



Anytown Central School District

Telecom Room Master Plan

- About Telecom Rooms (TRs)
- Design Specifications and Construction Management Guidance
- Product and Documentation Standards
- Installation Detail Drawings
- Design and Construction Checklists

September 13, 2023

*Prepared for Anytown Central School District staff, and
its Architects, Electrical Engineers, and other contractors*

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About this TR Master Plan

Purpose

To ensure all the district’s Telecommunications Rooms (TRs)—the spaces that securely house IT telecommunications and other systems’ equipment—are designed and constructed to the same industry best practices, system technology, and manufacturer-specific standards.

TRs are located and designed in accordance with the Serving Zone (SZ) drawings that have been developed for the District and delivered under separate cover as one of the Technology Planning deliverables.

Serving Zones are determined by:

- Building architecture
- Existing labeling
- Cable IDs

Serving Zones are designed to keep cabling within 300’ of the TR for optimal performance. These provided SZ drawings will assist with the planning of future cabling projects.

Audiences

These Design Standards shall be used by the following involved parties in the design, procurement, or installation of Telecommunications Rooms and other IT-equipment spaces:

- Architectural/Engineering firms
- Design professionals
- System integrators/vendors
- District IT professionals to assist in troubleshooting and locating the origination and destination of cabling.
- Tradespeople

Additional References

This TR Master Plan was developed in conjunction with the following Planning Project deliverables that may be referenced in this document:

- Comprehensive Technology Report and Plan
- 10-Year Comprehensive Technology Roadmap
- Serving Zone Drawings

Applicable Industry Codes and Standards

The following codes and standards apply to the scope of this document.

1. ANSI/TIA-EIA-568-C, Commercial Building Telecommunications Wiring Standard
 - a. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises, published 2009
 - b. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard, published 2009
 - c. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard, published 2009
 - d. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard , published 2008, errata issued in October, 2008
2. ANSI/TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces.
3. ANSI/TIA-606-A Administration Standard for Commercial Telecommunications Infrastructure
4. ANSI-J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
5. ANSI/TIA-758-A, Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
6. BICSI: Comply with the most current editions of the following BICSI manuals:
 - a. BICSI - Telecommunications Distribution Methods Manual
 - b. BICSI – Installation Transport Systems Information Manual
 - c. BICSI – Network Design Reference Design Manual
 - d. BICSI – Outside Plant Design Reference Manual
 - e. BICSI – Wireless Design Reference Manual
 - f. BICSI -Electronic Safety and Security Design Reference Manual
 - g. Infocomm/BICSI – AV Design Reference Manual
7. New York State Uniform Fire Prevention and Building Code
8. New York State Department of Labor Rules and Regulations
9. New York State Department of Health
10. Federal Occupational Safety and Health Administration (OSHA)
11. National Life Safety Code, NFPA 101
12. National Electrical Code, NFPA 70
13. Underwriters Laboratory (UL)
14. IEEE Standards
15. Federal Communications Commission
16. National Electrical Manufacturers’ Association (NEMA)
17. Americans with Disabilities Act (ADA)

Introduction to Telecommunications Rooms (TRs)

Overview

Telecommunications Rooms (TRs) contain Network, Voice, Access Control, Intrusion Detection, Video Surveillance and Public Address (PA) equipment and cabling. There are several types of these rooms which are described below along with their functions and requirements. The terms and definitions are specific to the District’s IT Department. They also hold sensitive data on servers such as student data and surveillance video.

Telecommunications Room (TR)

These are rooms that contain equipment and cabling for systems such as Network, Voice, Public Address (PA), Access Control, Intrusion Detection, Video Surveillance, Life Safety, and CATV cabling and equipment. Each TR provides a connection point between the work area outlets and edge devices of each system and the network in a predetermined serving zone.

Each building must have at at least one TR but most buildings have several. The number of TRs a building has depends on the several factors such as:

- Distance limitations of the Horizontal cabling
- Connected Device counts
- Building Construction

Because of their function TRs are specialized rooms that have unique requirements that need to be considered during the Design phase such as;

- Security
- Environmental control
- Power/ Emergency Power
- Telecommunications Grounding Backbone

These and other TR requirement categories are discussed in greater detail in the *TR Design Specifications and Guidance* section of this document.

TRs are grouped into two primary categories:

- Main Telecommunications Rooms (MTR) and;
- Intermediate Telecommunications Rooms (ITRs).

An MTR connects all ITRs via intra-building backbone cabling and pathways. The MTR is also the location where the building Network equipment connects to the Inter-building Outside Plant Cabling (OSP) cabling of the District’s CORE Networks.

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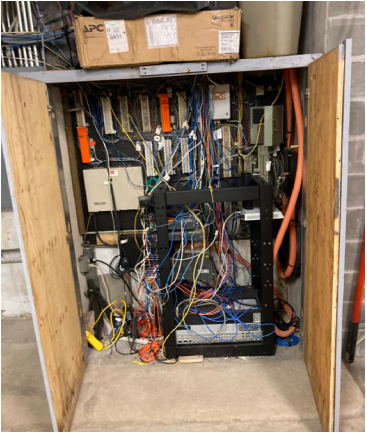
Introduction to TRs (cont.)

Building Entrance Facilities (BEF)

Building Entrance Facilities (BEF) are communications spaces that provide a Transition Point between the Outside Plant (OSP) cabling and the Inside Plant cabling.

BEFs can be located within a TR but, due to code considerations with respect to OSP cabling, these are often separate spaces near the point where the OSP cabling enters the building.

Building Entrance Facilities also provide a Demarc location between Outside Service Providers where the district can connect to the Services.



A Building Entrance Facility that does not meet design and construction requirements.

Server Rooms (SR)

Server Rooms (SR) are climate controlled spaces dedicated to the continuous operation of data servers.

These spaces shall have minimum of 36"-wide doors to allow for the installation and removal of large equipment.

Location

- The room shall not be located on the top floor or in basements.
- To maximize security, the room shall not be located in spaces that have exterior walls with windows.
- The room shall be accessible from a corridor without having to use stairs of any type. Generally first levels are preferred locations.
- Ideally (but not a requirement), the room:
 - Should be located in a centralized location within the building.
 - Will not also function as distribution for horizontal cabling.

As its name implies, a Server Room is a space dedicated to the proper operation of a district's servers. Environmental controls and security protocols are especially important for these spaces.

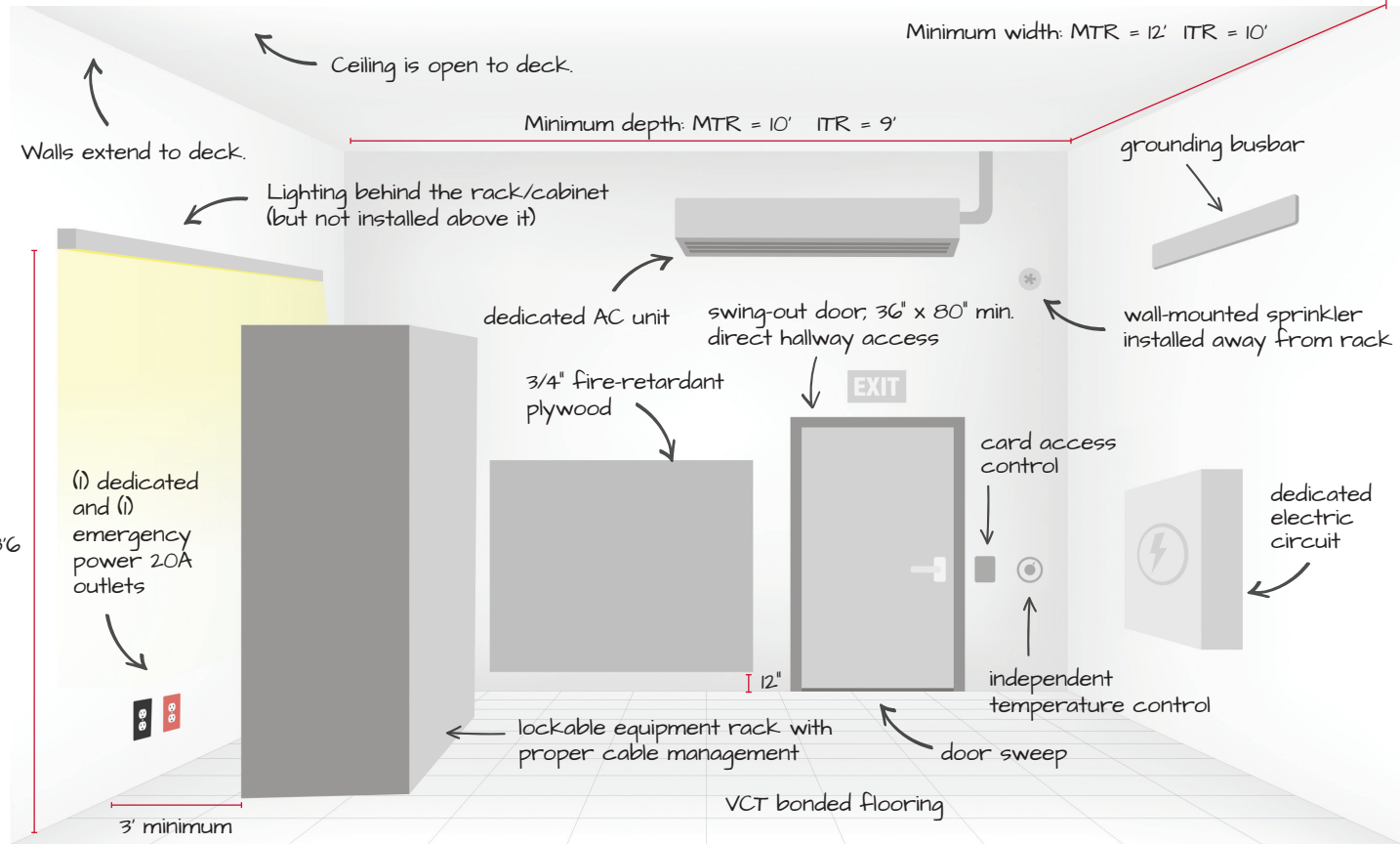


Major Design Considerations for standards-compliant Telecom Rooms

TR Design Factors

- The following factors should be taken into consideration when designing a standards-compliant Telecom Room.
1. **Room size.** Size with 3' clear space front and back.
 2. **Water threats.** No risks of water damage.
 3. **Location/access.** Central location in the Serving Zone with direct hallway access.
 4. **Security.** Secure/dedicated space or locked cabinet.
 5. **Environment.** Environmental controls.
 6. **Electrical power.** Dedicated, redundant power.
 7. **Emergency power.** Uninterruptible Power Source (UPS)/Emergency Management (EM) power.
 8. **Grounding.** Grounding infrastructure.
 9. **Overhead cable management.** Overhead cable management.
 10. **Rack cable management and termination** and management at the rack.
 11. **Room construction** with walls extended to deck, fire-retardant plywood mounted on at least one wall, and compliant, sealed cable penetrations.
 12. **Floor.** Vinyl-Coated Tile (VCT) flooring.
 13. **Ceiling.** Open to deck with minimum height of 10'.

