

Cabling Specifications for Contractors

Cabling Specifications for Contractors	1
Contractor Qualifications and Requirements	3
Warranties	4
Contractors Warranty	4
Codes, Standards, and Best Practices	5
Codes	5
Insulated Cable Engineers Association (ICEA)	5
National Fire Protection Association (NFPA)	5
Other Codes	6
Reference Standards	6
Telecommunications Industry Association	6
Building Industry Consulting Service International	7
Site Preparation Guidelines	7
General Information	7
Specifications	7
Labeling Specification	8
Color coding	9
The City of Melrose uses the following color coding:	9
Main Distribution Frame (MDF) and Intermediate Distribution Frame (IDF) Equipment Subsystem and Telecommunication Closets	10
Definition:	10
Main Distribution Frame (MDF)	11
Intermediate Distribution Frame (IDF)	11
General Information - The following are general requirements for an IDF	11
MDF/IDF Specifications	12
Floor Loading (Floor Mount Cabinets)	12
Provisioning	12
Water Infiltration	13
Heating Ventilation and Air Conditioning (HVAC)	13
Electromagnetic Interference	13
Vibration	14
Size	14
In-Building Backbone Subsystem (Horizontal and Vertical)	14
Definition	14
General Information	14
Electromagnetic Interference (EMI)	14
Physical Routing	15
UTP Splices and Bridge Taps	16
UTP Cable Bends	16
Patch Cords	16

Conduit	16
Surface Raceway	16
Pullstring	17
Reaming	17
Length	17
Bends	17
Physical Media Specifications	17
Service Provider Coordination	18
Wall/Face Plates	18
Cable bundles	18
J-hooks	18
Threaded Rod	18
Cable Tray	19
Hook and Loop Cable Ties	19
Cable Management	19
Modular furniture outlets	20
Power Pole Outlets	20
Fiber Optic Cable	20
Fiber Optic Installation Testing	21
Multimode fiber optic connector	21
Single-mode fiber optic connector	21
Single-mode Fiber Optic Adapter	22
Patch Panels	22
Service Loops	22
Firestopping	23
Definition:	23
Approved material types:	23
Telecommunications Bonding and Grounding Requirements	23
Cabinet Specifications	24
Cabinet Size Specifications - Closed Racks	24
Size Specifications - 2-Post Open Frame Racks	24

1. Contractor Qualifications and Requirements

- a. Contractor must possess a valid MA State contractor's license. This license must have been issued five (5) years prior to the date on this Statement of Work.
- b. All City of Melrose cabling projects are prevailing wage.
- c. Contractor shall be responsible for all fees and permits required to any governmental agency having jurisdiction over the work in the proposal. The contractor shall arrange inspections.
- d. Contractor employees shall act in a professional manner, and dressed appropriately for the task. No person shall bring alcoholic beverages, controlled substances, firearms, or animals to the job site. Smoking and tobacco products are not permitted on City Property.
- e. Contractor shall clear the work area every evening. If available space exists, contractor equipment and materials may be stored at the facility with approval of the Owner. All packing material shall be disposed of at the end of each day. The Owner will not be responsible for the loss, theft, or damage of any equipment or material.
- f. The Contractor shall hand sweep any work areas and remove debris from work surfaces after work is completed and every evening.
- g. Contractor shall follow the security policies and procedures defined by the Owner. This may include providing key access, creating access badges, and escorts for restricted areas. All employees performing work in school facilities must be CORI checked prior to performing work.
- h. The Contractor shall take all precautions necessary to protect existing structures and furniture. Any items that are damaged during the course of the work shall be repaired or replaced by the contractor at no cost to the Owner.
- i. Owner will provide the contractor with reasonable access to the job site Monday-Friday 8-4 (Federal / State holidays excluded). The Owner must approve any work that requires access outside of these parameters.
- j. Contractor shall take special precautions to ensure a safe work environment for the employees, contractors, and visitors. All OSHA requirements shall be adhered to.
- k. Contractor will make a reasonable effort to not be disruptive to other contractors, or working staff at the job site.
- l. Contractor will install only material that is new and undamaged. Refurbished or used materials are not acceptable.
- m. Owner expects the workmanship to be of high quality. All equipment shall be plumb and true with the structure. All materials shall be firmly secured in place, adequately supported, and permanent.
- n. Owner will consider the project complete when all work has been completed, the final documentation has been delivered, and the work site has been cleaned to the Owners satisfaction as well as inspected by the Owner
- o. Contractor agrees to replace or repair, as new, any defective work or materials, which are identified by the Owner within 2 years of final payment.
- p. Contractor must have sufficient network expertise and certifications for installations of equivalent size and scope. Contractor must be able to provide documentation upon request.
- q. It is preferred that the Contractor has extensive knowledge and experience working with school and city systems within the state.
- r. Contractor must have been in business for a minimum of 3 years providing cabling services. Contractor must be able to provide documentation upon request.

- s. The contractor selected for the Project must be certified by the manufacturers of the products, adhere to the engineering, installation and testing procedures and utilize the authorized manufacturers components and distribution channels in provisioning the Project.
- t. The Contractor directly responsible for this work shall be a "Structured Cabling System Contractor" who is, and who has been, regularly engaged in the providing and installation of commercial and industrial telecommunications wiring systems of this type and size for at least the immediate past five years. Any subcontractor who will assist the SCS contractor in the performance of this work, shall have the same training and certification as the SCS contractor.
- u. Certification: The contractor's Project Manager shall possess a current BICSI Registered Communications Distribution Designer (RCDD®) certificate. All shop drawings submitted by the contractor shall bear the RCDD's stamp.
- v. The contractor shall have a (BICSI) RCDD on Staff. Contract RCDD's shall not be acceptable.
- w. The contractor shall be responsible for any damage to any surfaces or work disrupted as a result of his work. Repair of surfaces including painting and ceiling tile replacement shall be included as part of this contract.
- x. Because of the detailed planning and coordination with CoMIT, Melrose Public Schools and/or other City departments, preference will be given to Contractors that have previously coordinated projects with them.

