

SECTION 16700

TELEPHONE AND COMPUTER CABLING

PART 1 - GENERAL

Verify the computer and telephone cabling standards with *MINES* CCIT and Telecommunications departments.

Telephone and computer lines shall be installed within a conduit when routed through walls and floors. An approved type of communication cable can be installed exposed within the air plenum (Specify appropriate sized "j-hooks" and cable slings or straps to support the cables within the plenum).

Conduit and required outlets in the labs or classrooms for local A/V system and remote capability including needs for computer projection capability should be defined.

Equipment with special power requirements shall be defined under the original renovation project so that the need for electrical power, air, vacuum, gas and water can be accommodated within the renovation project.

Asbestos - Buildings to be wired shall be inspected by *MINES* Environmental Health & Safety Department for Asbestos Containing Material (ACM). Where ACM exists, *MINES* will decide whether to abate the asbestos, or circumvent the asbestos by installing the cable infrastructure around the contaminated area.

1.01 MINES Telecommunications/Data Standards

A. Departments Involved in Project Design of Telecommunications and Data

1. This document provides design and installation specifications for voice, data, and other low voltage structured cabling infrastructure at the Colorado School of MINES, (*MINES*). Several departments are responsible for the communications infrastructure, and should be involved in the design and construction process. These departments include: CCIT for the physical infrastructure of the voice network to include fiber optics, outside plant copper, inside plant copper for voice, telecommunications equipment, physical infrastructure of data cabling that includes fiber optics, inside plant copper for data, and networking electronics; Facilities Management for building infrastructure such as HVAC controls, tunnel penetrations, electrical and security system requirements and standards. Contacts for these departments are given below.

**Table 1 Contacts**  
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| <b>Department</b>                      | <b>Name</b>    | <b>Phone Number</b> |
|--|----------------|---------------------|
| CCIT - Telecommunications              | Jeff Culligan  | 303-273-3949        |
| CCIT - Data                            | Phil Romig III | 303-273-3866        |
| Facilities Management -HVAC\Electrical | Bob Slavik     | 303-273-3312        |
| Facilities Management – Engineering    | Sam Crispin    | 303-273-3901        |
| Capital Planning and Construction      | Chris Cocallas | 303-273-3568        |
| Environmental Health & Safety          | Tim Switzer    | 303-272-3869        |

2. The Departments above shall be consulted during the planning, design, and construction phase of all projects that require any kind of low voltage cable installation.

Designs shall be approved prior to the construction phase. As questions arise during the construction phase, the above departments are also to be consulted.

3. The MINES CCIT Department shall be consulted prior to any new installations or modification of any part of the campus telephone or data networks inside or outside plant cabling systems. This includes any and all modifications of all voice and data jacks and cable within the realm of the project. This shall also include sign off on all project change requests affecting these systems.
- B. Design Professionals and Contractors
1. Design teams selected for new construction shall have at least one Registered Communications Distribution Designer (RCDD) on staff responsible for the infrastructure design of the project to include all low voltage cabling design, distribution per TIA/EIA standards. Contractors must be listed in *MINES* pre-approved contractor list and employ a minimum of one RCDD certified and in good standing with the Building Industry Consulting Service International, (BICSI). The RCDD must be a direct employee of the contractor. The RCDD shall inspect work in progress and certify the work at the completion of the project.
  2. See Emergency Phone cut sheets for pedestal and wall-mount emergency phones.
- C. Applicable Standards
1. Telecommunications physical infrastructure as defined by the Telecommunications Industry Association/Electronics Industry Association Latest addition and addenda (TIA/EIA), consists of six elements: Building Entrance, Building Equipment Room (ER), Backbone Cabling, Telecommunications Rooms (TR), Horizontal Cabling and Work Area. These elements may be augmented by a seventh element, equipment, required to provide a minimum level of voice/data service for the building.
  2. In general, the following minimum standards, shall be observed for telecommunications infrastructure, and are incorporated herein by reference: TIA/EIA 568B Commercial Building Telecommunications Cabling Standard, EIA/TIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces, TIA/EIA 607 Commercial Building Grounding and Bonding Requirements, TIA/EIA 598A Optical Fiber Color Code and TIA/EIA 758 Customer Owned Outside Plant Telecommunications Standards.
- D. General Guidelines
1. Essential to the telecommunications infrastructure within buildings is securing telecommunications room spaces, consisting of the ER and generally one or more TR's. These rooms must have access from a public access space such as a corridor and be secured, environmentally controlled to the level specified by CCIT for the equipment dedicated to support the space the TR services. Fiber must be terminated in these rooms, requiring a clean environment. Data networking and telecom equipment also require environmental controls. The ER, TR's and backbone pathways shall be constructed early enough within project timetables to allow full access to pathways for voice and data cable installation.
- E. Equipment and Materials Specifications
1. The MINES CCIT department shall provide specifications for materials to be installed for data and telecom on a project by project basis. Where substitutions are allowed, approval