The design of a standards-compliant TR space includes all the items shown below. Note that Overhead Cable Management and Rack Cable Management and Termination are not shown.



TR Design Specifications and Construction Management Guidance

1. Spaces

1. Room Sizing and Layout



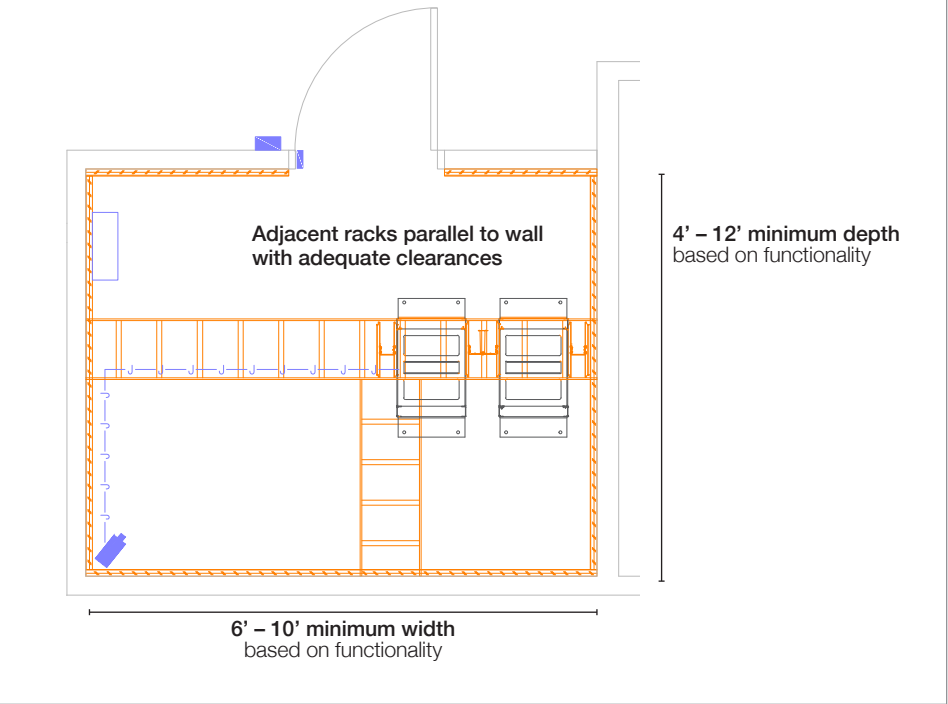
These TR racks lack adequate rear clearances; the one above also lacks sufficient lighting.



Design Specifications

- 1. Minimum sizes
 - Entrance Facility: 6’w x 4’d
 - Main Telecommunications Room (MTR): 10’w x 12’d
 - Intermediate Telecommunications Room (ITR): 9’w x 10’d
- 2. The communications rack(s) shall be installed adjacent to each other and parallel to the wall with the greatest length.
- 3. A clearance of 6” should be maintained from the first rack to the wall, and a minimum of 3’ should be left at the anticipated end of the row of equipment racks. A 3’ minimum clearance at the front and back of the equipment racks will allow space for wall-mounted equipment and cable terminations.
- 4. In larger buildings requiring additional rows of equipment racks, the racks shall be lined up in rows with 5’ separation row-to-row, and 3’ row-to-wall. The number of equipment racks required will determine the dimension.
- 5. Mechanical, electric and plumbing that does not serve the CER/TR shall not be in or pass through the CER/TR, either vertically or horizontally.

Partial TR Room Sizing and Layout Design Specs



◀ This undersized TR houses non-IT items that inhibit front and rear rack access.

TR Design Specifications and Construction Management Guidance/1. Spaces (cont.)

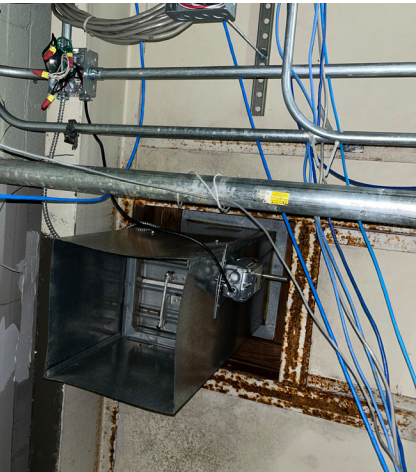
2. Water Threats

Design Specifications

- 1. Water lines to HVAC and/or heating/cooling equipment must not route over technology equipment.
- 2. Roof penetrations including those related to cooling equipment must not be above or near the equipment rack.
- 3. The space shall be free of water or drain pipes not directly required in support of the equipment within the room.
- 4. Sprinkler pipes and heads must be 18” away from equipment racks. (Side-wall mounted sprinklers are preferred.)
- 5. A dry chemical system is preferred but may be cost prohibitive.



This TR is shared with a custodial closet with a utility sink that should not be in the space.



Roof penetrations in TRs are another potential source of water damage. The rust on the frame of this rooftop vent is possible evidence of water leaks.



Pressurized water and glycol pipes are installed directly above and/or in close proximity to the IT equipment racks.

TR Design Specifications and Construction Management Guidance/1. Spaces (cont.)

3. Location

Design Specifications

- 1. The room shall be centrally located within the Serving Zone.
- 2. The room shall be located in an accessible area on each floor. Access to the TR should be directly from hallways or service corridors; not through classrooms, offices, or spaces not accessible by maintenance level keys.
- 3. TR shall be vertically stacked between floors where possible. When stacking TRs, make sure that the doors are also aligned to prevent conflicts with the riser pathways and cabling between floors.
- 4. The space shall not **shall not** be located:
 - a. In any place that may be subject to water, steam, humidity, heat, and any other corrosive atmospheric or environmental substance.
 - b. Near electrical power supply transformers, elevator or pump motors, generators, radio transmitters, induction heating devices, and any other potential sources of electromagnetic interference (EMI).
 - c. Near sources of mechanical vibration that could be conveyed to the room through the building structure such as air handlers and exhaust fans.
 - d. In a shared space or near electrical closets, boiler rooms, washrooms, janitorial closets and storage rooms.

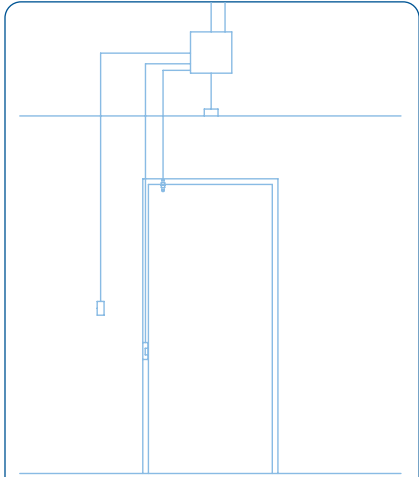
TRs shall be centrally located in their respective Serving Zone. Typically, each SZ has its own TR.



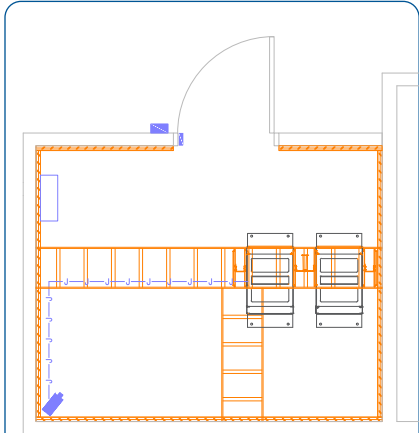
4. Security

Design Specifications

- 1. TR doors shall be equipped with Card Access with access limited to authorize District staff and contractors.
- 2. TRs doors shall have video surveillance coverage.
- 3. The room shall **not** be located in spaces that have exterior walls with windows.
- 4. The room shall be dedicated to IT equipment and materials. Non-IT items cannot be stored in the same space unless the IT equipment is housed in a lockable protected cabinet or a secure subdivided space is built.



See the related TR Access Control Pathway Detail Drawing on pg. 28.



See the related TR Video Surveillance Installation Drawing on pg. 29.



An IT equipment rack is installed in a space shared with a carpeted student resource room.



This TR exterior door lacks both a door knob and a locking mechanism.



A ceiling-mounted surveillance camera can provide good security coverage of the front of the equipment rack in the space that is installed near the opposite wall.

TR Design Specifications and Construction Management Guidance/1. Spaces (cont.)

5. Environmental Controls

Design Specifications

- 1. Environmental controls must be dedicated to the room.
- 2. The recommended operating temperature should be set between 60°F to 80°F.
- 3. The recommended humidity level should fall between 30% and 65%. Humidity should be a concern if it is anticipated that normal level within the TR would fall outside these parameters.
- 4. Heating, ventilation, and air-conditioning sensors related to the environment within the TR must be located in the TR. Alarms should be sent to facilities and IT departments via text or email.
- 5. Cooling equipment should be on emergency power, if available.
- 6. Cooling equipment must not be mounted over technology equipment within the room. FCUs or similar should be mounted outside the room and ducted in.



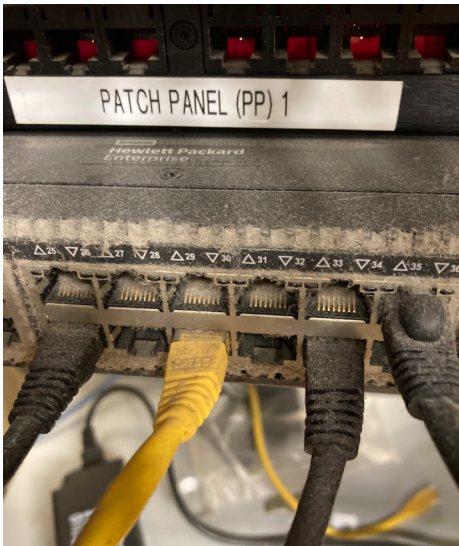
TRs require a dedicated Air Conditioning unit with independent controls. The split unit shown here works well for the space.



A standards-compliant, wall-mounted independent AC control unit in a TR.



HVAC equipment must not be installed directly over a rack as it presents a water threat to the IT equipment.