2. Warranties

a. **Contractors Warranty**

- i. Contractor shall provide all services, materials and equipment necessary to perform the installation and provide for a working telecommunications system at the end of the project and warranty for one year after system acceptance and or a Certificate of Final Acceptance is issued.. The scope of warranty includes all equipment, devices, wiring, accessories, software, hardware, installation, programming and configuration required to maintain a complete and operable system. Systems provided on a temporary basis, under this section shall not constitute a completion of the project or acceptance of work. The warranty shall cover repair or replacement of defective materials, equipment or and issues arising from poor workmanship, installation or any installation not acceptable under codes governing the installation or not to the satisfaction of the owner.
- ii. Warranty work shall be provided on a 2-business day service beginning on the date of substantial completion at no cost to the Owner.
- iii. The contractor's warranty will cover any damage incurred by correction of items under the warranty.
- iv. Contractors shall provide the City of Melrose IT with all manufacturer's warranties that the City is entitled to after installation of all equipment. The materials, equipment etc. shall be obtained under the name of the Owner. In addition, any and all operational literature including recommended maintenance periods for materials installed shall be provided prior to acceptance.
- v. If warranty work problems cannot be provided by the contractor to the Owner's satisfaction, the contractor shall advise the Owner, in writing, describing the problem, why the problem cannot be corrected, steps made to correct the problem thus far, and possible corrective action. If necessary, the contractor will hire, at no cost to the Owner, a third party engineer/contractor to analyze the problem and provide recommendations to correct the problem. This work will be provided to the Owner in a timely manner.

- vi. Replace material and equipment determined to require excessive service during the warranty period as determined by Owner.
- b. Owner's Rights: This section shall not be interpreted to limit Owner's rights under applicable codes and under this contract

3. Codes, Standards, and Best Practices

- a. General: All work, including but not limited to: cabling, pathways, support structures, wiring, equipment, installation and workmanship shall comply with the latest editions of the requirements of the Authority Having Jurisdiction (AHJ), National Electrical Code, National Electrical Safety Code, all applicable local rules and regulations, equipment manufacturer's instructions, and the National Electrical Contractors Association (NECA) Standard of Installation. In case of discrepancy or disagreement between the documents noted above, the Contractor shall satisfy the most stringent requirements.
- b. All work and materials shall be in full accordance with the latest codes, standards, and best practices. It is the responsibility of the Contractor to have access to each document. In the case that one of the following documents has a ratified update or addendum; it shall be incorporated into this scope of work. If multiple documents provide different requirements, the strictest requirement shall be followed. Not all documents may apply to this project.
- c. Cable routing and Installation practices shall be in accordance with ANSI/TIA/EIA standards, BICSI's Telecommunications Distribution Methods Manual (TDMM), Customer-Owned outside Plant Manual (CO-OSP) and BICSI's Telecommunications Cabling Installation Manual (TCIM).

d. Codes

i. Insulated Cable Engineers Association (ICEA)

1. ANSI/ICEA S-80-576-2002, Category 1 & 2 Individually Unshielded Twisted-Pair Indoor Cables for Use in Communications Wiring Systems, 2002.
2. ANSI/ICEA S-84-608-2002, Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor, 2002.
3. ANSI/ICEA S-90-661-2002, Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems, 2002.
4. ICEA S-102-700-2004, ICEA Standard for Category 6 Individually Unshielded Twisted-Pair Indoor Cables for Use in LAN Communication Wiring Systems
5. Technical Requirements, 2004

ii. National Fire Protection Association (NFPA)

1. NFPA 70 – 2017
2. NFPA 72, National Fire Alarm Code®, 2019
3. NFPA 75, Standard for the Fire Protection of Information Technology Equipment, 2017
4. NFPA 76, Recommended Practice for the Fire Protection of Telecommunications Facilities, 2016
5. NFPA 101, Life Safety Code®, 2018
6. NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials, 2006

7. NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces, 2019
8. NFPA 780, Standard for the Installation of Lightning Protection Systems, 2020
9. NFPA 5000™, Building Construction and Safety Code, 2018

iii. Other Codes

1. FCC 47 CFR 68
2. NEMA – 250
3. NEC - Articles 770 and 800
4. ADA - Americans with Disabilities Act
5. All Federal, State, and Local Codes

e. Reference Standards

i. Telecommunications Industry Association

1. ANSI X3T9.5, Requirements for UTP at 100 Mbps
2. TIA TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse Pair Positioning, 2001
3. TIA TSB-140, Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems (2004)
4. TIA-526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7 T-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – SFSTP-14
5. TIA-568
6. TIA-569
7. ANSI/TIA-598-D, Optical Fiber Cable Color Coding, 2014
8. ANSI/TIA-604.2-A, FOCIS 2—Fiber Optic Connector Intermateability Standard, 2003
9. TIA-606, Administration Standard for Commercial Telecommunications Infrastructures, 2008
10. ANSI J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2002
11. ANSI/TIA-758-A, Customer-owned Outside Plant Telecommunications Infrastructure Standard, 2005
12. ANSI/TIA-854, A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling, 2001
13. TIA-862, Building Automation Systems Cabling for Commercial Buildings, 2002
14. TIA-942, Telecommunications Infrastructure Standard for Data Centers, 2005
15. Category TSB-155, Guidelines for the Assessment and Mitigation of Installed 6 Cabling to Support 10GBASE-T, 2007
16. TSB-184-A, Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
17. ANSI/TIA/EIA – 526-7 – Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
18. ANSI/TIA/EIA – Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant
19. ANSI/TIA/EIA - 569-A Pathway and Spaces
20. ANSI/TIA/EIA – 606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings (labeling identifiers will be provided by Owner)

21. ANSI/TIA/EIA – 607-(A) Commercial Building Grounding/Bonding Requirements
22. ANSI/TIA/EIA-942 – Telecommunications Infrastructure Standard for Data Centers
23. ANSI/TIA/EIA-758-(A) – Customer-Owned Outside Plant Manual

ii. Building Industry Consulting Service International

1. BICSI - Telecommunications Distribution Methods Manual (latest edition)
 2. BICSI - Cabling Installation Manual (latest edition)
 3. BICSI – Customer-Owned Outside Plant Design Manual (latest edition)
 4. ANSI/BICSI N1-2019, Standard for Installing Telecommunications Systems, 2019
 5. BICSI Outside Plant Design Reference Manual (COOSP), current edition.
 6. BICSI Electronic Safety and Security Reference Manual (ESSDRM), current edition
 7. BICSI Information Transport Systems Installation Methods Manual (ITSIM), current edition
 8. BICSI Network Design Reference Manual (NDRM), current edition
- iii. BICSI Wireless Design Reference Manual (WDRM), current edition
 - iv. Institute of Electrical and Electronic Engineers (IEEE)
 - v. National Electrical Manufacturers Association (NEMA)
 - vi. Underwriters Laboratories (UL) Cable Certification and Follow Up Pro-gram
 - vii. ISO/IEC 11801 (International) Generic Cabling for Customer Premises Standard (including all the latest amendments and applicable addenda)

