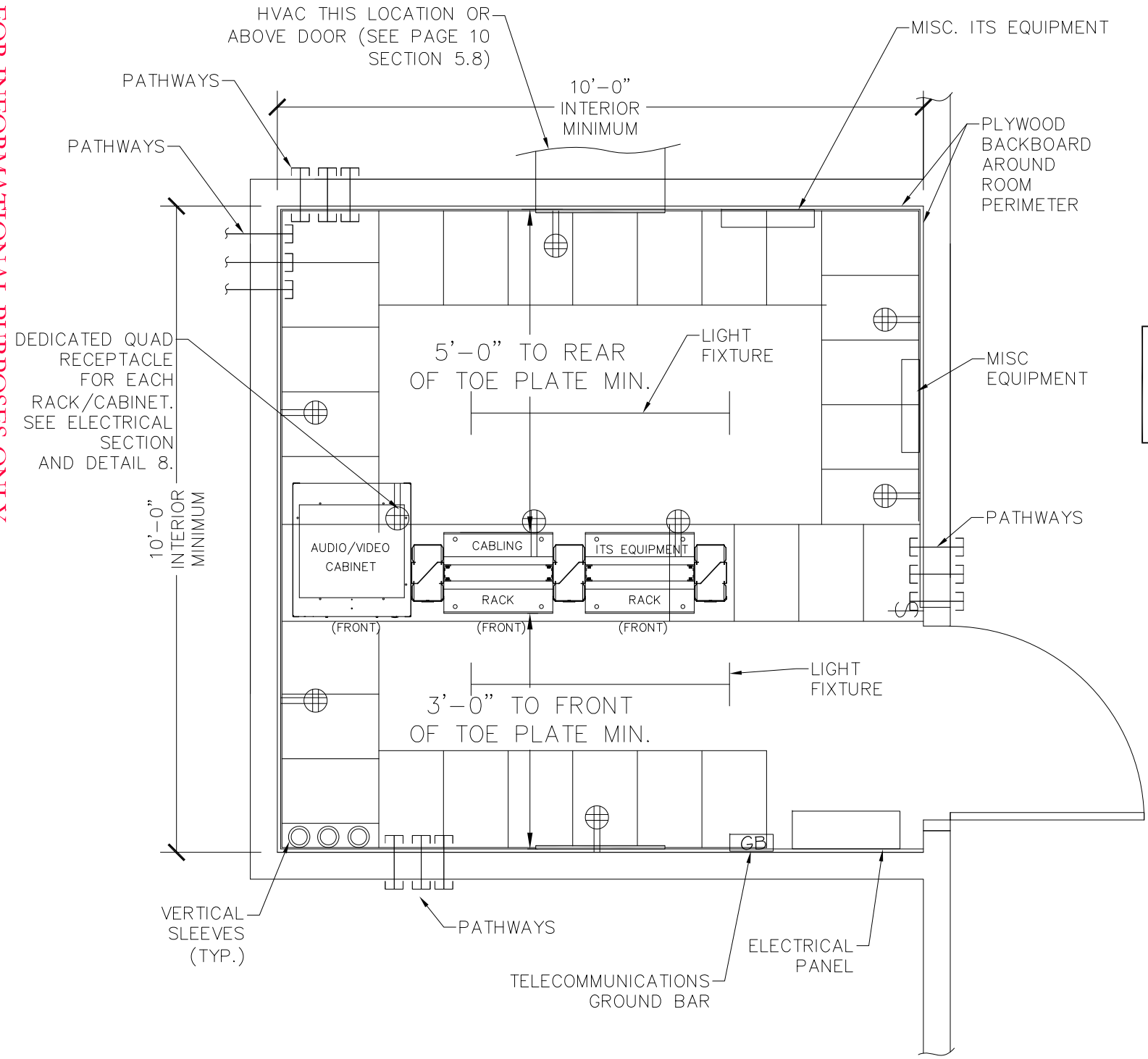
1. CONDUITS SHALL ENTER AND EXIT AT THE ENDS OF THE PULLBOX. NO SIDE ENTRY IS PERMITTED.
2. PULLBOX SHALL NOT BE UTILIZED AS A SUBSTITUTE FOR BENDS.
3. ALL PVC CONDUITS SHALL BE SCHEDULE 40 OR SCHEDULE 80 AS DIRECTED BY ETSU STANDARD FOR EACH APPLICATION TYPE (GRASSY AREAS, SIDEWALKS, ETC.).