Dust and dirt are other environmental factors that can negatively affect equipment performance. These network switches and air vents are clogged with dust.



A pedestal fan is not a standards-compliant environmental control.

6. Dedicated Power

Design Specifications

- 1. Dedicated Electric Panel (generator power if available) shall be installed in the TR that only serves technology devices within the room. These power circuits shall be sourced from two different electrical risers and one shall be sourced from emergency power, if available.
- 2. Each equipment rack shall have two dedicated 20A circuits, one normal and one emergency power. Larger circuits may be required for specialized equipment.
- 3. (2) convenience outlets, each in a different location, at minimum, in the room should not be connected to the in-room panel.
- 4. Check with the District's IT Department for additional UPS power requirements.



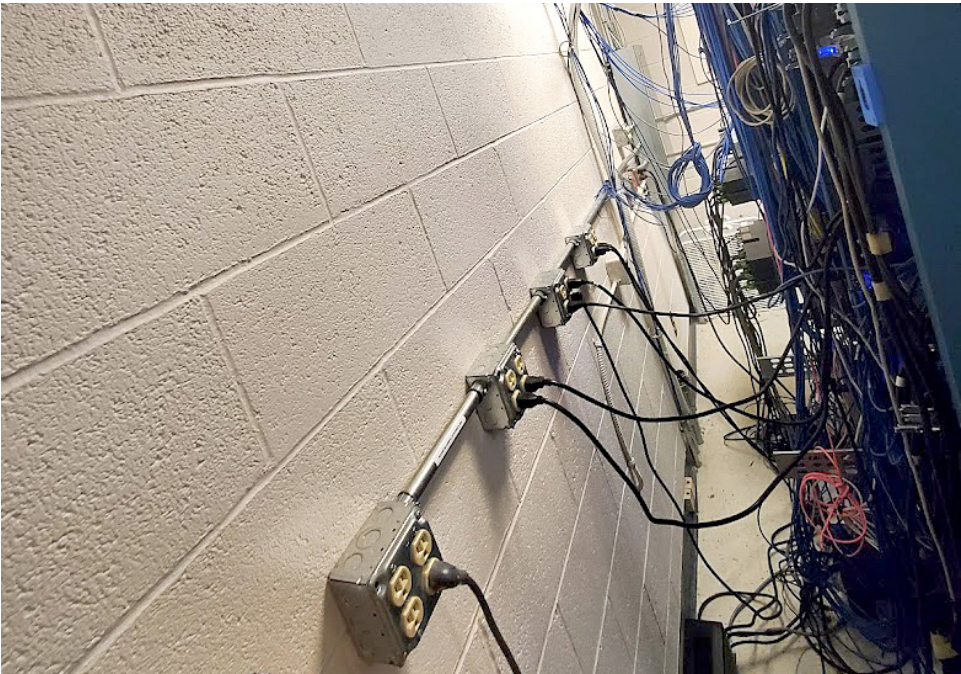
A dedicated electrical circuit with (2) 20A outlets (left) and an emergency generator outlet with proper labeling.



This outlet is not dedicated and lacks both emergency power and proper labeling.



While a TR emergency power outlet is present and in use, it is not properly labeled.



These power cords risk being unplugged when technicians are working behind the racks. Dedicated electrical power outlets should be located at the equipment racks and at least two convenience outlets, each in a different location, should also be available in a TR.

TR Design Specifications and Construction Management Guidance/1. Spaces (cont.)

7. Emergency Power

Design Specifications

- 1. Each equipment rack shall have two dedicated 20A circuits, one normal and one emergency power.
- 2. All emergency power outlets shall be properly labeled and identified as being connected to the building's generator.
- 3. All equipment in the rack shall be properly connected to a rack-mounted Uninterruptible Power Supply (UPS) with specifications based on battery calculations for all installed equipment with expansion capacity.



A dedicated electrical circuit with (2) 20A outlets (left) and a higher amperage twist-lock usually used for powering UPSs.



These two standards-compliant rack-mounted UPS units display adequate battery life and run times.



Electrical outlets should be mounted to all racks.



A dedicated electrical breaker panel should be installed in each TR.



Building generators provide electrical power to connected outlets installed throughout the facility including in all TRs.

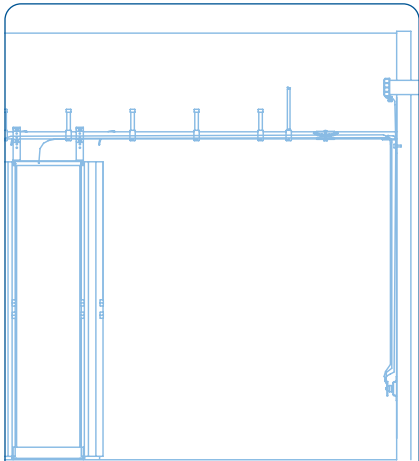


These emergency power outlets are correctly labeled and used in this TR.

8. Grounding & Bonding

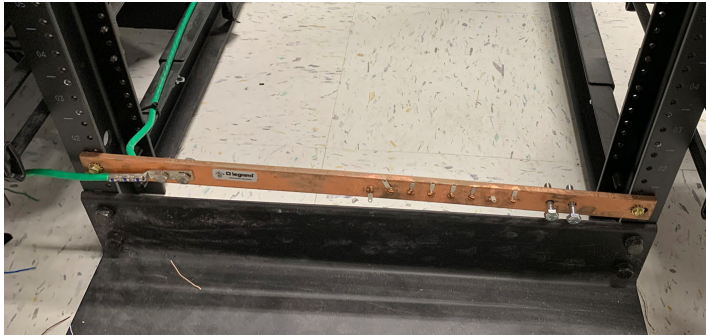
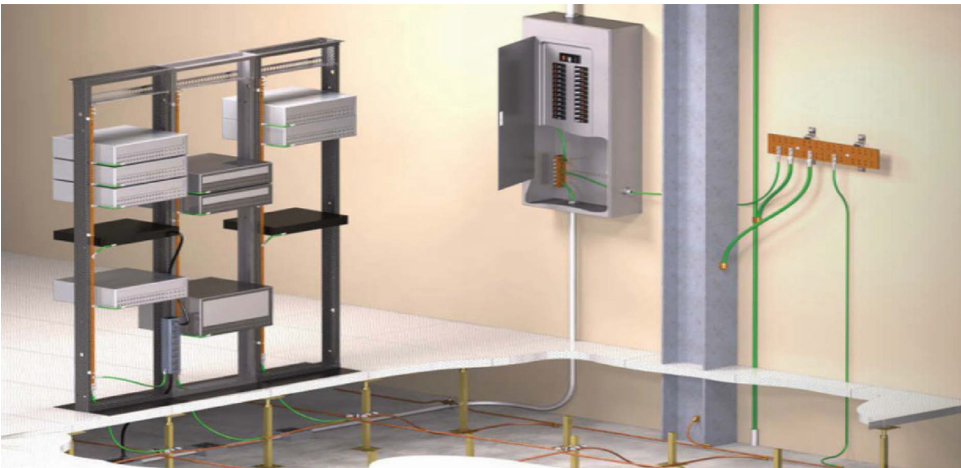
Design Specifications

- 1. Bonding and Grounding shall conform to ANSI/TIA-J-STD-607-B Generic Telecommunications Grounding and Bonding (Earthing) for Customer Premises, NEC Article 250 and hardware manufacturer's grounding requirements.
- 2. The telecommunications grounding main busbar must be connected to the electrical system building ground electrode.
- 3. The IT bonding and grounding system shall be dedicated to the TRs within the building.
- 4. All TRs must be provided with a Telecommunications Grounding Busbar (TGB) that is ANSI approved and UL listed.



See the related TR Grounding Installation Detail Drawing on pg. 26.

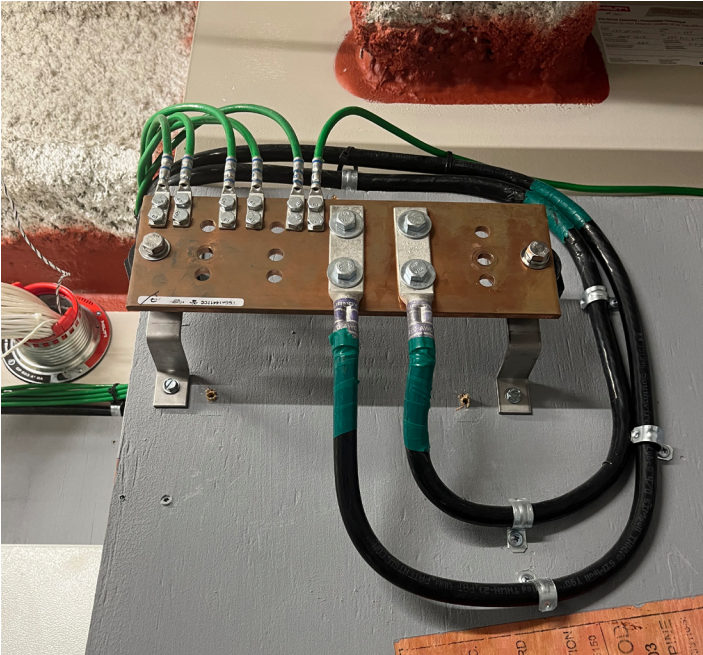
A standards-compliant TR Bonding and Grounding infrastructure. Image©BICSI. All rights acknowledged.



A Telecommunications Grounding Busbar (TGB) installed in an equipment rack as per industry standards.



Due to undersized conductors and single-hole lugs, this Grounding infrastructure does not meet industry standards.



A standards-compliant TR Grounding Busbar.

TR Design Specifications and Construction Management Guidance/1. Spaces (cont.)

9. Room Construction



Walls should extend to the deck which is lacking in this TR.



In this TR, the wall-mount open rack is mounted on properly treated, standards-compliant plywood.

This TR meets all construction criteria including light color (linen) walls, adequate rack clearances, VCT flooring, and rack cable management.

Walls

A. Design Specifications

1. Walls extend to the deck and rated per local code requirements.
2. Interior finishes shall be in a light color (linen) to enhance room lighting.
3. TRs shall be supplied with void-free, 3/4-inch AC-grade plywood 8' in length. Quantity and layout will be based on cable support structure and routing pathways required in the space. The plywood must be securely fastened to the wall-framing members and mounted vertically starting at 12" above the finished floor.
4. The plywood must be securely fastened to the wall-framing members.
5. Plywood shall be fire retardant or painted with fire retardant paint. Plywood will be mounted vertically starting at 6" above the finished floor.

B. Construction Notes

1. Drywall finished and painted. Completion to coincide with the start of low voltage cable installations.
2. Plywood is installed as directed leaving the fire retardant stamps visible and legible.
3. Completion of drywall and plywood to coincide with the start of low voltage cable installations.