4. Site Preparation Guidelines

a. General Information

- i. The contractor should conduct a site survey. The survey should address items such as floor plans, power requirements, telecommunications closet plans, environmental considerations, grounding, etc.
- ii. Contractors will work with the architects, building operations management, onsite employees and current occupants to secure the necessary information so that the site survey becomes a meaningful planning document.
- iii. All cables and materials used must comply with all relevant local standards for building and electrical materials and construction.
- iv. Cable routing and Installation practices shall be in accordance with ANSI/TIA/EIA standards, BICSI's Telecommunications Distribution Methods Manual (TDMM), Customer Owned Outside Plant Manual (CO-OSP) and BICSI's Telecommunications Cabling Installation Manual (TCIM).

b. Specifications

- i. A detailed site survey should include the following items:
- ii. The user should provide a floor plan with descriptions of communications locations and types of services, as necessary. This may be in the form of a descriptive grid sheet.
- iii. The floor plan should provide room sizes, new or existing telecommunications wiring facilities, planned types of office furniture, HVAC, power locations, and requirements.
- iv. Standards recommend that all premise data equipment be mounted in a standard 19" Closed, Open, or Wall-Mount IT Cabinets, in a secured telecommunications closet within the TSA controlled space. If located in Shared IT Communications or Equipment Rooms, Closed Floor or Wall Mount Racks are recommended. These cabinets should include power strips, side

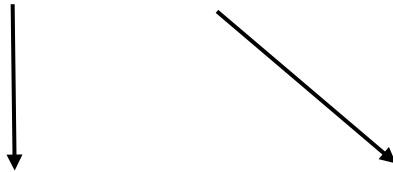
panels, and fans for ventilation if required. TSA standards state the necessity for bolting all full size racks to the floor for seismic requirements and security or local earthquake zone standards if greater.

- v. If access floors exist for cable routing, there shall be a minimum of 6 inches of clear space from the bottom of the floor panel to the deck below.
- vi. The cabinet with data equipment and rack with patch panel shall be connected via cable ladder for cable routing.

5. Labeling Specification

- a. In order to distinguish patch panels from each other, patch panels will be lettered in continuation with the existing lettering. For example, Existing patch panels A, B, C, & D will be followed by a new patch panel labeled, "E." When installing a patch panel in a new location for the first time, the first patch panel in that location shall be labeled as patch panel, "A."
- b. Each of the four-pair UTP Category 5E/6/6A cables will terminate in the MDF, or IDF, on the same numbered port on the appropriate patch panel. For example, a 2-port jack that has a data port with a cable terminating in IDF1 on patch panel A in port 21 would have a wall plate that is labeled for the IDF and a jack that is labeled A21. In the case where cables are running to more than one IDF or to an IDF and MDF, the wall plate port will be labeled with the IDF name (or room number of IDF cabinet), patch panel identifier and patch port number.

XXXX-XXX



For example, this may be IDF1 or if the IDF/MDF is designated with it's own room number, then indicate the room number.

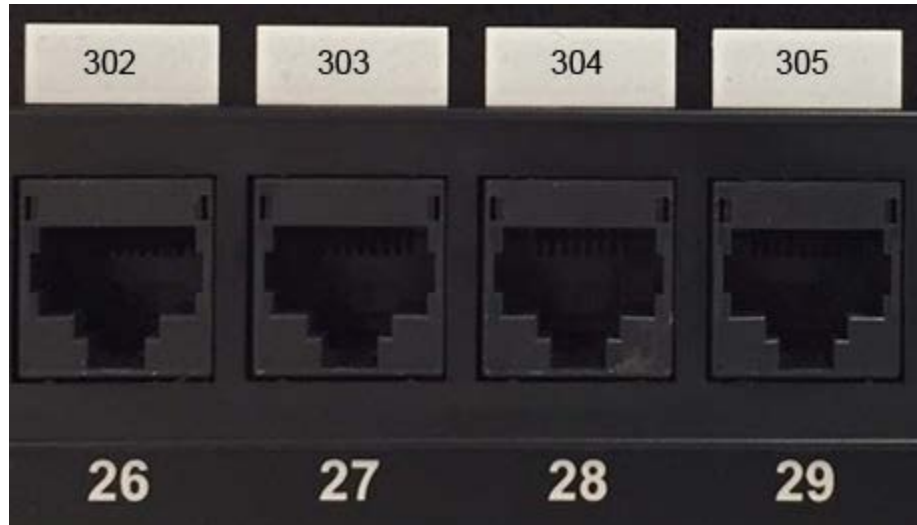
This should indicate the Patch Panel identifier in the IDF/MDF such as "A" or "1" and then the port number on that patch panel such as 21.

- c. RJ-45 Jacks will indicate the Category of cable to which they are connected. See example below:



- d. Wide Area Network (WAN) fiber patch panels should indicate the location from which the cables originated as well as the patch port on the origination patch panel
- e. Patch panel ports shall be labeled to indicate the room from which the cable originated. The label should not cover the number designation given to the port and shall instead be placed above or below the port to avoid coverage. See example below:

In this example, the patch panel ports are 26, 27, 28, & 29 respectively and the room numbers are above the ports.



- f. In order to ensure traceability between patch panel ports and the switch ports, patch cables are required to be labeled at both ends. The patch cable will be labeled with the appropriate patch panel and patch panel port designation at the switch end as well as the switch, switch blade and switch port at the patch panel end. Patch cables are to be labeled with only machine made labels. Permanent marker labeling on patch cables is unacceptable. See example below:



- g. Only permanent machine created labels will be acceptable on outlet wall plates, patch panels, or any locations needing labels that meet the EIA/TIA 606 requirements.
- h. Labeling shall be no less than 12pt. In size.
- i. Labeling shall be black type on white background
- j. Labeling font shall be in an arial font or similar.

6. Color coding

- a. **The City of Melrose uses the following color coding:**

Function	Material Type	Color
----------	---------------	-------

Data	Infrastructure cabling	Blue
Data	Patch cables	Blue
VoIP	Infrastructure cabling	Blue
VoIP	Patch cables	White
Security: Door Access/ Cameras	Infrastructure cabling	Orange
Security: Door Access/ Cameras	Patch cables	Orange
Wireless	Infrastructure cabling	Green
Wireless	Patch cables	Green
HVAC	Infrastructure cabling	Yellow
HVAC	Patch cables	Yellow
Data	Single mode 62.5/125 μm fiber optic cable	Orange
Data	Single mode 62.5/125 μm fiber optic connector	Orange
Data	Single mode 62.5/125 μm fiber optic adapter	Orange
Data	Single mode 50/125 μm fiber optic cable	Aqua
Data	Single mode 50/125 μm fiber optic connector	Aqua
Data	Single mode 50/125 μm fiber optic adapter	Aqua

- b. Jacks will match the color of the cable to which they are connected. For example, a green wireless infrastructure cable will be attached to a green RJ45 port on both the wall plate or other client-end termination, and on the patch panel. Color-coding the RJ45 female termination keystones requires using modular style patch panels which accommodate such terminations.

