City of Brantford
Network Cabling Specifications

Tuesday November 6, 2018

Information Technology Infrastructure Services Division

Specification Version History

Version #	Implemented	Revision	Approved	Approval	Reason
1	February 24th, 2020	1	Yes	Director, IT Services	Replaced Employee Name with Position Title.
2	May 5, 2023	3	Yes	Manager, IT Infrastructure Services and Support	Updated TOC with Building Code General Guidelines- requirement to follow building code Appendix V – Building Code
3	May 15, 2023	6	Yes	Manager, IT Infrastructure Services and Support.	Section F – remove bullets 2, 3 and 4. Section G – remove request to supply certifications in bullet 1-a. Section g - .remove bullet 2. Bullet 3 becomes 2, 4 becomes 3. II.A.2 – remove option to substitute. II.E – remove bullets 2 – 7 III – remove section F.
4	April 29, 2024	7	Yes	Manager, IT Infrastructure Services and Support	II – A.2 – Remove Belden and Panduit.

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I. General

A. Purpose of Document

1. This document is to provide a standard defining the structured communications cabling systems to be installed within City of Brantford facilities. It is geared toward leveraging our legacy cabling infrastructure while upgrading to more recent technologies in new installations. The goal is to accomplish this in the most economic and systematic fashion possible, and in a manner compliant with the latest codes, cabling standards, and industry best practices.

2. Within this document, the facilities owner is City of Brantford, and shall be referred to as such, or as IT infrastructure. Bidding low-voltage installers shall be referred to as “Installer” or “Contractor”.

3. It is the responsibility of the installing Contractor to evaluate these general recommendations and adapt them effectively to actual projects. Contractor is responsible for identifying and bringing to the attention of City of Brantford any design directions that may be improved. All such changes shall be approved in writing from IT infrastructure.

4. This specification defines quality standards and practices common to all City of Brantford network cabling upgrades and Greenfield (new) projects. The system offered and quoted, shall incorporate all features and facilities listed in this specification.

5. In addition to this cabling standard, individual projects will also have associated documentation such Requests for Proposals (RFP), facility drawings, and project schedules pertaining to that particular job. Such collateral will be referred to in this document as “Project-specific Documentation”, “Project Documentation”, or simply “Construction Documents”. Many of the requirements described herein may be detailed or expanded upon by such project-specific documents.

6. Any conflict between this general specification and any project-specific documentation shall be brought to the attention of City of Brantford and will be resolved by City of Brantford in writing.

7. Note that while many portions of this specification are addressed to "The Contractor", these requirements apply equally to architects, engineers, project managers, planning, or anyone doing network cabling and infrastructure work within City of Brantford facilities, whether those persons are outside contractors or persons directly employed by City of Brantford.

B. Scope of Work – Typical

1. Contractor shall be solely responsible for all parts, labor, testing, documentation, and all other processes and physical apparatus necessary to turn over the completed cabling system and associated infrastructure fully warranted and operational for acceptance by City of Brantford.

2. This specification includes structured cabling for the production Ethernet network, but may address other systems that have converged onto Ethernet-style cabling. These associated systems may include VoIP, Building Automation Systems (BAS), Building Access Control, Security Cameras and Audio Visual Systems.

3. The following cabling subsystems will be defined:

   i. Cabling Subsystem 1 – Horizontal Copper Cabling

   ii. Cabling Subsystem 2 – Intrabuilding Fiber Backbone Cabling OM4

   iii. Racks and Cable Management

   iv. Bonding and Grounding

   v. Cable Pathways

   vi. Network Labeling

4. In the event that requirements of the project documents cannot be met during design or installation, a written description of the need for variance will be submitted to the City of Brantford Project Manager for review by IT infrastructure

C. General Guidelines

1. All voice telephony systems shall be VoIP unless otherwise specified in the project-specific documentation.

2. Any copper or fiber patch cords shall be factory terminated. Hand terminated patch cords will not be accepted.

3. All Greenfield (new) projects shall use Cat 6A cable.

4. On Brownfield (existing) installations, Contractor shall consult project documentation for guidance on the current Category of copper cable to be installed.

5. Any deviation from Cat 6A cabling shall be approved in writing by IT Infrastructure .

6. Wiring configuration on Cat 6A systems shall be T568A.

7. Any communications/IT consulting engineers retained by City of Brantford shall be at the sole discretion of IT infrastructure.