in an addendum must be reviewed prior to installation. Questions concerning substitutions of materials should be referred to the project manager.

F. Contractors

1. Only pre-qualified contractors are permitted to install inside and outside plant telephone, network, security and door access cabling on the MINES campus, including all campus projects. Capital Planning and Construction and CCIT departments maintain a listing of pre-qualified cabling contractors. The installation of audio and video cabling does not fall under the list of pre-approved contractors. However, CCIT shall supervise all audio and video cabling.

2.01 Cabling

A. Outside Plant backbone – OSP

1. Outside plant cable installations shall follow TIA/EIA telecommunications standards as well as other MINES standards to include campus tunnel standards.
2. Copper OSP Cable:
3. Material Specifications for all copper backbone cabling shall be identified by the MINES CCIT Department on a per installation basis.
4. Installation
  - a. Tunnel installations of copper backbone cable shall be supported in the campus tunnel system on the existing conduit rack system. If new steps are required, the contractor will be required to provide and install steps on existing rack. Where no rack exists, new conduit racking will be required a minimum of every five feet. Tunnel requirements must be verified with CCIT and Facilities Management.
  - b. All copper OSP installations shall be terminated on a lightning protection device with solid state coils. Lightning protection device will be labeled with MINES building codes of connecting buildings and cable number assigned by CCIT. Multi pair tails from the lightning protector to the appropriate backboard shall be terminated on 110 blocks or rack-mounted patch panels within the TR. Terminations shall be identified by CCIT on a per installation basis.
  - c. Splices in any OSP cable installation will not be accepted unless specifically noted in the project specifications.
  - d. The Copper twisted-pair conductor color code shall follow the industry standard color code composed of 10 distinct colors to identify 25 pairs (refer to ANSI/ICEA S-80-576 for appropriate colors).
  - e. Copper cable installations shall be tested from end to end for:
    - DC loop resistance
    - Wire map
    - Continuity to remote end
    - Shorts between two or more conductors
    - Crossed pairs
    - Reversed pairs
    - Split pairs

- Any other mis-wiring.

B. Fiber Optic OSP:

1. Material Specifications for all fiber backbone cabling shall be identified by the MINES CCIT Department on a per installation basis.
2. Tunnel installations of fiber backbone cable shall be installed on the existing conduit rack system. If new steps are required, the contractor will be required to provide and install steps on existing rack. Where no rack exists, new conduit racking will be required a minimum of every five feet. Tunnel requirements must be verified with the CCIT Department and Facilities Management. All TIA/EIA standards for fiber optic installation shall be followed to include all raceway specifications unless directed otherwise by CCIT.
3. Fiber optic installations outside the tunnel area such as street crossings shall be encased in a minimum of 3" buried conduit raceway per TIA/EIA with the exception of interduct.
4. All Fiber Optic OSP installations shall be terminated in owner specified fiber LIU's mounted in designated racks within the building ER.
5. OSP Fiber Optic cables shall have a minimum of a 30' service loop at each end of the cable for future re-terminations. Each pull box within the raceway large enough to accommodate bend radius shall have a minimum of a 20' service loop.
6. Fiber Optic cable installations shall be tested as follows:
  - a. All strands shall be tested with an Optical Time Domain Reflectometer (OTDR) bi-directional end to end trace at two wavelengths per TIA/EIA 455-61.
  - b. All strands shall also be tested with an optical power meter bi-directional end to end at two wavelengths per TIA/EIA 455-53A.
  - c. Multimode cable at 850 and 1300nm.
  - d. Singlemode cable at 1310 and 1550nm.
  - e. An electronic copy of the test results must be delivered to MINES CCIT Department.