7. Main Distribution Frame (MDF) and Intermediate Distribution Frame (IDF) Equipment Subsystem and Telecommunication Closets

a. Definition:

The Main Distribution Frame or Main Data Feed is the primary location in a facility for the terminations of cables from IDF closets/cabinets and endpoint client devices. Typically, the MDF

will be the location where the fiber optic cable leaving the facility to connect to the Wide Area Network (WAN) exists. All IDF backbone cabling (mainly fiber) will ultimately be distributed to the MDF. The MDF will be where the routing equipment will be located as well as switching devices.

b. Main Distribution Frame (MDF)

- i. This room shall be designed/sized to serve the entire building/facility/location. This location is to be centrally located such that all IDF closets can connect to it. If MDFs are connected to IDF closets via copper data cable, the MDF shall be a distance from the IDF to ensure that a data cable sheath length does not exceed 295 ft in distance.
- ii. This room will contain the router or routing edge switch as well as other equipment necessary for that building besides switching
- iii. The main fiber optic patch panel will be in the MDF as well. This patch panel will congregate all fiber strands from all of the IDFs.
- iv. The MDF will be the location where fiber optic cable leaving the building to the WAN will be located
- v. The MDF will contain a UPS
- vi. The recommended size for an MDF is 10 ft. x 15 ft. or larger unless otherwise specified.
- vii. No matter the size of the building, an MDF should be the only distribution frame in the building if all copper cabling sheath lengths are less than 295 ft. to the end-point jacks throughout the building.

c. Intermediate Distribution Frame (IDF)

- i. This room will be designed/sized to server any spaces or areas of the building/facility/location, which are in excess of 295 ft., of the MDF
- ii. The IDF will usually only contain the switches and patch panels along with UPS equipment.
- iii. The IDF may contain security camera/door access equipment that is to be relayed to the MDF.
- iv. The recommended size for an IDF is 8 ft. x 8 ft. or larger.

d. General Information - The following are general requirements for an IDF

- i. It should be as close as possible to the areas for which it serves
- ii. It should be for switching/telecommunications equipment only.
- iii. It should not double as storage of any kind
- iv. In small buildings, an IDF should not be included if the copper cable end-point terminations are less than 295 ft. as indicated on the cable sheath length indication.
- v. Power requirements must meet manufacturer recommendations. This may include a conditioned power supply or UPS with an isolated AC ground.
- vi. There should be a minimum of 1 120 VAC circuit or 1 208 VAC circuits depending on the cabinet UPS requirements. It shall provide facilities (space, power, grounding, etc.) for passive or active devices used to interconnect the horizontal wiring to the backbone wiring.
- vii. Environmental factors (temperature and humidity) should conform to the equipment with the most stringent requirements.
- viii. All active equipment (i.e., wiring hubs, concentrators, controllers, switches, etc.) placed in telecommunications closets should only serve devices on the same floor. In the case of multiple telecommunications closets per floor, active equipment located in one of the telecommunications closets should only serve devices normally supplied from that closet.

- ix. When selecting a site for an IDF or MDF, be sure to place the IDF or MDF in a location where expansion is possible. Future expansion of the room may be required.

e. MDF/IDF Specifications

- i. The MDF and IDF should comply with EIA/TIA-569. Additionally, all voice-related cross-connections should utilize IDC-type connecting hardware. Cross-connections for data-related UTP should utilize plugended patch cords. All patch cords should be in accordance with EIA/TIA 568B polarization sequences and comply with TSB 36 and 40. All cross-connections involving the use of fiber optic cabling should be made using single mode fiber optic patch cords with LC compatible plugs on both ends.
- ii. IDF and MDF specifications for size and other considerations, should be discussed with the City of Melrose IT Department prior to design.

iii. Floor Loading (Floor Mount Cabinets)

1. Floor loading capacity in the MDF/IDF shall be sufficient to bear both the distributed and concentrated load of installed equipment. The recommended minimum distributed loading bearing capacity shall be 150 lb/ft. This is for the largest model of Closed Cabinet (42RU). Smaller locations may be able to use Wall-Mount IT Cabinets, which will require a plywood backboard, for mounting.
2. The weight of a configured MDF/IDF ranges between 1050 and 1400 lbs. for the largest Floor Mount Cabinets. Floor loading capacity in the MDF/IDF shall be sufficient to bear both the distributed and concentrated load of installed equipment. The recommended minimum distributed loading bearing capacity shall be 150 lb/ft. This is for the largest model of Closed Cabinet (42RU). Smaller locations may be able to use Wall-Mount IT Cabinets, which will require a plywood backboard, for mounting. Plywood shall be $\frac{3}{4}$ " A-C type and affixed to framing behind the wall.

iv. Provisioning

1. Lighting will be a minimum of 540 lux (50 foot candles) measured 3 foot above the finished floor, mounted 2600 mm (8 ft. 6 in.) above the finished floor.
2. There should be a minimum clearance height of 2440mm (8 ft.) throughout the room.
3. The installed equipment determines the electrical power requirements for the cabinets. IDF closets shall contain at least one (1) 208Volt 30 Amp electrical circuit terminating to a NEMA L6-30 locking receptacle and one (1) 120 Volt 20 Amp electrical circuit terminating to a NEMA 5-15 receptacle per vertical, floor standing rack. Consult with City of Melrose IT Department concerning the needed electrical needs prior to installing receptacles in an IDF/MDF.
4. The electrical receptacle must be located such that the UPS can be plugged in without the cord lying on the floor to be tripped over or walked on which could damage the supply cord or unplug it. Typically, this is accomplished by installing the receptacle above the rack.
5. A separate electrical circuit shall be designated for each IDF and MDF. The requirements for power in these locations should be determined by the designers in conjunction with IT staff.
6. Electrical outlets in the IDF and MDF shall be connected to a generator such that power is restored to equipment. UPS equipment will power network etc., equipment until the generator can return power.