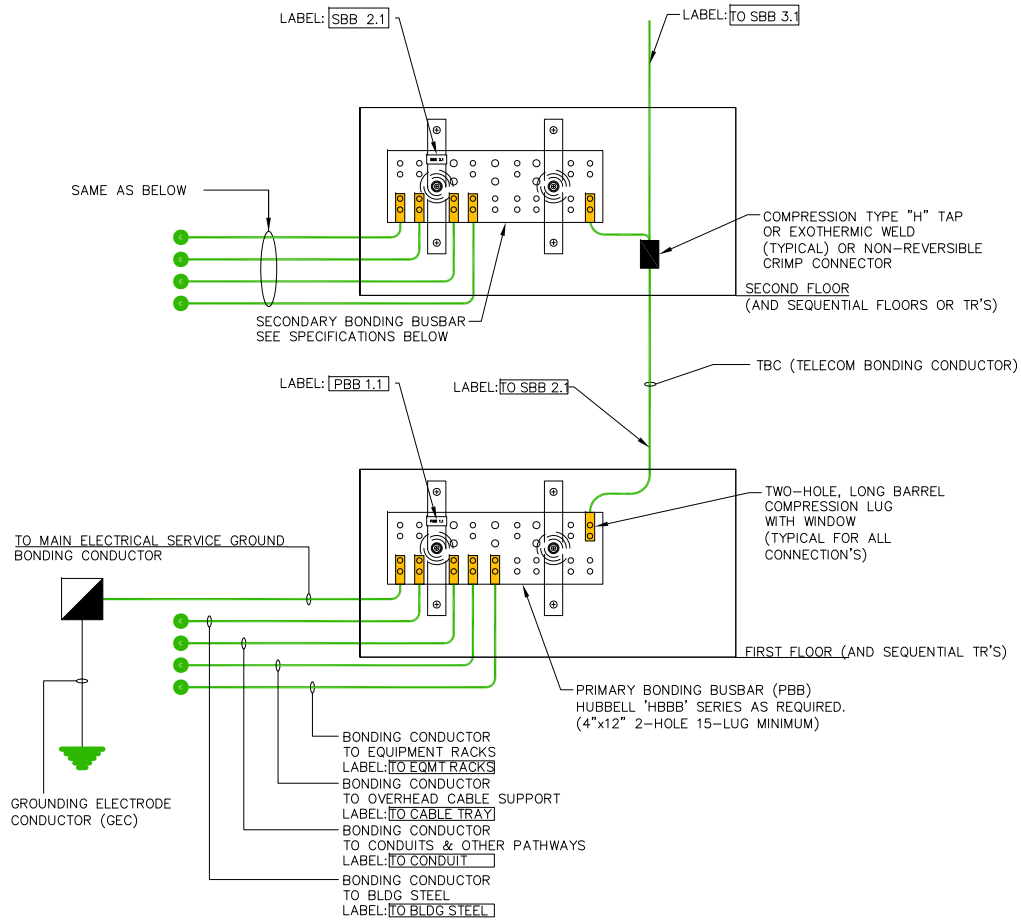
COMMUNICATIONS MAINTENANCE HOLE/PULLBOX
NOT TO SCALE



FOR INFORMATIONAL PURPOSES ONLY

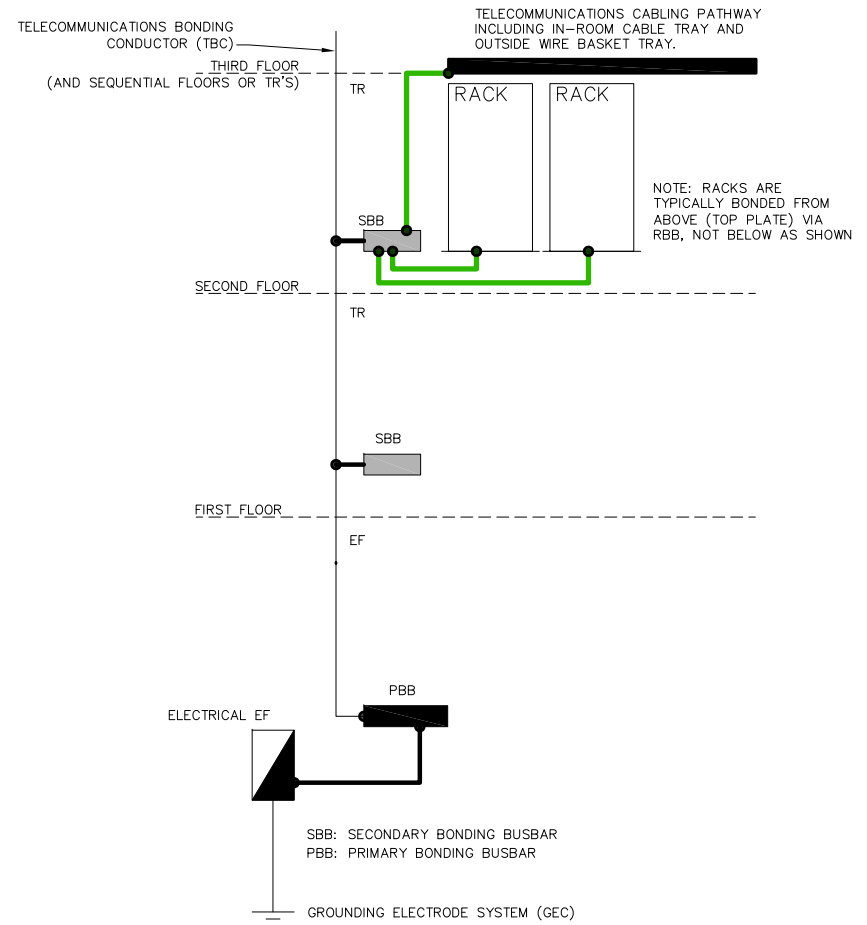


NOTE: SEE 'TELECOMMUNICATIONS ROOMS' SECTION OF THIS DOCUMENT FOR MINIMUM SIZES AND STANDARDS.