## 2.02 Equipment Room - ER

- A. Buildings shall have an ER, where voice and data enter the building (Ref. Figure 1). The ER also serves as the distribution point for voice and data, and must be secure to protect the integrity of these systems, particularly network physical security. Grounding and bonding shall be provided in the ER in strict accordance with the TIA/EIA 607 standard, and extended to all TR's as described therein. In particular, provide a Telecommunications grounding busbar. The busbar shall be a grounded, predrilled copper busbar with holes for use with standard-sized lugs, have minimum dimensions of 0.25" thick by 4" wide, and can be variable in length.
- B. EIA/TIA 569 shall be strictly observed for the ER, especially as to location (away from electromagnetic interference such as elevators and elevator equipment rooms), perimeters (no false ceilings), limited access (i.e. security), HVAC, lighting and electrical. In particular, ER's shall be provided with two dedicated 30-Amp, 120-volt, three-wire twist lock circuits - one on normal building power and the other on building EM power terminating on dual outlets 18" AFF on the wall adjacent to the back side of the data racks- these locations shall be determined in

consultation with MINES CCIT. No piping, ductwork, mechanical equipment, or power cabling or similar utility unrelated to the direct support of the ER shall be allowed to pass through an ER room. Switched non-florescent lighting of 75-100 fc placed 8' AFF shall be provided from the nearest building electrical circuit.

- C. The ER shall have 3/4" plywood on at least two walls, painted with two coats of fire resistant white paint on all sides, installed for wall mounting of the voice and data distribution systems (Ref Figure 1).
- D. The ER also serves as the fiber distribution point for the building and also houses the building data equipment. No other equipment, including other low-voltage equipment, shall be housed in the ER without prior approval from MINES CCIT. Note that if end user data is served out of the ER, data cable runs are to be limited to 90 meters in length, and this may affect placement of the ER or require a TR to be added.
- E. The ER shall be located off a public access area such as a corridor and be large enough to accommodate at least three 19"x7' vertical equipment racks, one for the building cable distribution and the other for the building data equipment, and a six-inch vertical wire manager connected side by side. 36" clearance will be required on three sides of the of the data racks to allow for maintenance of cabling and equipment. All penetrations of the ER shall be fire-stopped. These penetrations may consist of vertical penetrations for 4" diameter conduit, or horizontal "pass-through" 4" diameter conduit penetrations to ladder racks. Note that slings or J-hook hanger for cable shall not be used within the ER or TR's.