9. Room Construction (cont.)

Entrance Doors

Design Specifications

1. The solid door shall be a minimum of 36"w x 80"h. The door shall be fire rated for a minimum of one hour or more as required by local code requirements.
2. There shall be no windows in the door.
3. Out-swinging door preferred (code permitting).
4. Provide double doors for shallow closet TRs.
5. TR doors shall be equipped with Card Access.
6. The exterior of all TRs doors shall have video surveillance coverage.
7. All doors shall have automatic closers and storeroom locks.
8. Door seals and door sweep installed.

Lighting

Design Specifications

1. Lights and convenience outlets (two locations at minimum) in the room should not be connected to the in-room panel.
2. Provide a minimum of 50 fc. candles measured 3' above the finished floor.
3. Suspended light fixtures should be mounted at 8'6" above the finished floor.
4. Position the light fixture(s) above an aisle area, front and back only, and not directly over equipment racks or cabinets.
5. Wall-mounted fixtures are permissible if lighting standards are met. Wall mounts should be placed in such a manner that they will not interfere with infrastructure pathways, protective equipment, and cables.
6. Emergency lighting should ensure that the loss of power to normal lights will not hamper emergency exits from the telecommunication spaces.



An example of non-compliant rack illumination.



Entrance doors should swing out and have both card access and video surveillance.



This TR has proper illumination as well as standards-compliant cable management, both overhead and at the racks.

TR Design Specifications and Construction Management Guidance/1. Spaces (cont.)

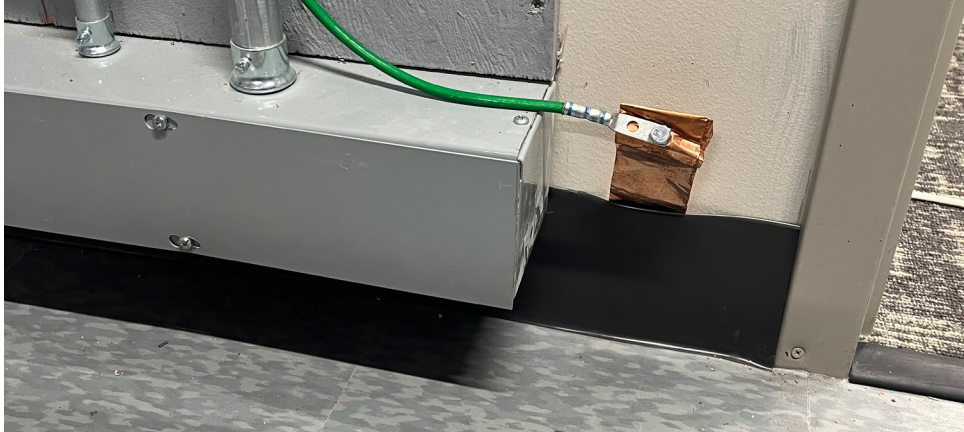
10. Floors

Design Specifications

- 1. Floors must be anti static Vinyl Composition Tile (VCT) that has been bonded to minimize dust and static electricity that can damage electronics located in the room.
- 2. Floor loading capacity in the TR shall be designed for a minimum distributed load rating of 50 lbf/ft².
- 3. Anti-static/grounded VCT to be installed early in the project schedule. Completion to coincide with the start of low-voltage cable installations. (Cable installations should coincide with drywall finishing and complete prior to ceiling grid).



Carpeting is not a standards-compliant flooring type due to risk of ESD.



Vinyl Coated Tile (VCT) bonded to the floor with copper strips to minimize the risk of Electro-Static Discharge (ESD) that can damage IT equipment.

13. Ceiling

Design Specifications

- 1. For maximum flexibility, drop ceilings shall not be installed and shall be open to the deck above.
- 2. If a ceiling is installed minimum height shall be 9'. Ceiling protrusions must be placed to assure a minimum clear height of 8'6 inches to provide space over the equipment facilities for cables and suspended racks.



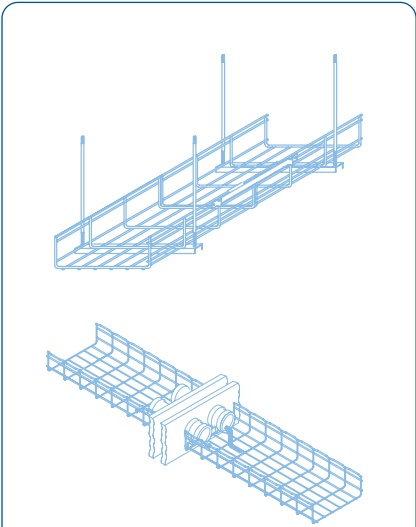
A non-compliant drop ceiling with tile cable cutouts in a TR.



A standards-compliant ceiling open to the deck to improve air circulation.

2. Cable Pathways and Cabling

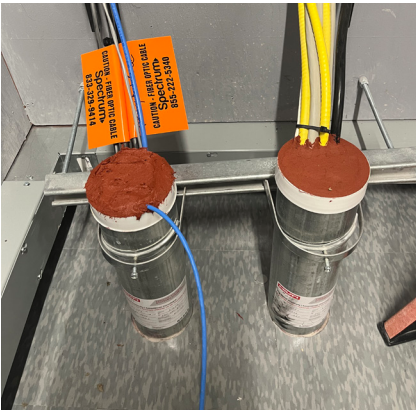
Primary Pathways



See the related Cable Tray Installation Detail Drawing on pg. 25.

Design Guidance and Specifications

- 1. Cables tray installed in corridors.
- 2. Cable trays do not run through walls; instead, they transition through sleeves.
- 3. Cable trays and J-hooks transition to conduit in areas of inaccessible ceilings.
- 4. Pull boxes installed for every 100' of conduit or 180° of bends.
- 5. Grommets sleeves or fire-rated pathway assemblies are installed where cables pass through wall assemblies.
- 6. All primary pathways shall be designed so as not to exceed a maximum fill ratio of 32%.
- 7. The distance from each outlet to the patch panel does not exceed 295'.
- 8. Maintain the following distances from EMI sources:
 - a. Fluorescent Lights: 12"
 - b. Power cables: 6"
 - c. Transformers: 36"
- 9. All metallic pathways are bonded to complete continuity back to the building ground.
- 10. Radius fittings shall be used when changing cable tray direction.
- 11. Dual hanger or trapeze type with 3/8"-minimum threaded rod are the approved mounting methods for cable trays. Center-hung hangers are not permitted.
- 12. Cable trays will be installed in accordance with NFPA 70 article 392.
- 13. Maintain 6" clearance from bottom of cable tray to the top of accessible ceiling tile, and 12" clearance above cable trays to facilitate access to the cable tray for cable installation.
- 14. Provide threaded rod covers to prevent damage to cables during installation.
- 15. All pathways must have a 250-lb. pulling tension pull string/tape installed.



At left: Correctly firestopped conduits between floors.

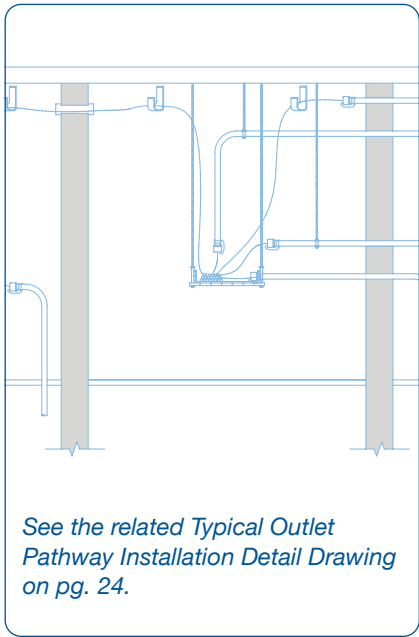
Below: Standards-compliant, fire-rated wall penetration assemblies.



J-hooks can be used for proper support where cables exit the tray and transition to conduit in areas with inaccessible ceilings. J-hooks are used here to support the Cat cables at right.

TR Design Specs and Construction Management Guidance/2. Cable Pathways and Cabling (cont.)

Secondary Pathways



See the related Typical Outlet Pathway Installation Detail Drawing on pg. 24.

Design Guidance and Specifications

- 1. Closed metallic pathways will be used in exposed visible areas of egress.
- 2. All pathways, pull boxes and junction boxes shall have an adequate access space provided to ensure the contractor or installer a safe means of entry.
- 3. J-Hooks
 - a. 4' spacing with hooks staggered 2 - 3" off center.
 - b. J Hooks shall be supported from the building structure utilizing wall adapters, beam clamps and or threaded rods.
 - c. J-Hooks are to be used only where cable counts are fewer than 30. Where cable counts exceed 30 cables, use a cable tray.
- 4. Metallic Surface Raceways
 - a. Raceways shall be installed with entrance end fittings
 - b. When the raceway is divided and shared, separate offset single-gang device brackets shall be used.
 - c. All raceways will be installed using mechanical fasteners. Velcro and adhesive tape are not permitted.
 - d. Radius fittings shall be installed at changes in direction.
- 5. Outlet/device locations
 - a. Whenever possible, outlets shall be flush mounted. In existing buildings when walls cannot be fished,surface outlets will be acceptable.
 - b. Recessed install or exposed in Mechanical Spaces: Use 4" x 4" x 2.5" with single-gang mud ring as applicable.
 - c. Surface Mount: Use 4" x 4" x 2.25"



Closed metallic pathways used in exposed visible areas of egress.



J hooks be spaced 4' apart and staggered 2 – 3" off center for each hook.



Whenever possible, data outlets shall be flush mounted. Labels shall be machine printed and not hand written.

Cabling

Design Guidance and Specifications

- 1. Inter-Building Backbone Cables and Connection Hardware
 - a. Fiber Cable
 - Type: Single-Mode Fiber
 - Loose Tube
 - 96 strands for CORE cables
 - 12 strands between buildings
 - Transition from outdoor to indoor cable - if required
 - Splices - fusion not mechanical
 - Connectors - fusion spiced pigtails or splice-on
 - 30ft service loop coiled in each building entrance location
 - Maintenance holes
 - Route the fiber around the internal perimeter to create a 20' service coil.
 - Secure fiber to cable-management racking.
 - Cable construction appropriate for installation environment
 - b. Copper Cable
 - Pair count: Determined by project need. 25 pair minimum
 - Cable construction appropriate for installation environment
 - Lightning protection installed within 50ft of building entry
 - c. Cable Installations
 - To coincide with drywall finishing and are completed prior to ceiling grid installation.