7. Lighting and equipment shall not be on the same circuit.
8. Emergency lighting shall be provided in IDF or MDF spaces.
9. All active equipment, such as wiring hubs, concentrators, controllers, switches, etc. which provide support to campus or critical subsystem equipment, shall connect to a UPS, or a Surge Suppressor (MDF requires a UPS; and IDF requires a Surge Suppressor). A review of the proposed equipment for the telecommunications closet will determine any other environmental settings, such as cooling and humidity.
10. A minimum of two walls shall be covered in ¾" A-C plywood 8' high and affixed to studs or other framing behind such that they are capable of supporting attached equipment.
11. Doors shall be a minimum of 36" wide and 80" high
12. Doors shall not contain a doorsill
13. Doors shall swing outward unless in violation of local code.
14. If anticipated large equipment is to be moved into an MDF, a double door shall be installed with a minimum of 72" wide and 90" high without a doorsill or center post.
15. Finishes in IDF or MDF shall be light colored
16. The MDF and IDF shall be void of contaminants that could affect installed equipment
17. Adequate ventilation must be provided if the IDF or MDF contain or will contain UPS batteries

v. Water Infiltration

1. The MDF or IDF shall not be located in a place where it could possibly receive water from any means.
2. The IDF or MDF shall not be located below a bathroom or janitorial closet containing a plumbing fixture or below a water feed or drain pipe of any kind.
3. A drain shall be placed in the IDF or MDF if there exists a risk of water infiltration
4. If a sprinkler system is required, consider a pre-action system.

vi. Heating Ventilation and Air Conditioning (HVAC)

1. The MDF shall have it's own independently operated HVAC or air conditioning system.
2. The HVAC equipment installed shall be adequate to run 365 days a year on a 24 hour a day basis. A second system may be necessary to achieve this redundancy.
3. The temperature and humidity shall provide continuous operating ranges of 65°F to 80°F with a 20% to 60% relative humidity. Humidification and dehumidification equipment may be required depending on local conditions. Measure ambient temperature and humidity at a distance of 1.5m (5 ft.) above floor level, after equipment is operational, and at any point along equipment aisle centerline.
4. HVAC equipment servicing IDFs or MDFs must be tied into a generator-backed circuit in order to provide cooling during a power outage.

vii. Electromagnetic Interference

1. The IDF or MDF shall be at a distance from sources of electromagnetic interference so as to assure a reduction down to 3.0 V/m throughout the frequency spectrum. Give special attention to power supply transformers, motors and generators, radio and induction sealing devices. It is desirable to locate the MDF close to the main backbone pathway.

viii. Vibration

1. The MDF will be designed to meet the vibration specifications listed below:

Frequency (Hz)	Vibration Amplitude
5 - 22	0.01 inches double amplitude displacement
22 – 500	0.25 g peak acceleration
500-22	0.25 g peak acceleration
22-5	0.01 inches double amplitude displacement

ix. Size

1. The size of the MDF shall meet the known requirements of specific equipment. If information is absent, then allow for 0.75 ft. of floor space in MDF for every 100 ft. of workstation space.
2. The MDF is recommended to be a minimum of 150 square ft. Optimum size is based on installed equipment, as well as relative cabling requirements. IT Rooms may also contain other equipment such as Physical Security, and/or other elements.
3. Environmental control equipment, such as power conditioning or distribution systems, and UPSs up to 100 KVA, are allowable in the MDF. Locate UPSs larger than 100 KVA in a separate room.

8. In-Building Backbone Subsystem (Horizontal and Vertical)

a. Definition

- i. The in-building backbone subsystem is the passive connective cabling between and IDF and IDF or IDF and MDF. The Backbones consist of Fiber Optic cable and copper cabling in addition to the fiber optic cable in some circumstances. The cables will terminate in a patch panel.

b. General Information

- i. Backbone fiber optic cabling will be terminated in LC type connectors in fiber optic patch panels at both ends of the backbone terminations.
- ii. The general design of the in-building backbone system will be a star topology. There shall be no more than two hierarchical levels of wiring cross-connects in the backbone wiring. Interconnections between any IDFs shall pass through three or fewer cross-connects. Wiring may pass through only one cross-connect to reach the main cross-connect. Cross-connects may be in telecommunications closets, equipment rooms, or at entrance facilities. All wiring cross-connects will be in secured rooms/closets.

c. Electromagnetic Interference (EMI)

- i. The backbone subsystem cabling shall be at a distance from sources of electromagnetic interference so as to assure a reduction down to 3.0 V/m throughout the frequency spectrum. Give special attention to power supply transformers, motors and generators, radio and induction sealing devices. It is desirable to locate the MDF close to the main backbone pathway.
- ii. When running cabling or planning for cable runs through pathways and spaces, the contractor and/or designer shall give consideration to nearby noise sources such as electric power wiring, radio frequency (RF) sources, large motors and generators, induction heaters, arc welders, etc.
- iii. The NEC governs co-installation of telecommunications cable and power cable for safety but take additional precautions to protect the integrity of information carried by copper telecommunications cable.
- iv. Closed metal pathways, (i.e., EMT conduits), generally provides adequate protection from nearby capacitive and inductive coupled (rapid changes in large voltages) noise sources typically found in commercial buildings. In cases where inductively coupled (rapid changes in large currents) noise sources are a problem, the closed metal pathway section in proximity to the source shall be of ferrous type material.
- v. Open or non-metal pathways (i.e., open tray or plastic wire ways) shall have sufficient separation from noise sources to eliminate any potential coupling problems. These pathways shall be a minimum of 5 inches away from fluorescent fixtures, ballasts, and high-intensity discharge devices.
- vi. IDFs and MDFs should not be in close proximity to motors, transformers or other high voltage equipment.
- vii. Cabling will be routed in such a way that it complies with standards listed in the standards section of this document and complies with separations from less than or equal to 480V power sources listed below:

Condition	<2 KVA	2-5 KVA	>5 KVA
Unshielded power lines or electrical equipment in proximity to open or non-Metal pathways	5"	12"	24"
Unshielded power lines or electrical equipment in proximity to grounded metal pathways	2.5"	6"	12"
Power lines enclosed in grounded metal conduit (or equivalent shielding) in proximity to grounded metal pathways		3"	6"

d. Physical Routing

- i. Contractor is responsible for providing all supports, hangers fasteners and inserts needed for mounting conduit or affixing cable to structures.
- ii. All items shall be supported from the structure of the building. Ceiling tile, grid, hanger wire or supports are not to be used as support for cabling or cabling supports. Boxes, plates, and termination biscuits shall not sit on ceiling tile.