### 2.03 Telecommunications Rooms - TR's

- A. The TR houses data equipment, which is used to distribute the data network to the end user and telephone connections to the end user. Data equipment is housed in vertical racks. Telephone connections shall be made on the data patch panels within the vertical racks. All sides of the plywood used for the backboard shall be painted with two coats of fire-resistant white paint.
- B. TR's shall be located at points that minimize the runs of the data network to the end user with door access to a public space such as a corridor. Data cable runs are to be limited to 90 meters, and this may affect placement of the TR or require additional TR's be to be added. TR's should be located such that future data runs to any part of the building is within this distance limitation. Each floor shall have a dedicated TR if required due to the square footage.
- C. TR's shall be secure and environmentally conditioned. TR's shall be supplied with two dedicated, 30-Amp, 120-volt, three-wire twist lock circuits - one on normal building power and the other on building EM power terminating on dual outlets 18" AFF on the wall adjacent to the back side of the data racks on the wall adjacent to the equipment racks. TR's shall be supplied with 75 fc of switched non-florescent lighting 8' AFF from the nearest building electrical circuit. TR's shall be supplied with a grounded, predrilled copper busbar with holes for use with standard-sized lugs, have minimum dimensions of 0.25" thick by 2" wide, and can be variable in length.
- D. TR's shall be sized such that there is ample room to install racks to house the equipment. The TR shall be sized to accommodate a minimum of two vertical 7'x19" racks with six inch wire managers joined side to side and 36" clearance on three sides. One rack will be used for cable distribution and one for data equipment. TR's shall be sized large enough to accommodate reasonable future growth of telephone and data connections.

### 2.04 Campus Tunnel Penetrations

- A. Use LinkSeal or pre-approved equal for each penetration of piping and conduits. Communication and electrical conduit shall have a minimum 12" clearance from any steam pipe within the tunnel. Do not block the tunnel access by running conduit across the tunnel. Conduits shall be installed underneath the tunnel ceiling. A minimum of 30" wide access will be needed for exiting. Contact MINES for directions when this minimum width is not possible when running conduit.

#### 2.05 Building Backbone Cabling

- A. The building backbone cabling consists of fiber cable for voice/data and copper cable for voice and misc. circuits. These cables shall be run between the ER and all TR's. The infrastructure for the building backbone cabling shall consist of conduit between the ER and TR's where the run is vertical, or ladders racks (not hooks or rings) where the run is horizontal. In general, conduit shall be used for vertical runs, and ladder racks shall be used for horizontal runs. Copper cable supports and fiber cable supports must be separate dedicated support systems.
- B. EIA/TIA 569 shall be strictly observed for the building backbone pathways. Conduits shall be sized to be no more than 40% full by volume when serving the entire number of cables entering the TR. Long-radius sweeps shall be used instead of 90-degree fittings. No more than 180 degrees of bends shall exist in conduits without inclusion of an easily accessible pull box, the location of which shall be clearly marked on drawings. In situations where cable tray, conduit, or sleeves extend outside the construction area into occupied portions of the building, they shall be fire-stopped in accordance with NEC 300-21.
- C. Fiber and copper shall be run in a star configuration from the ER to all TR's. Fiber cables shall be run in conduits with fiber optic labels on the conduit every twenty feet. MINES CCIT will determine the fiber type and count into and out of the TR. Copper cables between the ER and TR's shall be a minimum of 25 pair each.
- D. Cable ladder racks shall be hung in a manner that ensures a minimum of 12" vertical clearance and 18" horizontal clearance on at least one side, to allow for sufficient access to the ladder rack for cable installation and maintenance. Cable ladder racks shall be mounted no lower than 7 feet AFF (above the finished floor) whenever possible. Transitions where changes in height are unavoidable shall be gradually sloping. The cable ladder rack shall be routed so as not to interfere with installation of other systems or access to those systems for maintenance. Coordination with other systems shall be maintained so that where these systems traverse above or below the ladder rack shall not be blocked or interfered with. Cable ladder racks shall pass through firewalls with appropriate fire rated fittings approved by owner. The pass-through fitting shall be no more than 40% full.