Data Cabling Comparison

	Category 5e	Category 6	Category6A
Maximum Bandwidth	100 mhz	250 mhz	500 mhz
1Gb distance	100m	100m	100m
10Gb distance	N/A	55m	100m
Cable Construction	UTP/STP	UTP/STP	UTP/STP

—continued—

TR Design Specs and Construction Management Guidance/2. Cable Pathways and Cabling (cont.)

Cabling (cont.)

Design Guidance and Specifications

- 2. Intra-building Backbone Cables Connection Hardware
 - a. Fiber Optical Cable
 - Type: 50um Multimode OM4 or Single-Mode
 - Strand count: To be determined by project need. Min 12 strands between CER/TRs
 - Cable construction: Armored Plenum rated
 - Connector type: LC
 - Enclosures: 4U in MTR, 2U in TRs
 - 20’ of service loop shall be coiled in each TR.
 - Splices - fusion not mechanical
 - Connectors - fusion spiced pigtails or splice-on connectors
 - Labeling requirements:
 - All cables shall be labeled on both ends within 1’ of the termination enclosure.
 - All Connector Panels shall be labeled with the to and from end points generally the TR No. and/or the Room No.

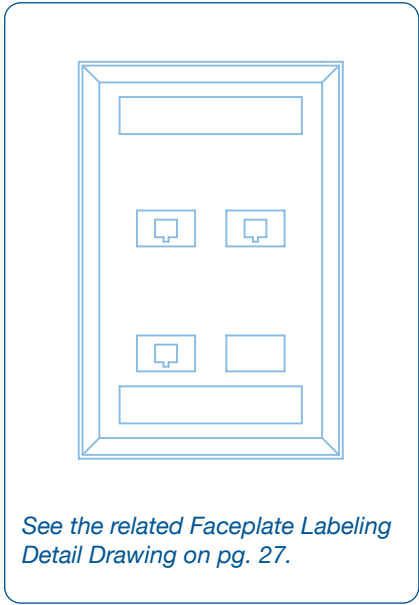
Single Mode fiber provides longer cable runs at a lower cable cost compared to Multimode Fiber. However, the electronics costs for Single-Mode are higher than Multimode.

Single Mode

- Long-distance cable runs
- Highest bandwidth support
- Lower cable cost
- Higher electronics costs
- Harder to terminate due to smaller core size

Multimode om4

- Short distance cable runs (less than 400M)
- High bandwidth support
- Higher cable cost
- Lower electronics costs
- Easier to terminate due to larger core size



- 3. Horizontal Cables Connection Hardware
 - a. UTP (Unshielded Twisted Pair)
 - b. Category 6 or 6a Plenum rated
 - c. Patch Panels: 48 port, modular
 - d. Outlet connectors
 - Cat6 or Cat6a
 - e. Horizontal UTP and fiber optic cables will be tested for full compliance with ANSI/TIA/EIA 568-C and addenda.
 - f. (2) Cat6A cables installed per Wireless Access Point.
 - g. Cable shall be loosely bundled to minimize crosstalk and Power Over Ethernet heat loads
 - h. Tie wraps and Velcro hook-and-loop connectors are not permitted.
 - i. Labeling requirements:
 - Each Cable must have a unique cable identification.
 - Cable IDs shall be preprinted or computer printed. Label printing area and font shall contrast.
 - Label shall be secured to the cable within 4” of each end.
 - Handwritten labels are not permitted.

Product Standards for TRs and Spaces

Design Specifications

Racks

- **Size:** 19”w x 84”h
- **Type:** 4 post
- **Fittings**
 - Provide communications racks within each TR.
 - Racks must accommodate at least 33% growth after original design.

Cabinets

- **Size:** 19”w x 7’h x 28”d

Horizontal and Vertical Cable Management

- **Size:** 16”w x 7”h
- **Vertical Cable Management Fittings:** Provide a minimum of (2) vertical Front/Rear cable management to each rack.

Overhead Cable Management - Ladder Racks

- **Size:** 12” – 24”w
- **Type:** Hollow bar, Telco-style construction with 9” spacing between rungs and black powder coated.
- **Fittings:** Hollow-bar, metal cable runway shall be provided around the room and over the communication racks. (Wire basket tray or any other cable tray is not permitted. See details for typical room configuration).
 - The cable runway shall be mounted 6” above the Communications Racks.
 - Provide a rack mount kit that connects to the cable runway to the Communications Racks.
 - Provide radius drop out kits where cables will drop into vertical management of the Communications Racks.
 - Runway must accommodate at least 33% growth after original design.
 - Runway must be supported by wall brackets, trapeze hangers and minimum 3/8”-threaded rod and rack connection kits (provide threaded rod covers as required).

Power Distribution Units

- **Type:** 8-outlet, 20 Amp
- **Fittings:** Provide (2) power strips for each rack.
- **UPS:** Connect to UPS.

Documentation Standards

All Technology Infrastructure projects shall have the following components for Design and As-Built documentation.

Design Documentation

T-Drawings Technology drawings shall be identified as “T” series (Technology) drawings in the approved construction drawings, separated from “E” (Electrical) drawings. These T-series drawings shall include:

- Symbols and Legends: Use industry standard symbols with explanatory legends.
- Riser diagrams for communications cabling.
- System one-line drawings
- Serving Zone Boundaries Identified
- Plan view drawings showing outlets, cable pathways, sleeves, and conduits.
- Telecommunications Room layout/elevations
- Equipment rack layouts
- Installation Details to include, but not limited to:
 - Communications outlets
 - Teaching Stations
 - Cable trays
 - Grounding and bonding
 - Wireless Access Points
 - Camera locations
 - IP clocks and PA speaker locations.
 - Installation information
- Outside plant, cabling, methods and paths with footages and bends.

Documents MUST be provided to the District for review and approval before final design acceptance will be issued.

As-Built Drawings

Upon completion of each project, a complete As-built of the installed cable plant shall be provided by the contractor to the district’s IT department. As-built documentation shall include the following:

Drawings

Including cable routing, termination location and labeling information

- CAD files of the As-builts
- PDFs of the As-builts
- Hard copies: (1) set of drawings printed at the same size as the Contract Construction drawings.

Cable schedules

Excel formatted minimally with individual columns labeled:

- TR
- Cable ID# (ex 1A-A-48)
- Room #

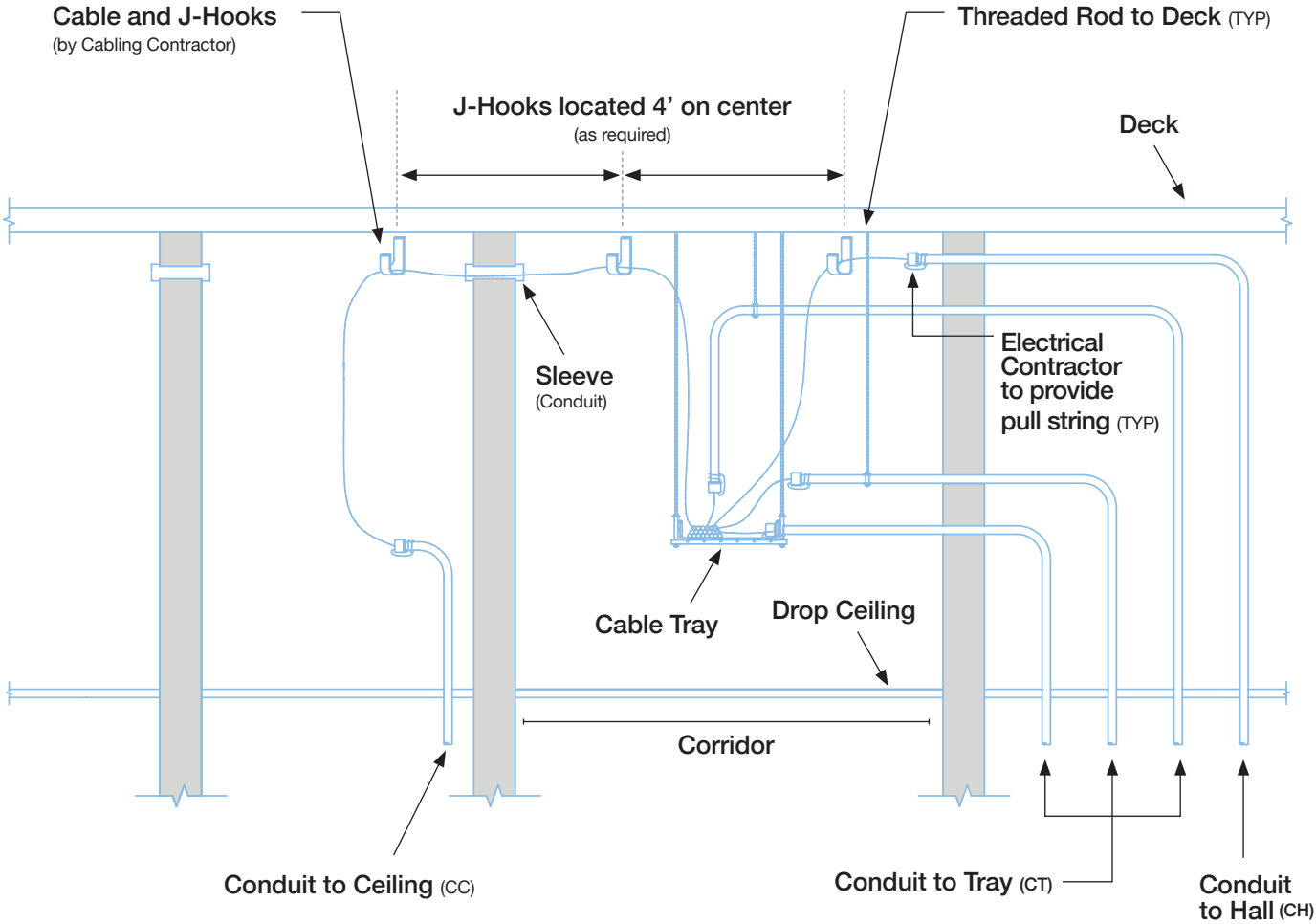
Cable Test results

- **Copper test results:** Organized by TR in electronic format
- **Fiber test results:** Organized by TR in electronic format

Documents MUST be provided to the District for review and approval before final acceptance will be issued and or the project closed out.