- iii. Cables should not be run from floor to ceiling/roof with no conduit, surface raceway or bracket to support the cable.
- iv. Cable should be supported every 2' with some type of support that is affixed to the building.
- v. Whenever possible, routing of cable shall be over corridor areas or along lines that are parallel to contours of building. All deviations from straight runs should be made at right angles. Use pre-constructed distribution systems designed to support and protect standard cable plant when penetrating through wall partitions or between floors.
- vi. Contractor is responsible for providing sleeves through openings and for coring through walls, floors and ceilings during installation
- vii. Cables should never be visible in or outside any structure or on walls, ceilings and floors (any visible surface), in any finished spaces such as rooms, hallways, etc.
- viii. Follow Federal, State and Local fire codes when considering wall penetrations and closing those penetrations once work has completed

e. UTP Splices and Bridge Taps

- i. Standards prohibit use of splices and bridge taps

f. UTP Cable Bends

- i. UTP cable bends should comply with standards and be no less than 4 times the diameter of the cable.

g. Patch Cords

- i. Patch cords shall meet or exceed the requirements for the adjoining cabling that the patch cable is patching.
- ii. As discussed in section 5, "Color Coding," patch cables should match the color specified for its purpose
- iii. Consult with IT staff as to the proper patch cables to purchase and use.
- iv. Patch cords shall be purchased from a reputable contractor and not manufactured by the installer.
- v. Patch cords should not exceed 20'
- vi. Patch cords should be an appropriate length for the distance between the ports they are connecting.

h. Conduit

- i. Follow appropriate electrical codes for use of conduit when required.
- ii. In open garage bays, always use Electrical Metallic Tubing (EMT) or Galvanized Rigid Steel (GRS) conduit.
- iii. Contractor is responsible for providing all conduit as well as fasteners and clamps etc. necessary for installation

iv. Surface Raceway

- 1. Cabling in surface raceway shall have a maximum 40% fill capacity. Future installations should be anticipated

2. Surface raceway shall be affixed using screws into the surface being mounted to; adhesive cannot be used as a permanent method of affixing surface raceway.
3. Surface raceway shall be installed using a level to assure a level appearance.
4. Surface raceway shall contain all needed pieces to be complete i.e., elbows should be used at turns, couplings used where two lengths come together etc.
5. End caps shall be used where wire enters into surface raceway at ceilings
6. When using plastic surface raceway, screws shall be placed within 16" of each other in order to avoid sagging.

v. Pullstring

1. Place a pullstring along with cabling in all conduit to allow for future cable installation
2. During installation of pull strings, all pull strings shall be marked with vinyl tags indicating where the opposite end may be found.

vi. Reaming

1. Ream conduit to eliminate sharp edges and terminated with an insulated bushing. Terminate conduit protruding through the floor 25-50 mm (1-2 in) above the floor surface.

vii. Length

1. No section of conduit shall be longer than one hundred (100) ft or contain more than two (2) 90 degree bends between pull points or pull boxes.

viii. Bends

1. The inside radius of a bend in conduit shall be at least 6 times the internal diameter. When the conduit size is greater than 2 in., the inside radius shall be at least 10 times the internal diameter of the conduit. For fiber optic cable, the inside radius of a bend for fiber optic cable shall always be at least 20 times the internal diameter of the conduit. No 90 degree bends of fiber optic cable shall occur within the confines of a pull box.
2. PVC conduits shall utilize long radius sweeps at all 90 degree transitions. For Copper cables minimum ten (10) times the internal conduit diameter. For Fiber Optics cables minimum twenty (20) times the internal conduit diameter. Field bending of PVC is allowed as long as the bend radius of the intended cable type is not exceeded.

i. Physical Media Specifications

- i. Refer to standards in EIA/TIA-568-A
- ii. Cable lengths shall not exceed 295' from termination points on either end.
- iii. Breaking strength of a completed cable shall be a minimum of 90 lbs.
- iv. Four-pair UTP cable should have a bend radius of 1" minimum at a temperature of -4 Fahrenheit +/- 1.8 degrees without the insulation or jacket cracking.
- v. UTP Polarization - The City of Melrose uses the 568B wiring
- vi. Refer to the color table in section 5 for media colors.

j. **Service Provider Coordination**

- i. The Contractor shall notify the service provider companies (telephone, cable television, etc.) when the conduit system for their entrance cable(s) is being installed. The Contractor shall coordinate the work with the service provider field representative as required.

k. **Wall/Face Plates**

- i. Unless otherwise noted all outlet boxes shall receive blank plates matching the finish of plates on electrical devices in the same room.
- ii. Wall plates shall accommodate **universal keystone jacks**
- iii. Outlets shall be able to accommodate 1, 2, 4, 6 or 8 modular jacks for a single gang faceplate and 8, 10, or 12 modular jacks in a double gang faceplate.
- iv. Provide blank module inserts for all unused module locations.

l. **UTP Terminations at Keystone Modules at Client-End Room Wall Plates**

- i. Network cable will be terminated in RJ45 female universal keystone jacks
- ii. No proprietary network terminations (jacks) shall be used.

m. **Cable bundles**

- i. In suspended ceiling and raised floor areas if duct, cable trays or conduits are shown on the contract drawings, the Contractor shall bundle, in bundles of 40 or less, horizontal wiring with cable ties snug, but not deforming the cable geometry. Cable ties shall be hook and loop type. Cables of like system and application (Data, Voice, Wireless etc.) shall not be mixed together. The contractor shall adhere to the manufacturers' requirements for bending radius and pulling tension of all cables.

n. **J-hooks**

- i. Where J-hooks are required by the drawings, from cable tray to outlet conduit stubs, or needed for any purpose when running cabling, provide a minimum of two hangers at any corners or 90 degree turns. Attachment shall be to the building structure and framework randomly supported at 3, 4 or maximum of five (5) foot intervals.
- ii. The J-hooks shall feature a wide base loop with smooth curves to eliminate snag potential and cable deformation. Listings: J-hooks shall be in accordance with NEC, ANSI/NECA/BICSI 568-2001 requirements for structured cabling systems. All cable supports shall be U.L. listed.

o. **Threaded Rod**

- i. Where cable is run above the ceiling in areas without walls, threaded rod shall be used (minimum 1/4", however sized to support the intended weight) with the appropriate cable category hanger for cross-room support. Support rods shall be level and plumb after cable installation.