#### 2.06 Horizontal Cabling

- A. The MINES CCIT Department shall specify all voice and data cable and components. Data cable runs shall be strictly limited to 90 meters in total length, according to standards. In particular, TR's are to be located to maintain less than a total 90-meter cable run.
- B. Cable Color – Telephone and Data cable shall be BLUE.
- C. Plenum spaces - Plenum cabling or conduit shall be used in plenum spaces. Contractor shall determine, in consultation with MINES Facilities Management prior to work being done, whether the space is a plenum space.
- D. All cables shall be labeled with the most current labeling format to be provided by the MINES CCIT department to include backbone copper and backbone fiber optics. All cables must be tested to the correct specification and test results must be delivered in electronic format to CCIT

#### 2.07 Conduit

- A. Where conduit is used, a minimum of 1" conduit with no more than 40% fill (three cables) shall be permitted, 90-degree fittings shall be used between outlet boxes and cable tray. Conduit bends shall conform to accepted radius for the type of cable used. Conduit segments shall not contain more than two 90-degree bends, or equivalent bends exceeding 180 degrees total. Of the 180 degrees, offsets and kicks cannot exceed 30 degrees. Contractor shall submit detailed installation plans with the MINES Facilities Management for approval prior to any installation. Conduit ends must be fitted with an appropriate bushing to minimize chafing.
- B. Should also comply with Mines electrical design standards.

#### 2.08 Other Low Voltage Cabling Requirements

- A. Other systems that require low voltage cable distribution within the ceiling space such as fire alarm, security systems, audio/visual equipment and building controls shall follow the same standards as the telephone and data structured cabling system.
- B. Cable supports – Other cable systems shall be installed in their own independent support structure. No other cabling shall be installed within the telephone/data support structure or attached to the telephone/data cabling in any way.
- C. Cable Color  
Fire alarm cabling shall be RED.  
Security systems UTP shall be GREEN.  
HVAC controls shall be GRAY.  
Coax shall be BLACK.
- E. Cable Path – All cable shall follow building lines when ever possible.
- F. Over Head Coordination – Cable installations shall not interfere with any other utility, such as HVAC systems, electrical boxes, Tele/Data pathways, etc. If and when there are areas in question during an installation, the installing contractor shall be responsible for coordination with the assigned MINES project manager prior to installation.

#### 2.09 Labeling

- A. Telephone/Data Station labels:

**\*\*NOTE:** Room numbers shall not be construction numbers. Contractors will be responsible to verify room numbers with MINES Capital Planning and Construction.

- C. Each CAT 6 or CAT 5e cable must have this label on each end of the cable within six inches of the termination and the faceplate.
- D. Mine's data labeling scheme is as follows:

[TR Room]- [Room #]-[Jack w/in room]-[Patch panel #] [Building code] [Port on Patch Panel]

Example from the GRL Building would be: **2-210-A-2RL26**

2 = TR room number  
210 = Building Room Number  
A = Jack # within room  
2RL26 = (2) patch panel (RL) Building Code (26) port on patch panel

- E. The front of the patch panel shall be labeled with room and Jack ID only.

- F. Brady labels part number 32432-size code 517 is acceptable or equivalent. Equivalent labels must make a complete overlapping wrap when installed on the cable ends. Face plate and patch panel labels shall be black on white P-Touch labels Part number TZ-231 or equivalent.
- G. Label the faceplate in the office with block printed adhesive labels (black on white is preferred). Size of labels must allow label to remain whole and not be attached as separate pieces.
- H. Labels for new cables in an existing building must continuous with existing cable system numbers.

**\*\*NOTE:** Existing cable numbers may not be in numerical order and verification may be required with CCIT.

#### 2.10 Fiber Optic labels:

- A. The jacket of the OSP cable shall be labeled at each end and inside each pull box with the MINES assigned cable number with black on orange for multi mode and black on yellow for single mode.
- B. The assigned cable numbers for multi mode are 1000-1xxx to be assigned by MINES CCIT (add M5 to the end of the cable number for 50 micron fiber). The assigned cable number for single mode is 2000-2xxx to be assigned by MINES CCIT. The assigned cable number for any hybrid cable is 3000-3xxx to be assigned by MINES CCIT.
- C. These cable numbers must be preceded with MINES building codes. Example: An OSP fiber cable from Berthoud Hall to the GRL building would be BE-RL-1025.
- D. The inside plant fiber optic cables shall be labeled at each end with the assigned MINES cable numbers, black on orange for multi mode and black on yellow for single mode.
- E. The assigned cable number for multi mode is 4000-4xxx (add M5 to the end of the cable number for 50 micron fiber). The assigned cable number for single mode is 5000-5xxx.
- G. On the patch panels themselves the labels should be a set of 2 lines for each fiber. The labels are of the format:

[Far end]  
[Near end]

- a. Where each code is:  
[Building] [TR room code] – [Fiber LIU #] – [fiber port] [S or M or M5]
- b. Example: For a single mode fiber between Berthoud Hall and the GRL building, if the fiber is in LIU 3 in Berthoud Hall and in LIU 1 at the GRL building, the code at the GRL building is:  
BE2-3-10S  
RL1-1-10S  
  
This would be a single mode fiber strand that is terminated in the GRL building data room 1, in LIU 1 on port 10. The other end is in Berthoud Hall data room 2 (where the GRL cable terminates), on LIU 3, port 10.
- c. For the intra-building fiber, an example would be:  
RL2-1-24M  
RL1-1-12M  
This is a multi mode fiber terminated in data room 2, in LIU 1, port 24. The other end of the fiber is in data room 1, LIU 1, port 12.



## 2.11 OSP Copper Cable Labels

- A. The OSP copper cable shall be labeled at each end with the MINES assigned cable number stamped or etched into a brass ring secured to each end of the cable or specified labels of the appropriate color.

Example: the assigned number (cable numbers to be assigned by CCIT) for the 100 pair cable from the GRL building to Guggenheim Hall is:

GH-RL  
#109

## 3.01 Specified Materials List

### A. Fiber Optic Cable

1. Tunnel System:
  - a. Corning Interlocking Armored Cable with outer jacket - Minimum 24MM 50 micron or 24SM or 24/24 hybrid (as specified by CCIT)
2. Interbuilding:
  - a. Corning MIC Interlocking Armored Cable plenum rated - Minimum 12MM 50 micron, 12SM or 12/12 hybrid
  - b. Corning MIC riser rated cable (for conduit pathways only - Minimum 12MM 50 micron or 12SM)

### B. Copper Cable

1. Horizontal Cable:
  - a. Category 6a Berk-Tek Lanmark 2000 6EXHP4P24-BL-S-BER-AP
  - b. Category 6a Panduit TX6500 (PUP6504BU-UY)
2. In areas where category 6 equipment is not installed, category 5e may be installed using: Category 5e Systemax 5EXHP4P24-BL-P-MAX-GP

### C. LIU's

1. Corning pre loaded 72 port (CCH-O4U-7291) SC Duplex Couplers.

### D. Couplers

1. Black for multi mode 50 um fiber terminations
2. Beige for multi mode 62.5 fiber terminations
3. Blue for single mode fiber terminations

### E. Equipment racks, wire managers, ladder rack, power strips

1. See Chatsworth Product Drawing on previous page with list of applicable parts list for TR.

F. Wall Mount Rack (When approved by CCIT)

1. Chatsworth:
  - a. Cabinet Cube-IT Black (12419-736)
  - b. Wall Enclosure Fan Kit (12804-701)
  - c. Power Strip (12820-703)
  - d. Corning Fiber LIU CCS-03U
  - e. Corning CCH-CP12-57 Panels
  - f. Corning CCH-CP12-59 PNL W/6 568SC