Installation Drawings and Detail Notes

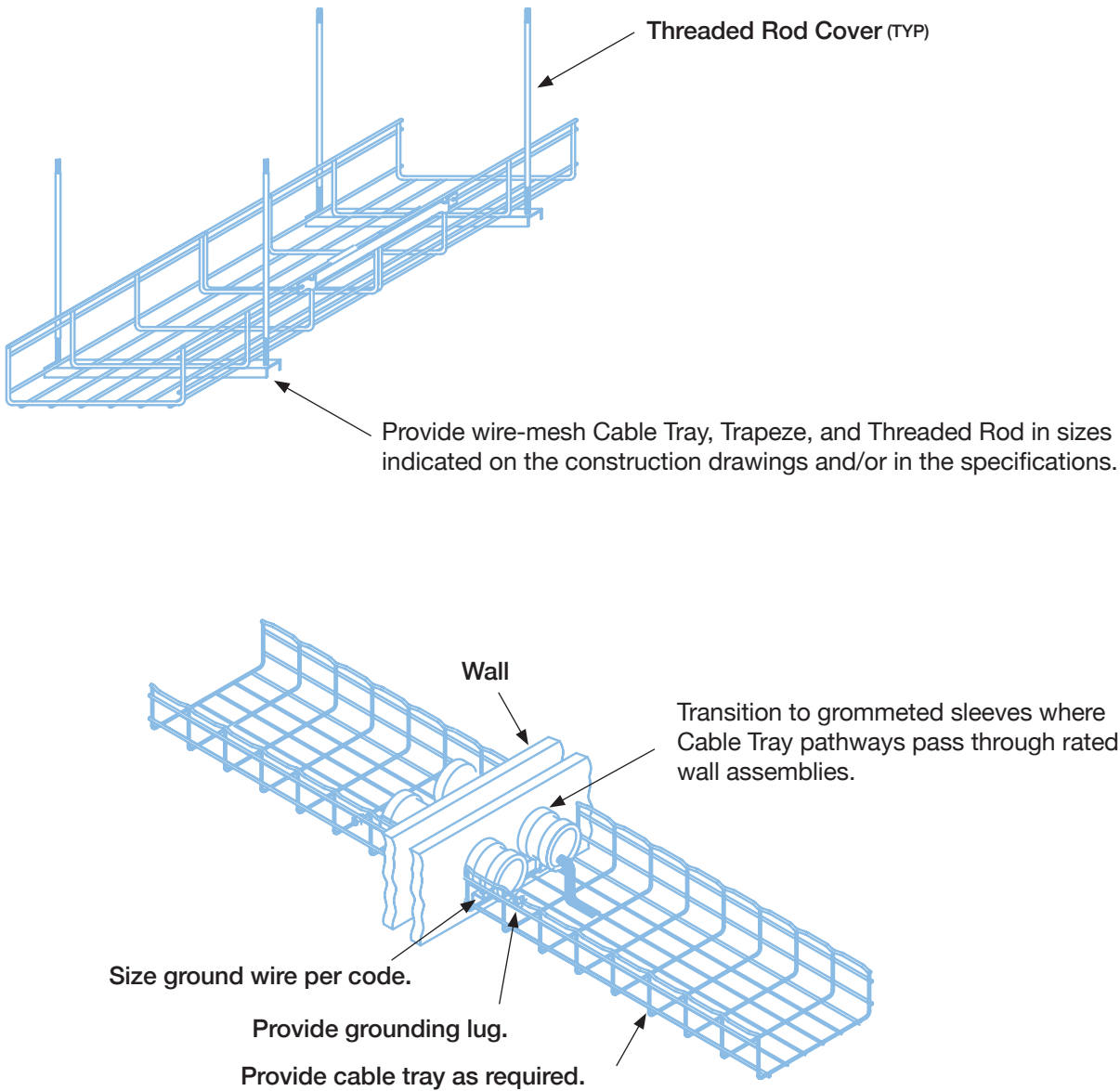
1 TYPICAL OUTLET PATHWAY INSTALLATION
NTS



DETAIL DRAWING NOTES

- A. Provide UL-listed through-penetration firestop system as required by code.
- B. All conduits to be installed within wall cavity or above ceiling. No exposed conduit is allowed.

2 CABLE TRAY INSTALLATION DETAIL
NTS

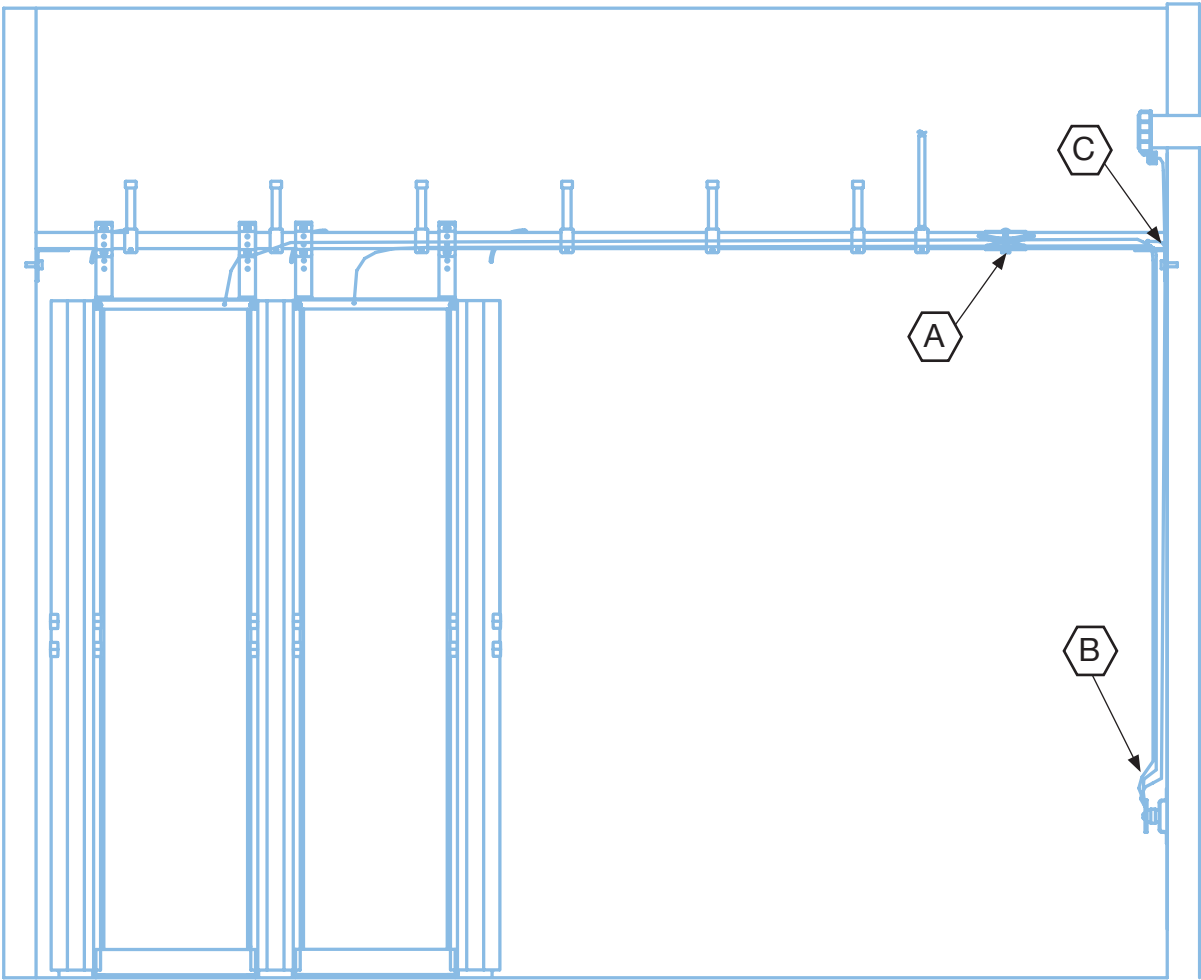


DETAIL DRAWING NOTES

Provide UL-listed through-penetration firestop system as required.

Installation Drawings and Detail Notes (cont.)

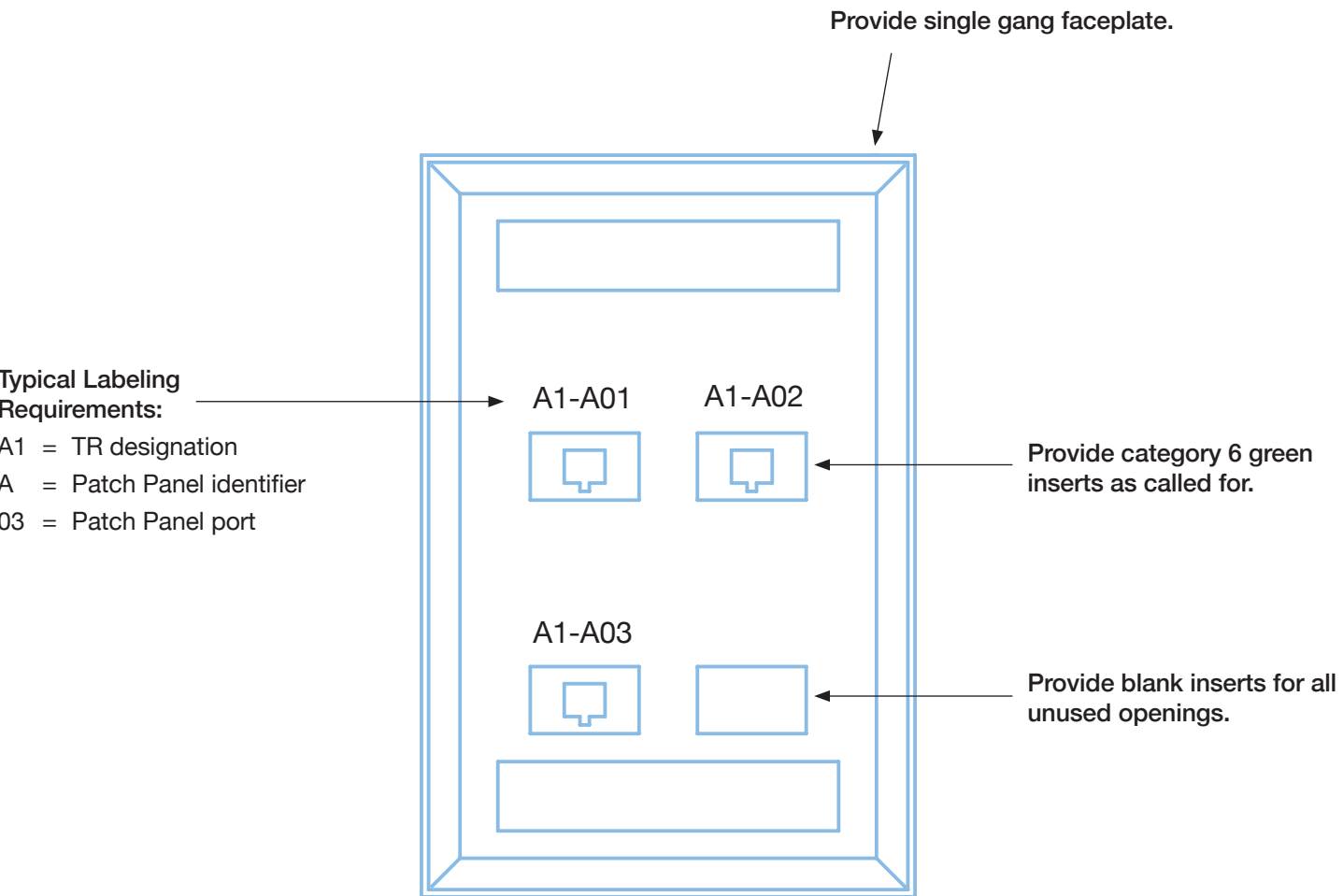
3 TELECOM ROOM (TR) GROUNDING DETAIL
NTS