8. Must follow Ontario building code – Appendix V. Non-plenum cable must be encased in EMT as per section 3.1.5.18 1.b.v of the code.

D. Terminology from TIA 569

1. New Terms for LAN Rooms

   a. This section reviews some of the current terminology for communications rooms and spaces as defined in TIA 569-D (April 2015).

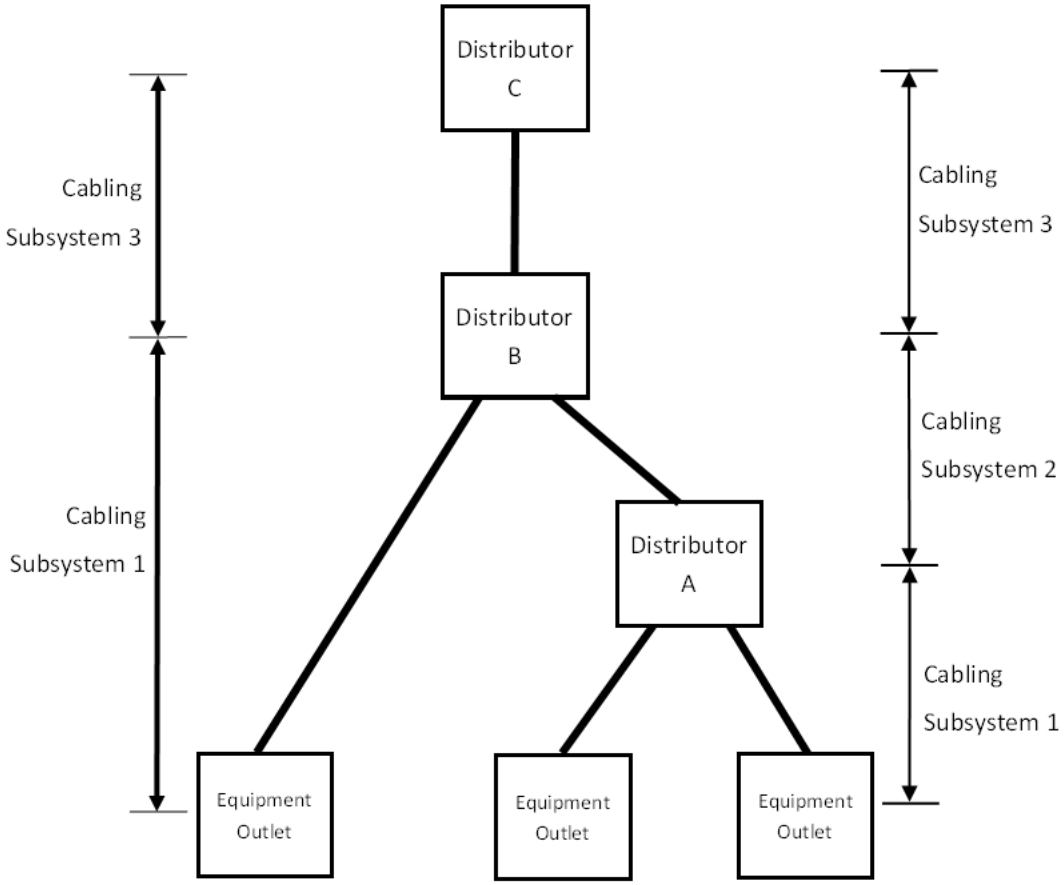
b. Awareness of these new terms is important for communicating accurately and for clearly understanding language used in specifications and other documents.

c. This specification will use both new and old terms side-by-side for clarity.

d. The table below shows some of the most important new terms and how they relate to traditional terminology:

Old Term(s)	New Term
Entrance Facility.	Entrance Room
LAN Room, Equipment Room.	Distributor Room
LAN Room, Equipment Room.	LAN Room
Cross-connect, Patching System, Optical Enclosure.	Distributor
Horizontal Cross-connect. Usually copper patch panels in enterprise installations.	Distributor A
Intermediate Cross-connect, Intermediate Distribution Frame. Usually multimode optical enclosure in enterprise installations. Can apply to intra and interbuilding fiber cabling subsystems.	Distributor B
Main Cross-connect, Main Distribution Frame. Usually singlemode optical enclosure in enterprise installations. Can apply to intra and interbuilding fiber cabling subsystems.	Distributor C
Faceplate, Surface Box, Work Area Appliance.	Equipment Outlet
Work Area.	Equipment Outlet Location
Horizontal Cabling. Extends from Equipment Outlet to Distributor A, B, or C depending on size of cable plant. Usually balanced twisted pair cable in enterprise installations.	Cabling Subsystem 1
Extends from Distributor A to Distributor B or C, depending on size of cable plant. Usually 50-micron intra-building backbone fiber cable in enterprise installations. But may be singlemode fiber.	Cabling Subsystem 2
Connects Distributor A to Distributor B. In enterprise installations, this is usually singlemode fiber between buildings.	Cabling Subsystem 3

Example of a logical cabling topology with the new terminology see illustration below:



E. Applicable Regulatory References

1. Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.