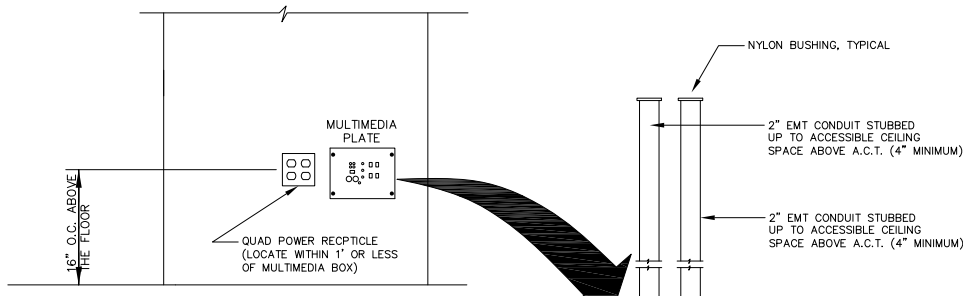


* ALL BONDING CONDUCTORS ARE GREEN-JACKETED #6 AWG COPPER. TWO-HOLE CONNECTIONS/LUGS ARE REQUIRED. ALL LABELS SHALL BE APPLIED WITHIN 2" OF LUG.

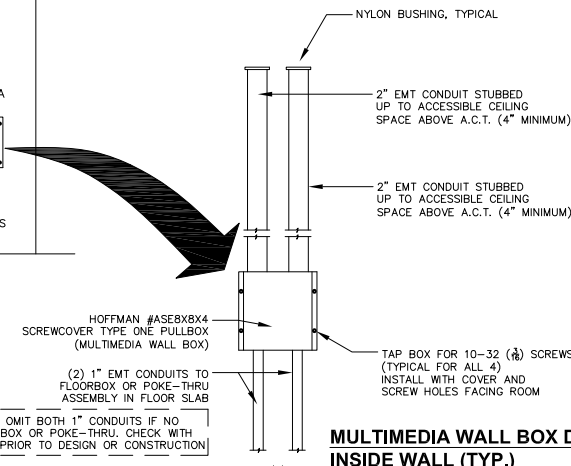
INTRA-BUILDING BONDING/GROUNDING RISER DETAIL
NOT TO SCALE



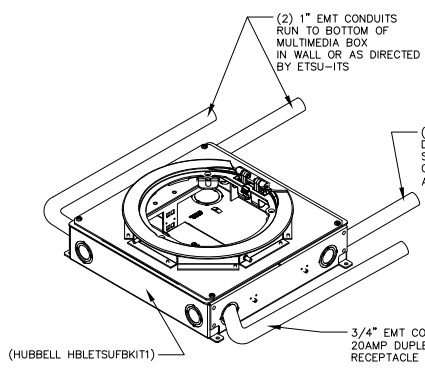
TELECOMMUNICATIONS GROUND AND BONDING RISER DIAGRAM
NOT TO SCALE



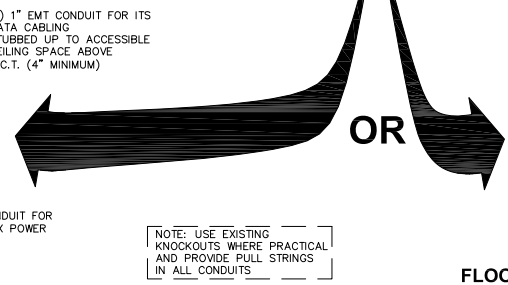
MULTIMEDIA WALL CHASE (TYP.) NTS



MULTIMEDIA WALL BOX DETAIL INSIDE WALL (TYP.)



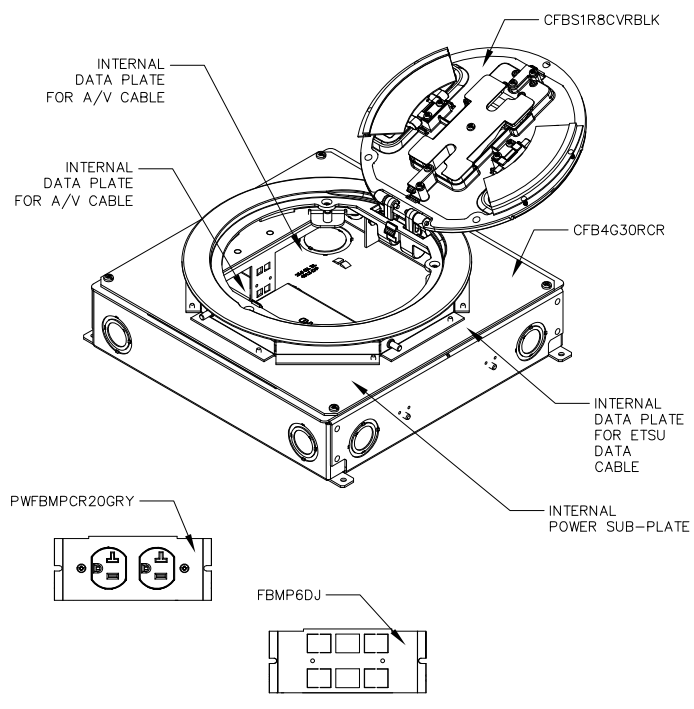
RECESSED FLOOR BOX DETAIL (HUBBELL # HBLETSUFBKIT1)