DETAIL DRAWING NOTES

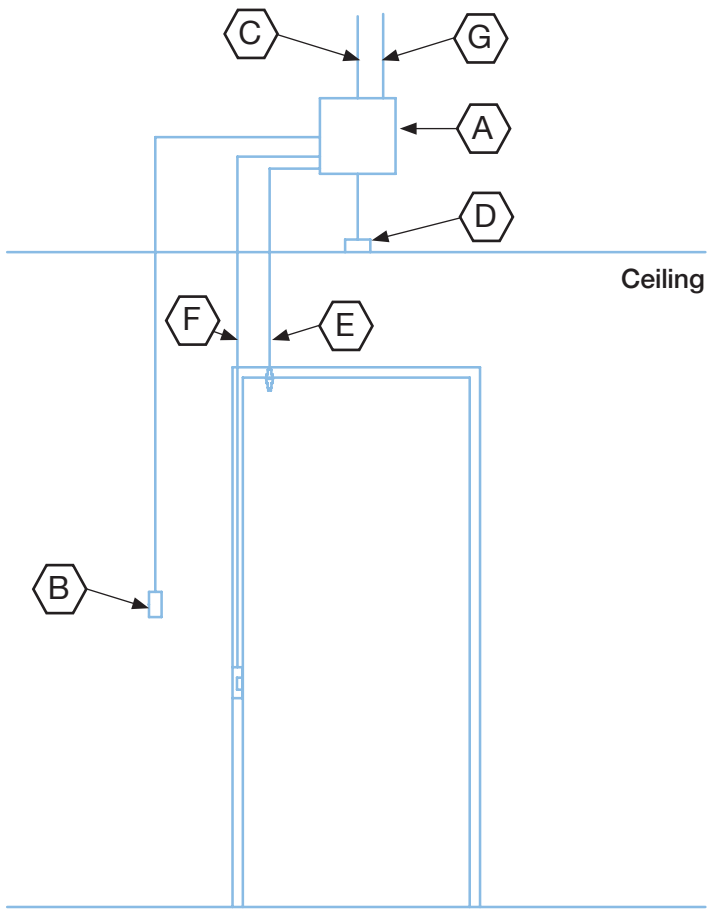
- A. Provide cable runway ground strap kit for each junction of the cable runway.
- B. Grounding/bonding within the TR shall be accomplished by one of the two options:
 - 1. Provide individual home runs of a minimum of #6 AWG green insulated stranded copper bonding jumper from all required metallic objects within the TR back to the MTGB/TGB.
 - 2. Provide a continuous loop around the room with a minimum of #4 AWG green insulated stranded copper bonding conductor; then bond the end of each of the conductors to the MTGB/TGB. Provide irreversible compression connectors to connect #6 AWG bonding jumpers to the #4 AWG main bonding conductor looped around the TR.
- C. Provide irreversible compression type connector/tap to bond grounding jumper to bonding conductor. Use paint piercing washers to connect two-hole lug of bonding jumper to cable runway. (TYP)
- D. Bond conductor to cable runway on both sides of an intersection.
- E. Grounding and bonding within the telecommunications room by Division 27 Contractor.
- F. Provide bonding jumpers. Minimum size: #6 AWG (TYP)

4 FACEPLATE LABELING DETAIL
NTS



Installation Drawings and Detail Notes (cont.)

5 ACCESS-CONTROLLED DOOR PATHWAY DETAIL
NTS



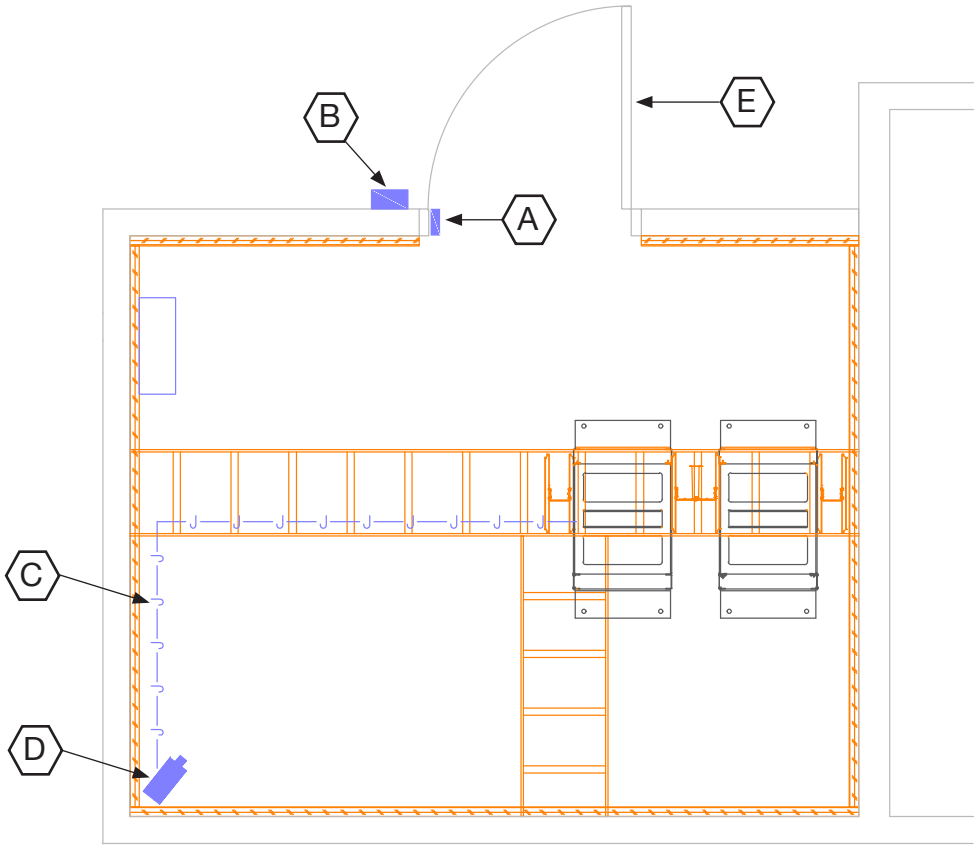
GENERAL PATHWAY NOTES

1. All conduit to be 3/4" unless otherwise noted.
2. All conduit and boxes furnished and installed by electrical contractor.
3. Diagram is schematic only and should be verified with all door hardware submittals and contractor on a door-by-door basis.

DETAIL DRAWING NOTES

- A. 8" X 8" x 4" box above ceiling on secured side of door. Box furnished and installed by electrical contractor.
- B. 3/4" conduit and single-gang box for card swipe reader on unsecured side of door.
- C. 3/4" conduit to cable tray, ceiling, or pullbox as indicated.
- D. Conduit and single-gang back box for Request-to-Exit motion detector, ceiling mounted on secured side of door. (Not required for accessible ceiling tiles.)
- E. Conduit for door monitoring contact.
- F. Conduit to door strike.
- G. Conduit to fire alarm relay (if required).

6 TR SECURITY DRAWING



DETAIL DRAWING NOTES

- A. Electric door strike.
- B. Access-control card reader. (See opposite page for a related detail drawing.)
- C. J-hooks as needed to support Cat6 cable connected to the IP-camera (D).
- D. IP-based Video Surveillance Camera with a clear view of the entry door (E).
- E. Solid entry door with automatic closer and storeroom lock.

Checklists: TR Design Review & Construction Management

Instructions



Scan this QR code to access a form-fillable PSF version of this checklist from MasterLibrary.com

This section is designed to assist the following professionals in the design and construction of Telecommunications Rooms (TRs):

- Architects
- Electrical Engineers
- Construction Managers
- School district management and staff
- Contractors

Refer to the previous sections of this *TR Master Plan* for specifications and other details required to design and construct an industry-compliant TR.

The checklist that follows (pp. 31 – 37) can be used for quality control of:

1. Telecom Room (TR) design during the Design Review phase
2. Construction Management—Technology Construction Management (TCM), in this case—during the Build phase.
3. Final Punchlist prior to project hand-off.

These pages are intended for use by Construction firms, contractors and especially district IT and Facilities professionals to ensure that the construction of TRs does not deviate from the final design and construction drawings.

You will need checklist (3) sets for each of these three phases.

Note: This checklist can be downloaded as a form-fillable PDF at <http://masterlibrary.com/forms/tr-design-checklist> (or use the QR code at left).

1. Label each checklist with the:
 - Building name (if multiple buildings are involved)
 - TR Designation and Room Number (e.g., TR-3, 1326)
 - Applicable building phase.
2. During the appropriate phase, review drawings, specs, and construction for every item, checking off those that follow all the guidance provided in this Master Plan.
3. For deficient items, use the Comments/Notes field to briefly state the deficiency and what party is responsible for correction.
4. While electronic PDF versions of completed checklists are preferable for collaboration, storage, and future access, paper-based completed lists should be scanned and uploaded to a secure project folder as part of the project archive.