2. ANSI/TIA:

   a. ANSI/TIA-526-7-A (July 2015) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

   b. TIA-526.2-A (July 2015) Effective Transmitter Output Power Coupled into Single-Mode Fiber Optic Cable - Adoption of IEC 61280-1-1 ed. 2 Part 1-1: Test Procedures for General Communication Subsystems – Transmitter Output Optical Power Measurement for Single-Mode Optical Fiber Cable

   c. ANSI/TIA-4994 (March 2015) Standard for Sustainable Information Communications Technology

   d. ANSI/TIA-526-14-C (April 2015) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

   e. ANSI/TIA-568.0-D (September 2015) Generic Telecommunications Cabling for Customer Premises (supersedes TIA-568-C.0 and TIA-568-C-1)

   f. ANSI/TIA-568-C.2 (August 2009) Balance Twisted Pair Communications and Components Standards

   g. TIA-568-C.2-1 (July 2016) Balanced Twisted-Pair Telecommunications Cabling and Components Standard, Addendum 1: Specifications for 100 Next Generation Cabling

   h. TIA-568-C.2-2 (November 2014) Balanced Twisted-Pair Telecommunications Cabling and Components Standard, Addendum 2: Additional Considerations for Category 6A Patch Cord Testing

   i. TIA-568-C.3 (June 2008) Optical Fiber Cabling Components Standard (will be superseded by ANSI/TIA-568.3-D after default ballot)

   j. TIA-568-C.3-1 (October 2011) Optical Fiber Cabling Component Standard- Addendum 1, Addition of OM4 Cabled Optical Fiber and array connectors (will be superseded by ANSI/TIA-568.3-D after default ballot)

   k. ANSI/TIA-568-C.4 (July 2011) Broadband Coaxial Cabling Components Standard

   l. ANSI/TIA-568.1-D (September 2015) Commercial Building Telecommunications Infrastructure Standard (supersedes ANSI/TIA-C.1)

   m. ANSI/TIA-569-D (April 2015) Telecommunications Pathways and Spaces

   n. ANSI/TIA-598-D (July 2014) Optical Fiber Cable Color Coding

   o. ANSI/TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard

   p. ANSI/TIA-606-B (June 2012) Administration Standard for Telecommunications Infrastructure

   q. ANSI/TIA-606-B-1 (December 2015) Administration Standard for Telecommunications Infrastructure Addendum 1 - Automated Infrastructure Management Systems - Addendum to ANSI/TIA-606-B

r. ANSI/TIA-607-C (November 2015) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

s. ANSI/TIA-758-B (March 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard

t. ANSI/TIA-862-B (February 2016) Structured Cabling Infrastructure Standard for Intelligent Building Systems

u. ANSI/TIA-942-B (July 2017) Telecommunications Infrastructure Standard for Data Centers

v. ANSI/TIA-1005-A (May 2012) Telecommunications Infrastructure Standard for Industrial Premises

w. ANSI/TIA-1005-A-1 (January 2015) Telecommunications Infrastructure Standard for Industrial Premises, Addendum 1- M12-8 X-Coding Connector - Addendum to TIA-1005-A

x. ANSI/TIA-1183 (August 2012) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems

y. ANSI/TIA-1183-1 (January 2016) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems, Extending Frequency Capabilities to 2 GHz - Addendum to TIA-1183

z. TIA-1152 (November 2016) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling

aa. TIA-1179-A (September 2017) Healthcare Facility Telecommunications Infrastructure Standard

bb. ANSI/TIA-4966 (May 2014) Telecommunications Infrastructure Standard for Educational Facilities

cc. TIA-455-104-B (February 2016) FOTP 104- Fiber Optic Cable Cyclic Flexing Test (supersedes TIA-455-104-A)

dd. TIA/EIA-455-25-D (February 2016) FOTP-25 Impact Testing of Optical Fiber Cables