FLOOR POKE-THRU ASSEMBLY DETAIL (HUBBELL # HBLETSUPTKIT1)

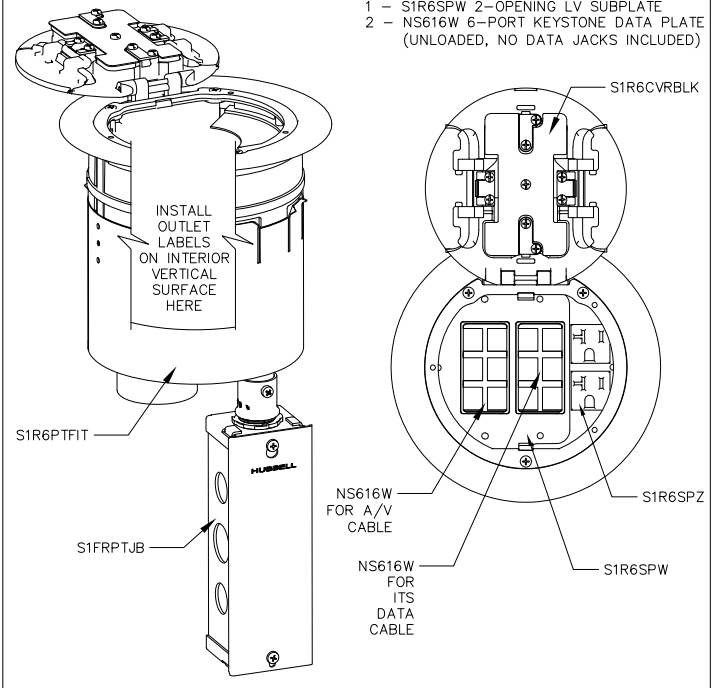
RECESSED FLOOR BOX KIT (HUBBELL # HBLETSUFBKIT1)

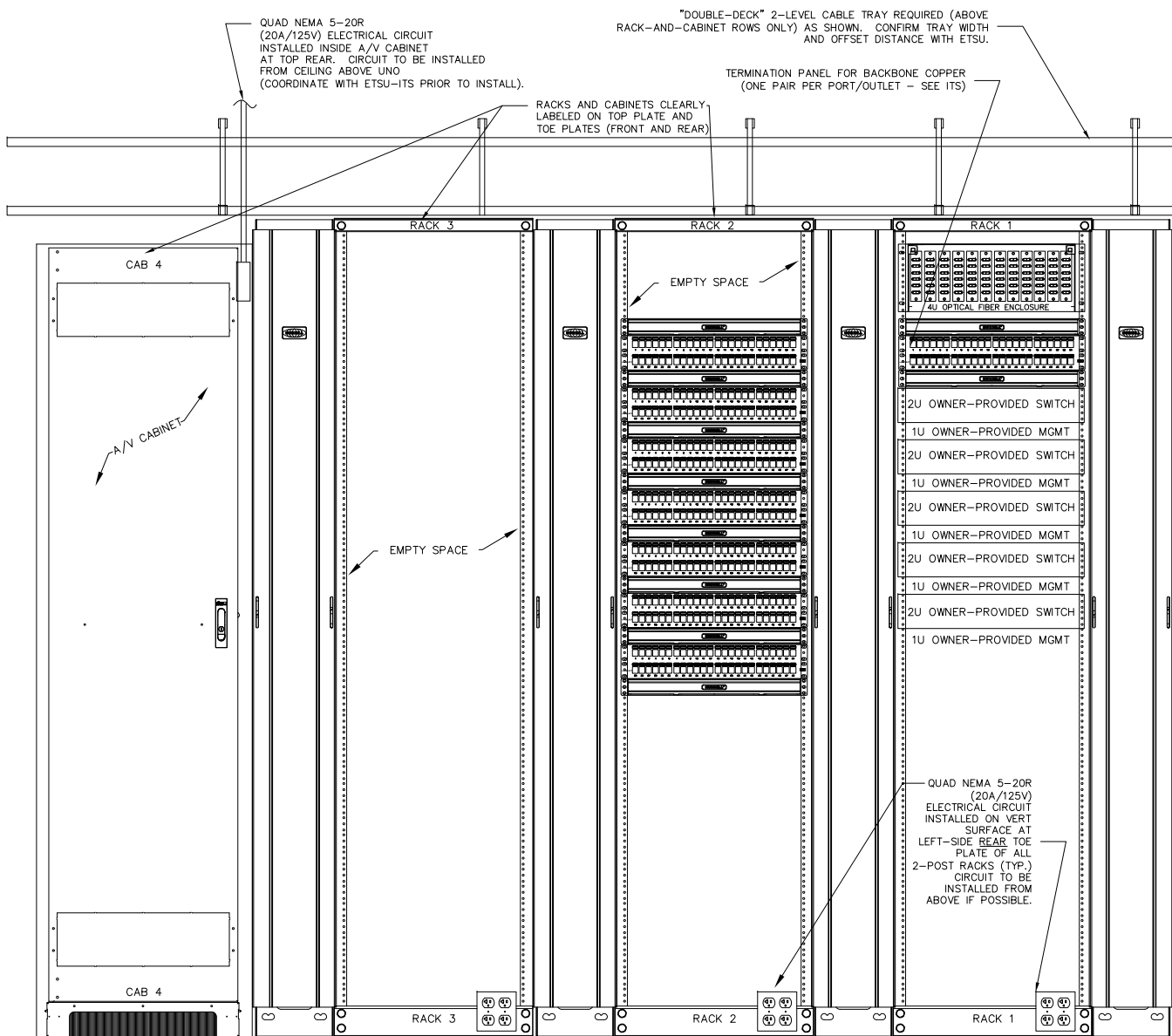
- NOTE: HBLETSUFBKIT1 COMES COMPLETE WITH THE FOLLOWING COMPONENTS INCLUDED:
- 1 - CFB4G30RCR SYSONE 12x12 FLOORBOX
 - 1 - CFBS1R8CVRBLK BLACK COVER
 - 1 - PWFBMPCR20GRY DUPLEX PWR SUB-PLATE
 - 3 - FBMP6DJ 6-PORT DATA JACK PLATE (UNLOADED, NO DATA JACKS INCLUDED)