- p. Ceiling suspension wire or independent tie wire shall not be allowed in any space for cable support.

q. **Cable Tray**

- i. Wherever possible, install horizontal cable trays above water and below steam piping. Coordinate installation of tray with other trades for clearances, to avoid conflicts.
- ii. A minimum of 12 in. (300 mm) access headroom shall be provided and maintained above the cable tray system or cable runway.
- iii. A minimum of 6 in. (150 mm) access headroom shall be provided and maintained at one side (two sides if center hung support method specified) of the cable tray system or cable runway. Care shall be taken to ensure that other building components (e.g., air conditioning ducts, pipes, structural elements) do not restrict access.
- iv. The cable tray must be installed with at least 3 in. (75mm) of clear vertical space above the ceiling tiles and support channels (T-bars) to ensure accessibility. When crossing other building components with the cable tray or runway the above specified clearances shall be maintained.
- v. When installing cable in an IDF or MDF, cable shall be run on a cable tray connecting the cable entering the IDF/MDF through a wall penetration to the rack.
- vi. Cable tray shall be rated to carry the weight of the cable being installed.
- vii. Cable bundles running along a cable tray shall be affixed to the cable tray using hook and loop type cable ties at a maximum of 2 ft. between cable ties.

r. **Hook and Loop Cable Ties**

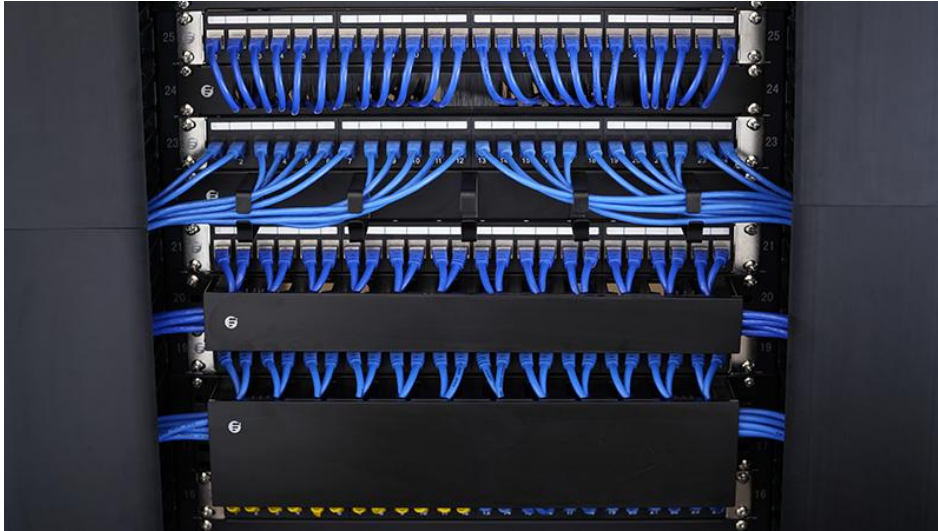
- i. Horizontal cables shall be fastened by hook and loop cable ties from cable tray to outlets in addition to the J-hooks or other approved supports. Fire retardant hook and loop cable ties shall be used in plenum environments. Ties wraps not compliant or not approved for use with cabling Cat6 (when installing Cat6 cables) or Cat6A (when installing Cat6A cables) cabling shall not be used.
- ii. Zip ties or twist ties shall not be used on network cabling
- iii. Example of hook and loop cable ties (Example is of a reel that is cut to length for application)



s. **Cable Management**

- i. Vertical and horizontal cable management shall be used in places such as patch panels, in order to keep cables organized and neat.
- ii. As a general rule, there should be at least one 2U cable management panel for every 8U of patch panel
- iii. Cables in a rack shall be organized in such a way as to split the cables running in two opposite directions from the middle of a device such as a switch and run along the cable management to its destination.
- iv. The top row of cables from a switch should run to a cable organizer above the device

- v. Ensure the least amount of stress on the switch or patch panel port when installing patch cables.
- vi. Bottom row of cables from a network switch shall be run to a lower patch panel beneath the device.
- vii. Example of proper network cable management at a rack with proper flow directions



t. Modular furniture outlets

- i. Where modular furniture outlets are indicated on drawings, they shall consist of modular furniture faceplate capable of housing up to (4) 8-position modular connectors. Provide blank module inserts for all unused module locations.

u. Power Pole Outlets

- i. Where power pole outlets are indicated on drawings, keystone jacks shall snap directly into the standard cutouts in most major power poles including Wiremold. Include any spacers or adapters to ensure a proper fit. Coordinate adapter with power pole provided prior to ordering. Provide a blank device plate for each spare or unused jack.

v. Fiber Optic Cable

- i. Reference ANSI/TIA-568-C.3
- ii. Fiber optic cable colors: See table in section 5 for color coding.
- iii. Vertical risers between floors shall use fiber optic cable listed for use as riser type cable.
- iv. Cable installed in plenum spaces shall utilize cable listed for use in plenum spaces.
- v. All new fiber optic cable cables shall be 50/125 μm (OM4 or better) with LC type connectors..
- vi. Only use 62.5/125 μm (OM1) cable when needed to connect with legacy cables or hardware that strictly uses only 62.5/125 μm .
- vii. All cross-connections involving the use of fiber optic cabling should be made using single mode fiber optic patch cords with LC compatible plugs on both ends.
- viii. Approved manufacturers for Wide Area Network fiber optic cable, adapters and connectors are: Corning Cable Systems
- ix. Outdoor Single Mode fiber optic cable shall be of OS2 type
- x. Indoor Single Mode Fiber can be of either OS1 or OS2 type.

- xi. Use appropriate lengths for fiber optic patch cable at patch panels so as to avoid coiling or entanglement with other cable and accidental tight bends.

w. Fiber Optic Installation Testing

- i. Any new fiber optic cable installed shall be tested according but not limited to the following standards and procedures:

- ANSI/TIA-568 “Commercial Building Telecommunications Cabling Standard” specifically the TIA/EIA-568-B.1 which advocates the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B for multimode systems and ANSI/TIA/EIA-526-7, Method A.1 for single-mode systems.
- ISO/IEC 11801, “Information technology - Generic cabling for customer premises”
- IEC 61280-4-1, “Fibre-optic communication subsystem test procedures – Part 4-1: Installed cable plant – Multimode attenuation measurement”

x. Multimode fiber optic connector

- i. Refer to the color table in section 5 for connector colors.
- ii. Multimode 62.5/125 or 50/125 μm LC type connector field installable. Connector shall be compliant with industry standard ANSI/TIA/EIA-568-B.3 and the applicable TIA/EIA Fiber Optic Connector Intermateability Standard (FOCIS) document, TIA/EIA 604 series.
- iii. All new fiber optic cable connectors shall be 50/125 μm LC type. Only use 62.5/125 μm cable when needed to connect with legacy cables or hardware utilizing only 62.5/125 μm .
- iv. The connector shall have a ceramic ferrule.
- v. Connectors shall meet or exceed the following transmission and mechanical specifications:
- vi. The maximum insertion loss shall be 0.75 dB (maximum) when installed in accordance with the manufacturer’s recommended procedure and tested in accordance with FOTP171.
- vii. Connector reflectance shall be less than or equal to -26 dB when installed in accordance with the manufacturer’s recommended procedure.
- viii. Connectors shall sustain a minimum of 500 mating cycles without violating specifications.
- ix. Connectors shall have an optical axial pull strength of 2.2 N (0.5lbf) at 90° angle, with a maximum 0.5dB increase in attenuation for both tests when tested in accordance with ANSI/EIA/TIA-455-6B.