Telecommunications Room Design/TCM/Punchlist Review Checklist

BUILDING		TR DESIGNATION & ROOM NO.		PHASE	☐ DESIGN	☐ TCM	☐ PUNCHLIST
A. Room Construction					COMMENTS/NOTES		
LOCATION & ROOM SIZING							
The room meet these minimum sizes based on its functionality. ☐ Entrance Facility ≥ 6'w x 4'd ☐ Main Telecommunications Room (MTR) ≥ 10'w x 12'd ☐ Intermediate Telecommunications Room (ITR) ≥ 9'w x 10'd ☐ The distance from each data outlet to the patch panel in the TR does not exceed 295'.							
FLOORS							
☐ Floor loading capacity in the TR shall be designed for a minimum distributed load rating of 50 lbf/ft². ☐ Anti-static/grounded VCT to be installed early in the project schedule. Completion to coincide with the start of low-voltage cable installations.							
WALLS							
☐ Walls extend to the deck and are rated per local code requirements. ☐ There are no interior or exterior windows in the space. ☐ Drywall is finished and painted with Interior finishes that are a light color (linen) to enhance room lighting. ☐ Fire retardant, void-free, ¾-inch AC-grade plywood 8' in length is installed per construction drawings and painted as directed leaving the fire-retardant stamps visible and legible. ☐ Plywood completion to coincide with the start of low-voltage cable installations. The plywood must be securely fastened to the wall-framing members and mounted vertically starting at 12" above the finished floor.							
ENTRANCE DOORS							
☐ The door shall be a minimum of 36"w x 80"h. ☐ There shall be no windows in the door. ☐ Out-swinging door preferred (code permitting). ☐ TR doors shall be equipped with Card Access. ☐ Door seals, door sweep, automatic closet, and storeroom lock are all installed.							

—continued—

Telecommunications Rooms: Design Review Checklist (cont.)

BUILDING		TR DESIGNATION & ROOM NO.		PHASE	☐ DESIGN	☐ TCM	☐ PUNCHLIST
A. Room Construction (cont.)				COMMENTS/NOTES			
CEILING ☐ Drop ceilings shall not be installed and shall be open to the deck above. ☐ If a ceiling is installed, the minimum height Above Finished Floor shall be 9'. Ceiling protrusions must be placed to assure a minimum clear height of 8'6 inches to provide space over the equipment facilities for cables and suspended racks.							
ELECTRICAL ☐ Dedicated Electric Panel (generator power if available) installed in the TR that only serves technology devices within the room. ☐ Each equipment rack shall have two dedicated 20A circuits, one normal and one emergency power. Larger circuits may be required for specialized equipment. ☐ Lights and convenience outlets (at minimum two locations) in the room should not be connected to the in-room panel.							
LIGHTING ☐ Provide a min of 50 fc. candles measured 3' above the finished floor. ☐ Suspended light fixtures should be mounted at 8'6" above the finished floor. ☐ Position the light fixture(s) above an aisle area, front and back only, and not directly over equipment racks or cabinets. ☐ Wall-mounted fixtures are permissible if lighting standards are met. Wall mounts should be placed in such a manner that they will not interfere with infrastructure pathways, protective equipment, and cables. ☐ Emergency lighting should be installed.							

Telecommunications Rooms: Design Review Checklist (cont.)

BUILDING		TR DESIGNATION & ROOM NO.		PHASE	☐ DESIGN	☐ TCM	☐ PUNCHLIST
A. Room Construction (cont.)				COMMENTS/NOTES			
ENVIRONMENTAL ☐ Environmental controls must be dedicated to the room. ☐ The recommended operating temperature should be set between 60°F to 80°F. ☐ The recommended humidity level should fall between 30% and 65%. Humidity should be a concern if it is anticipated that normal level within the TR would fall outside these parameters. ☐ Heating, ventilation, and air-conditioning sensors related to the environment within the TR must be located in the TR. Alarms should be sent to facilities and IT departments via text or email. ☐ Cooling equipment should be on emergency power, if available. ☐ Cooling equipment must not be mounted over technology equipment within the room. FCUs or similar should be mounted outside the room and ducted in. Water lines to cooling equipment must not route over technology equipment. ☐ Roof penetrations must not be located above or near the equipment.							
BONDING AND GROUNDING ☐ Bonding and Grounding shall conform to ANSI/TIA-J-STD-607-B Generic Telecommunications Grounding and Bonding (Earthing) for Customer Premises, NEC Article 250 and hardware manufacturer's grounding requirements. ☐ The telecommunications grounding main busbar must be connected to the electrical system building ground electrode. ☐ The IT bonding and grounding system shall be dedicated to the TRs within the building. ☐ All TRs must be provided with a Telecommunications Grounding Busbar (TGB) that is ANSI approved and UL listed.							
FIRE PROTECTION ☐ Sprinkler pipes and heads must be 18" away from equipment racks. (Side-wall mounted sprinklers are preferred)							
MISCELLANEOUS ☐ Mechanical, electric and plumbing that does not serve the TR shall not be in or pass through the TR.							

—continued—

Telecommunications Rooms: Design Review Checklist (cont.)

BUILDING

TR DESIGNATION & ROOM NO.

PHASE

☐ DESIGN

☐ TCM

☐ PUNCHLIST

B. Cable Pathways		COMMENTS/NOTES
PRIMARY PATHWAYS ☐ Cables tray installed in corridors. ☐ Cable trays do not run through walls; instead, they transition through sleeves. ☐ Cable trays and J-hooks transition to conduit in areas of inaccessible ceilings. ☐ Pull boxes installed for every 100' of conduit or 180° of bends. ☐ Grommated sleeves or fire-rated pathway assemblies are installed where cables pass through wall assemblies. ☐ All primary pathways shall be designed so as not to exceed a maximum fill ratio of 32%. ☐ Maintain the following distances from EMI sources: ☐ Fluorescent Lights: 12" ☐ Power cables: 6" ☐ Transformers: 36" ☐ All metallic pathways are bonded to complete continuity back to the building ground. ☐ Radius fittings shall be used when changing cable tray direction.		
PRIMARY PATHWAYS (CONT.) ☐ Dual hanger or trapeze type with 3/8"-minimum threaded rod are the approved mounting methods for cable trays. Center-hung hangers are not permitted. ☐ Cable trays will be installed in accordance with NFPA 70 article 392. ☐ Maintain 6" clearance from bottom of cable tray to the top of accessible ceiling tile, and 12" clearance above cable trays to facilitate access to the cable tray for cable installation. ☐ Provide threaded rod covers to prevent damage to cables during installation. ☐ All pathways must have a 250-lb. pulling tension pull string/tape installed.		

Telecommunications Rooms: Design Review Checklist (cont.)

BUILDING

TR DESIGNATION & ROOM NO.

PHASE

☐ DESIGN

☐ TCM

☐ PUNCHLIST

B. Cable Pathways (cont.)	COMMENTS/NOTES
SECONDARY PATHWAYS ☐ Closed metallic pathways will be used in exposed visible areas of egress. ☐ All pathways, pull boxes and junction boxes shall have an adequate access space provided to ensure the contractor or installer a safe means of entry. ☐ J-Hooks ☐ 4' spacing with hooks staggered 2 - 3" off center. ☐ J Hooks shall be supported from the building structure utilizing wall adapters, beam clamps and or threaded rods. ☐ J-Hooks are to be used only where cable counts are fewer than 30. Where cable counts exceed 30 cables, use a cable tray. ☐ Metallic Surface Raceways ☐ Raceways shall be installed with entrance end fittings ☐ When the raceway is divided and shared, separate offset single-gang device brackets shall be used. ☐ All raceways will be installed using mechanical fasteners. Velcro and adhesive tape are not permitted. ☐ Radius fittings shall be installed at changes in direction. ☐ Outlet/device locations ☐ Whenever possible, outlets shall be flush mounted. In existing buildings when walls cannot be fished,surface outlets will be acceptable. ☐ Recessed install or exposed in Mechanical Spaces: Use 4" x 4" x 2.5" with single-gang mud ring as applicable. ☐ Surface Mount: Use 4" x 4" x 2.25" ☐ Surface-Mount Wall Phone/Call Switch: Use 2" x 4" x 1.75"	

—continued—

Telecommunications Rooms: Design Review Checklist (cont.)

BUILDING TR DESIGNATION & ROOM NO. PHASE ☐ DESIGN ☐ TCM ☐ PUNCHLIST	
Cabling	COMMENTS/NOTES
INTER-BUILDING BACKBONE CABLES AND CONNECTION HARDWARE Fiber Cable ☐ Type: Single-Mode Fiber ☐ Loose Tube ☐ 96 strands for CORE cables ☐ 12 strands between buildings ☐ Transition from outdoor to indoor cable to meet local code requirements ☐ Splices - fusion not mechanical ☐ Connectors - fusion spiced pigtails or splice-on ☐ 30ft of service loop coiled in each building entrance location ☐ Maintenance holes ☐ Rout fiber around the internal perimeter to create a 20' service coil. ☐ Secure fiber to cable-management racking. ☐ Cable construction appropriate for installation environment. ☐ Cable installations coincide with drywall finishing and are completed prior to ceiling grid installation.	

Copper Cable

☐ Pair count: Determined by project need. 25 pair minimum

☐ Cable construction appropriate for installation environment

☐ Lightning protection installed within 50ft of building entry

☐ Cable installations coincide with drywall finishing and are completed prior to ceiling grid installation.

Telecommunications Rooms: Design Review Checklist (cont.)

BUILDING TR DESIGNATION & ROOM NO. PHASE ☐ DESIGN ☐ TCM ☐ PUNCHLIST	
B. Cable Pathways/Cabling (cont.)	COMMENTS/NOTES
INTRA-BUILDING BACKBONE CABLES CONNECTION HARDWARE Fiber Optical Cable ☐ Type: 50um Multimode OM4 or Single-Mode ☐ Strand count: To be determined by project need. Min 12 strands between CER/TRs ☐ Cable construction: Armored Plenum rated ☐ Connector type: LC or owner preference ☐ Enclosures: 4U in MTR, 2U in TRs ☐ 20' of service loop shall be coiled in each TR. ☐ Splices - fusion not mechanical ☐ Connectors - fusion spiced pigtails or splice-on connectors ☐ Labeling requirements ☐ All cables shall be labeled on both ends within 1' of the termination enclosure. ☐ All Connector Panels shall be labeled with the to and from end points generally the TR No. and/or the Room No. ☐ Cable installations coincide with drywall finishing and are completed prior to ceiling grid installation.	

HORIZONTAL CABLES AND CONNECTION HARDWARE

☐ UTP (Unshielded Twisted Pair)

☐ Category 6 or 6a Plenum rated

☐ Patch Panels: 48 port, modular

☐ Outlet connectors

☐ Cat6 or Cat6a

☐ Horizontal UTP and fiber optic cables will be tested for full compliance with ANSI/TIA/EIA 568-C and addenda.

☐ (2) Cat6A cables installed per Wireless Access Point.

☐ Cable shall be loosely bundled to minimize crosstalk and Power Over Ethernet heat loads

☐ Tie wraps and Velcro/hook-and-loop closures are not permitted

☐ Labeling requirements:

☐ Each Cable must have a unique cable identification.

☐ Cable IDs shall be preprinted or computer printed. Label printing area and font shall contrast.

☐ Label shall be secured to the cable within 4" of each end.

☐ Handwritten labels are not permitted.