6" FLOOR POKE-THRU KIT (HUBBELL # HBLETSUPTKIT1)

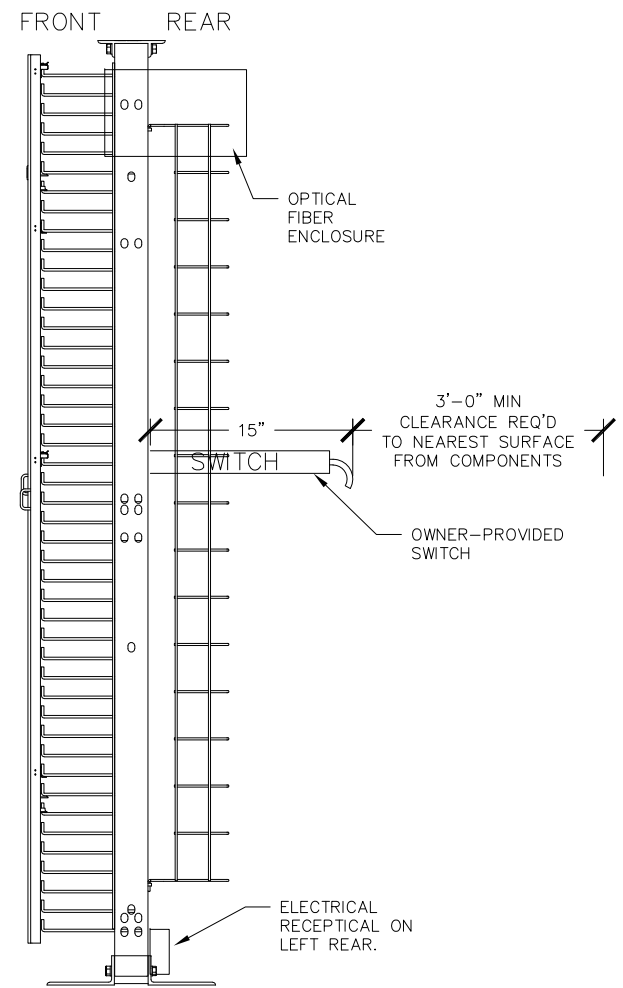
- NOTE: HBLETSUPTKIT1 COMES COMPLETE WITH THE FOLLOWING COMPONENTS INCLUDED:
- 1 - S1R6PTFIT 6" POKETHRU
 - 1 - S1FRPTJB ELECTRIC JBOX
 - 1 - S1R6CVRBLK BLACK COVER
 - 1 - S1R6SPZ DUPLEX POWER RECEPTACLE
 - 1 - S1R6SPW 2-OPENING LV SUBPLATE
 - 2 - NS616W 6-PORT KEYSTONE DATA PLATE (UNLOADED, NO DATA JACKS INCLUDED)





NOTE: THIS IS A REPRESENTATION OF A 'TYPICAL' ITS RACK LAYOUT. COORDINATE DESIGN VARIANCES WITH ETSU FOR EACH INDIVIDUAL PROJECT AND COMM ROOM.

ALL RACKS AND CABINETS MUST BE INSTALLED WITH MINIMUM 3' OPEN CLEARANCE FROM FRONT AND REAR OF DEEPEST COMPONENT.