y. Single-mode fiber optic connector

- i. Refer to the color table in section 5 for connector colors.
- ii. Single-mode LC type connector, field installable.
- iii. Connector shall be compliant with industry standard ANSI/TIA/EIA-568-B.3. The connector shall comply with the applicable TIA/EIA Fiber Optic Connector Intermateability Standard (FOCIS) document, TIA/EIA 604 series.
- iv. The connector shall have a ceramic ferrule.
- v. Connectors shall meet or exceed the following transmission and mechanical specifications:
 - 1. Maximum insertion loss shall be 0.75 dB per each mated connector pair when installed in accordance with the manufacturer’s recommended procedure and tested in accordance with FOTP-171.

2. Reflectance of the connector shall be less than or equal to -40 dB (UPC) when installed in accordance with the manufacturer's recommended procedure.
3. Connectors shall sustain a minimum of 500 mating cycles without violating specifications.
4. Connectors shall have an optical axial pull strength of 2.2 N (0.5lbf) at 90° angle, with a maximum 0.5 dB increase in attenuation for both tests when tested in accordance with ANSI/EIA/TIA-455-6B.
5. Connectors shall meet the following performance criteria:

Test	Procedure	Max. Attenuation Change (dB)
Cable Retention	FOTP-6	.2 dB
Durability	FOTP-21	.2 dB
Impact	FOTP-2	.2 dB
Thermal Shock	FOTP-3	.2 dB
Humidity	FOTP-5	.2 dB

6. Connectors for video transmission applications shall be Angled Physical Contact (APC) and shall have a reflectance less than or equal to -65 dB.
7. The connector shall be pre-terminated on a factory installed pigtail for fusion-splicing field termination.

z. Single-mode Fiber Optic Adapter

- i. Refer to the color table in section 5 for adapter colors.
- ii. Single-mode LC adapters shall be constructed of one piece. It shall allow for the termination of two LC connectors in a duplex adapter in accordance with TIA/EIA-568-B.3.

aa. Patch Panels

- i. Patch panels should be of the modular type utilizing industry standard high-density RJ-45 keystones
- ii. Patch panels shall come fully loaded. Please see the color coding section of this document for color specifications.
- iii. For patch panel labeling, please see section 4 of this document.
- iv. For patch panel cable management, please read the beginning of section 7 and reference the cable management section.

bb. Service Loops

- i. 5' circular service loops of horizontal or vertical cable shall be placed in the ceiling above client-end network jacks.

- ii. Service loops of at least 1' for every 1' distance from the ceiling shall be placed overhead above the distribution frame in the IDF/MDF
- iii. A service loop of at least 5' should be affixed to or above the rack or IDF cabinet
- iv. Service loops shall be properly affixed to ladder tray or other mechanical support intended to support cable.
- v. Service loops shall be bundled with hook and loop cable ties.

9. Firestopping

a. Definition:

This section describes how the use of fire stopping is to be used when penetrating walls and where called for in any plans for running new cable. Additionally, the considerations for re-establishing firestopping when it has been removed.

- b. Firestop all penetration with appropriate materials in accordance with the manufacturer's specification, NFPA practices and applicable codes (See codes listed in Section 1 of this document).
- c. Materials used for firestop may be outlined in an architectural or engineer's drawing or plan/specification. Those specifications should be followed and take precedence over any material listed in this section.
- d. **Approved material types:**

Type	Application
Elastomeric components	Used in pre-manufactures mechanical systems
Putties	May be used with ceramic fiber or rock wool
Caulks	
Cementitious materials	
Intumescent sheets	
Intumescent wrap Strips	used to wrap plastic or metal piping, or cable bundles that may burn away and leave a significant void.
Pre-manufactured pillows	
Silicone foam	

10. Telecommunications Bonding and Grounding Requirements

- a. Bonding and grounding is needed to protect equipment, satisfy warranty requirements, for system performance, service protection and for personnel safety (code requirement – NEC/CSA/BS/IEC).
- b. Telecommunications bonding and grounding shall follow the following applicable standards:
 - ANSI J-STD 607B
 - ANSI/NECA/BICSI 607:2011
 - ANSI/TIA 607B: 2011
 - BICSI TDMM 13th Edition:2014

- BS 7430:2011
- IEEE 1100:2005
- IEEE 81:2012
- ISO/IEC 30129:10.2015
- NFPA 70:2014 (NEC)
- Motorola R56:2005

11. Cabinet Specifications

a. Cabinet Size Specifications - Closed Racks

Cabinet	Height (in.)	Width (in.)	Device Depth (in.)	Stationary Weight Rating (lbs.)	Rolling Weight Rating (lbs.)
25U	48-52	23-25	37-42	3000	2250
32U	63-65	23-25	37-42	3000	2250
42U	81-83	23-25	37-42	3000	2250

- Closed cabinets should be specified in locations where the cabling and equipment are located in rooms not dedicated to low-voltage wiring.
- Closed cabinets shall have keyed entry
- Keys should be marked for the IDF/MDF and the cabinet number
- Keys should be sent to the City of Melrose IT Dept.
- All closed rack cabinets shall have a standard 19" device width mounting

b. Size Specifications - 2-Post Open Frame Racks

- All racks shall have a standard 19" device width mounting

Cabinet	Height (in.)	Width (in.)	Device Depth (in.)	Stationary Weight Rating (lbs.)	Rolling Weight Rating (lbs.)
25U	≥48	24	≥35	3000	2250
32U	≥60	24	≥35	3000	2250
42U	≥78	24	≥35	3000	2250
48U	≥90	24	≥35	3000	2250

- Open cabinets are preferred in locations where cabling and equipment are only accessible to IT personnel in rooms such as an IDF or MDF.
- Wall hanging cabinets or cabinets on casters should have the following features:

- | |
|--|
| <ul style="list-style-type: none"> ● Hinged swinging rack ● Depth shall be enough to accommodate switching, cabling and UPS (typically 30") ● Proper air flow to provide enough cooling in the location in which it will be installed |
|--|

- Rated to properly support the equipment being installed in the cabinet
- Proper grounding
- 19" wide mounting width
- Side access or removable side access panels