G. Patch Panels

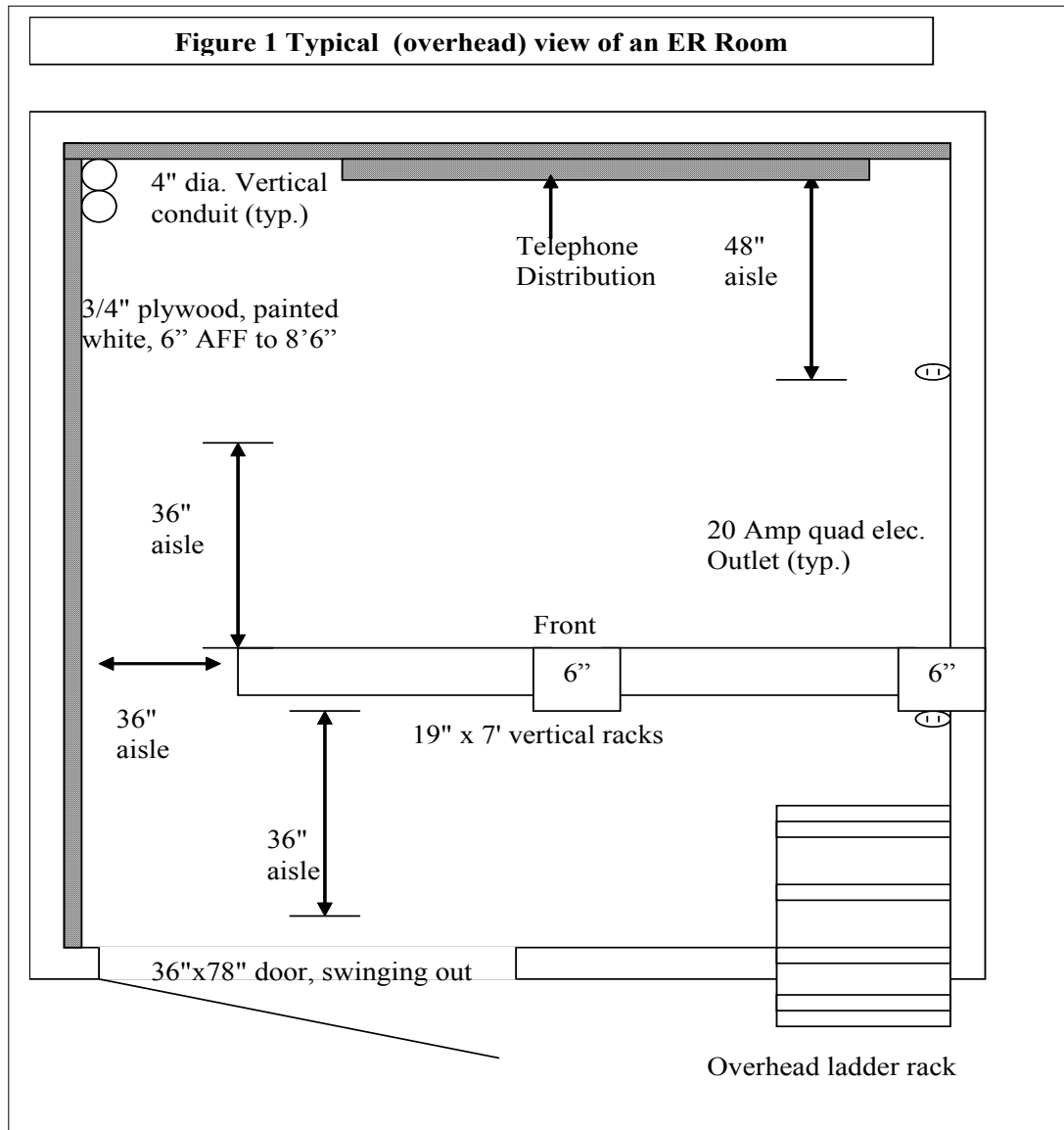
1. Category 6 Panduit DP48688TP
2. Category 5E Systemax 1100-PS48 (in areas where category 6 equipment is not installed)

H. Jacks

1. Category 6 Panduit CJ688TPBU Blue
2. Category 5E Systemax MPS100E – 317 Blue (in areas where category 6 equipment is not installed)

I. Faceplates

1. Category 6 Panduit (CFPE4EI) with blanks as required
2. Category 5E Systemax four port (M14L-246) with blanks as required (in areas where category 6 equipment is not installed)



End of Section