A/V CABINET FRONT ELEVATION
NOT TO SCALE

SPARE (OPEN) CABLE RACK FRONT ELEVATION (TYP.)
NOT TO SCALE

HORIZONTAL CABLE RACK FRONT ELEVATION (TYP.)
NOT TO SCALE

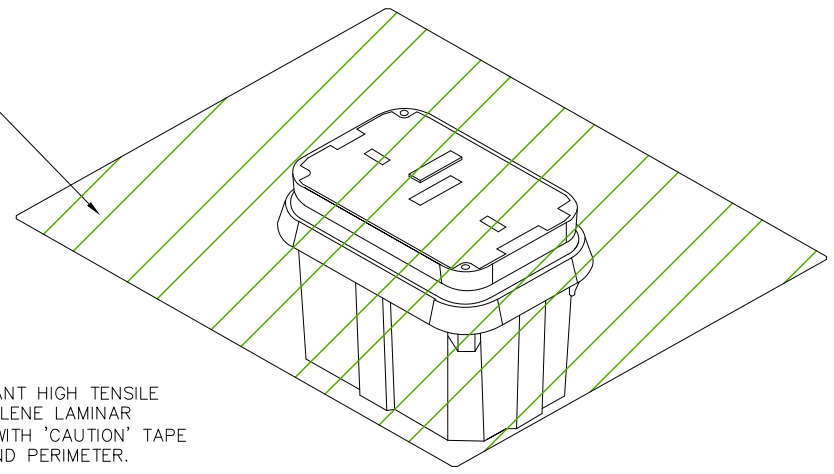
BACKBONE CABLING RACK FRONT ELEVATION (TYP.)
SCALE

ITS EQUIPMENT RACK SIDE ELEVATION (TYP.)
SCALE: AS SHOWN

FOR INFORMATIONAL PURPOSES ONLY

NOTE: SEE REQUIREMENTS FOR EXISTING OSP BOX PROTECTION IN SECTION 6.10 OF THIS DOCUMENT. ALL EXISTING BOXES AND ENCLOSURES WITHIN OR ADJACENT TO AN AREA OF CONSTRUCTION MUST BE PROTECTED. NO EXCEPTIONS.

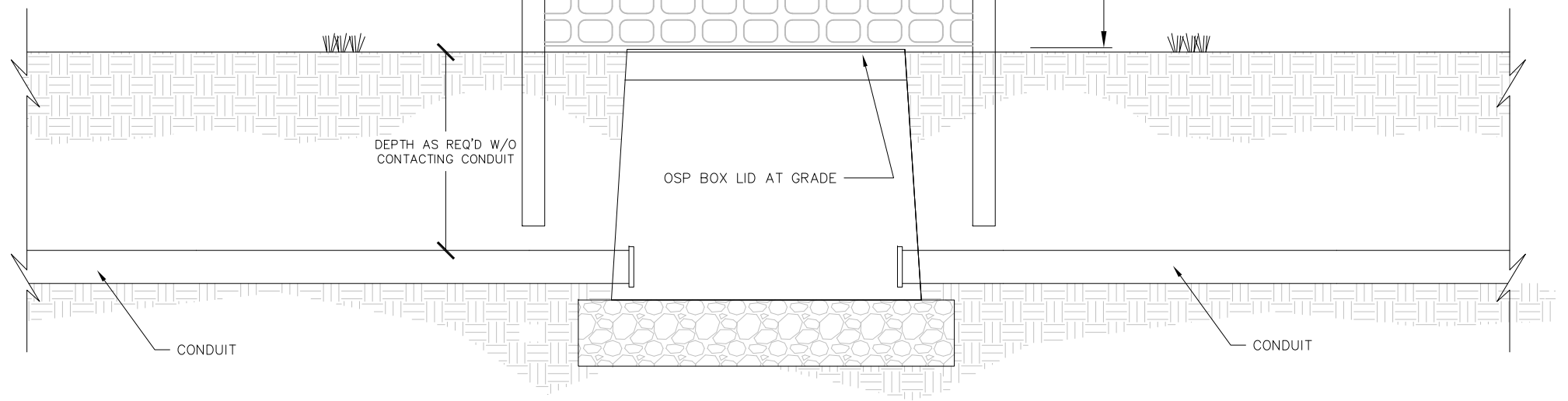
STEEL ROAD PLATE
(COVERAGE TO EXTEND WELL BEYOND LID DIMENSION)

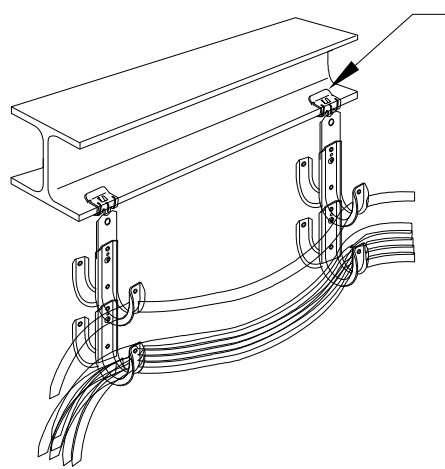


STEEL POST (TYP)

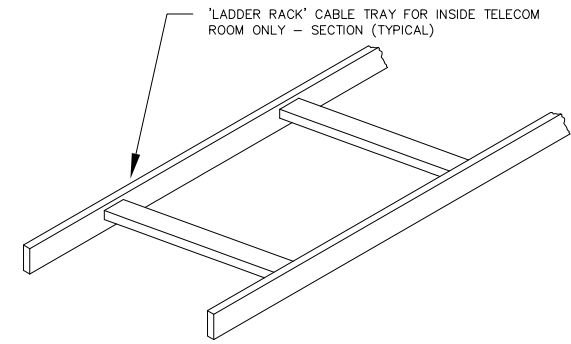
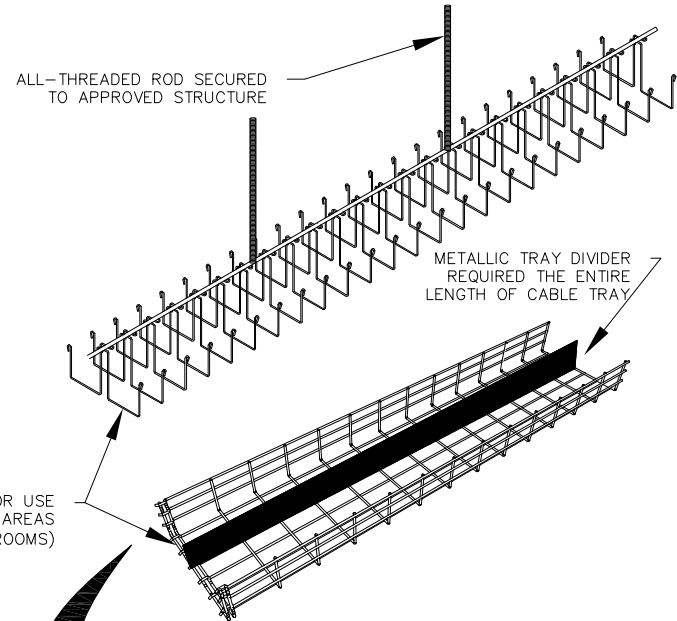
FENCE MATERIAL:
ORANGE, UV RESISTANT HIGH TENSILE STRENGTH POLYETHYLENE LAMINAR BARRICADE FABRIC WITH 'CAUTION' TAPE AT TOP EDGE AROUND PERIMETER.

4'-0" MIN

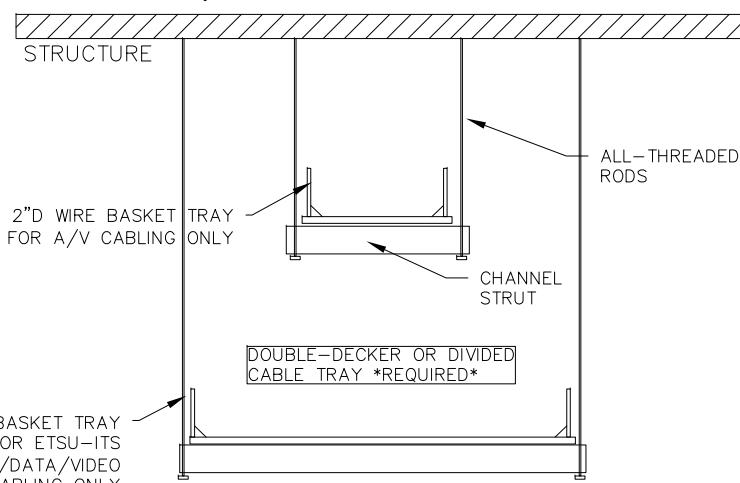
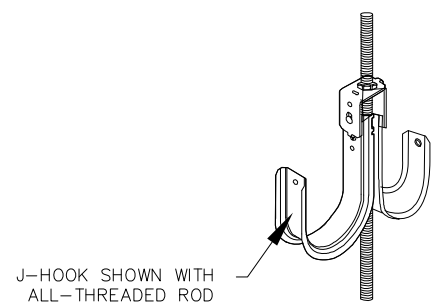
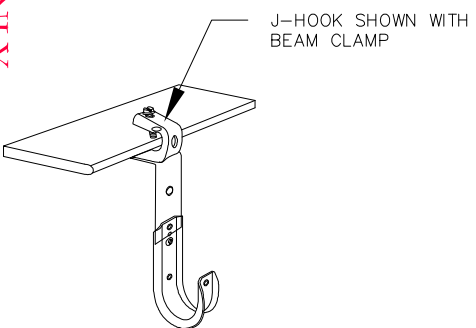




WIRE BASKET CABLE TRAY FOR USE IN HALLWAYS AND COMMON AREAS (NOT IN TELECOM ROOMS)

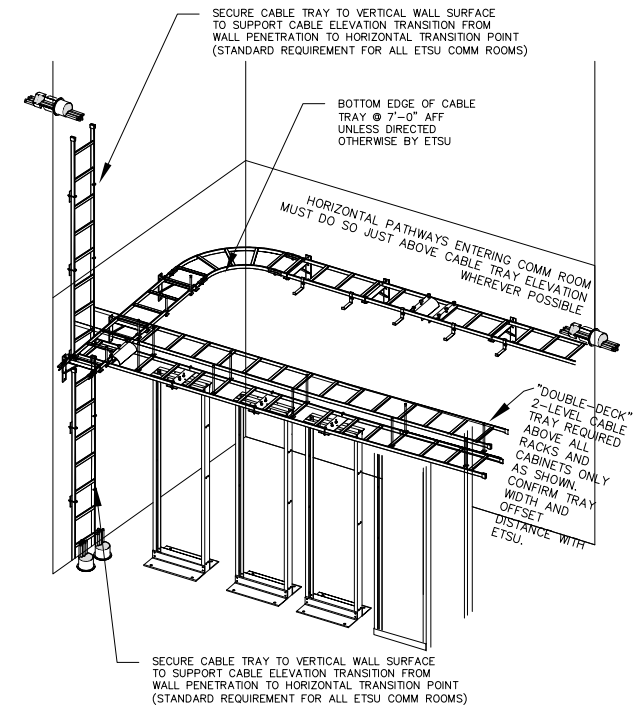


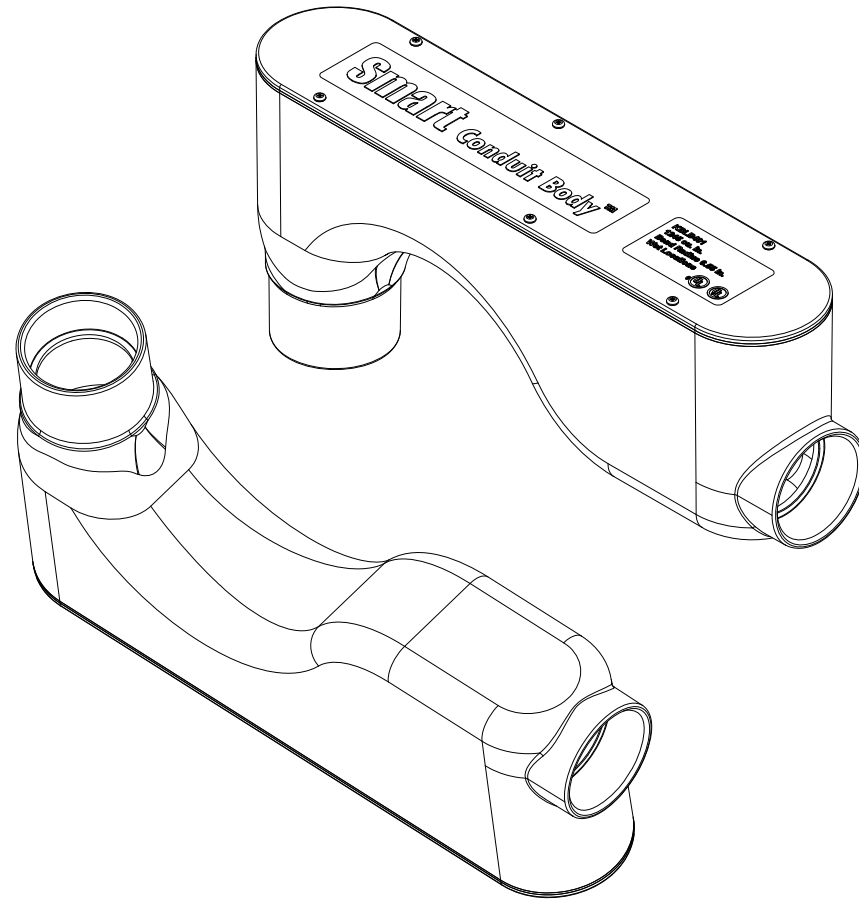
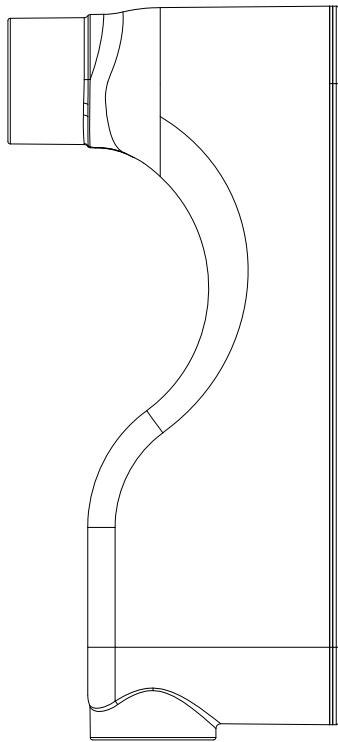
NOTE: DESIGN AND INSTALL CABLE TRAY SECTIONS AND SUPPORTS PER MANUFACTURER RECOMMENDATIONS. SEE BICSI TDMM FOR MORE INFORMATION. PROTECTIVE ENDCAPS ARE REQUIRED ON ALL EXPOSED ENDS.



TYPICAL HALLWAY CABLE TRAY SECTION (DATA & A/V)

NOT TO SCALE





* "SMART CONDUIT BODY" OR APPROVED EQUAL
(MADISON ELECTRIC PRODUCTS INC. -MEPRODUCTS.NET)