ee. TIA-604-18 (November 2015) FOCIS 18 Fiber Optic Connector Intermateability Standard – Type MPO-16

ff. TIA-604-5-E (November 2015) FOCIS 5 Fiber Optic Connector Intermateability Standard - Type MPO

gg. TIA-5017 (March 2016) Telecommunications Physical Network Security Standard

hh. TIA-TSB-155-A (Reaffirmed 10-6-2014) Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T

ii. TSB-184 (July 2009) Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling

jj. TSB-4979 (August 2013) Practical Considerations for Implementation of Multimode Launch Conditions in the Field

kk. TSB-190 (June 2011) Guidelines on Shared Pathways and Shared Sheaths

ll. TIA-TSB-162-A (November 2013) Telecommunications Cabling Guidelines for Wireless Access Points

mm. TSB-5018 (July 2016) Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems

nn. TIA-492AAAE (June 2016) Detail Specification for 50-µm Core Diameter/125-µm Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers with Laser-Optimized Bandwidth Characteristics Specified for Wavelength Division Multiplexing

oo. TIA-492AAAB-A (November 2009) Detail specification for 50-µm core diameter/125-µm cladding diameter class Ia graded-index multimode optical fibers

pp. TIA-455-243 (March 2010) FOTP-243 Polarization-mode Dispersion Measurement for Installed Single-mode Optical Fibers by Wavelength-scanning OTDR and States-of-Polarization Analysis

qq. TSB-172-A (February 2013) Higher Data Rate Multimode Fiber Transmission Techniques

3. ISO/IEC

a. ISO/IEC TR 11801-99-01 Information technology – Generic cabling for customer premises: Guidance for balanced cabling in support of at least 40 GBit/s data transmission: Parts 1 and 2

b. ISO/IEC TR 29106 AMD 1 Information technology -- Generic cabling -- Introduction to the MICE environmental classification

c. ISO/IEC 24764 AMD 1 Information technology – Generic cabling for data centers

d. ISO/IEC 11801 AMD 1 AMD 2 Information technology – Generic cabling for customer premises

e. ISO/IEC 15018 AMD 1 Information technology – Generic cabling for homes

f. ISO/IEC 24702 AMD 1 Information technology – Generic cabling – Industrial premises

g. ISO/IEC 14763-1 AMD 1 Information technology – Implementation and operation of customer premises cabling – Part 1: Administration

h. ISO/IEC 14763-2 Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation

i. ISO/IEC 14763-2-1 Information technology – Implementation and operation of customer premises cabling – Part 2-1: Planning and installation – Identifiers within administration systems

j. ISO/IEC 14763-3 Ed 2.0 Information technology -- Implementation and operation of customer premises cabling -- Part 3: Testing of optical fiber cabling

k. ISO/IEC TR 24704 Information technology – Customer premises cabling for wireless access points

l. ISO/IEC TR 24750 Information technology – Assessment and mitigation of installed balanced cabling channels in order to support 10GBASE-T

m. ISO/IEC TR 29125 IT Telecommunications cabling requirements for remote powering of terminal equipment

4. BICSI – Building Industry Consultative Services International – Published Standards

a. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions

b. ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices

c. ANSI/BICSI-003-2014 Building Information Modeling (BIM) Practices for Information Technology Systems

d. BICSI 004-2012, Information Technology Division Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities

e. ANSI/BICSI 005-2016, Electronic Safety and Security (ESS) System Design and Implementation Best Practices

f. BICSI 006-2015 Distributed Antenna System (DAS) Design and Implementation Best Practices

g. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling

h. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

5. BICSI – Building Industry Consultative Services International – Manuals

   a. Telecommunications Distribution Methods Manual, 13th Edition

   b. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition

   c. Outside Plant Design Reference Manual, 5th Edition

   d. BICSI's ICT Terminology Handbook, Version 1.0

   e. Telecommunications Project Management Manual (TPMM), 1st edition

   f. Telecommunications Project Management Reference Document (TPMRD), 2nd Edition

   g. BICSI's Special ICT Design Considerations, Version 1.0

   h. Essentials of Bonding and Grounding, Version 1.0

6. National Electric Codes

   a. National Electrical Safety Code (NESC) (IEEE C2-2012)

   b. NFPA 70-2016, National Electrical Code© (NEC©)

   c. ANSI/IEEE C2-207, National Electrical Safety Code®

   d. National Electrical Code (NEC) (NFPA 70)

   e. NFPA 72 National Fire Alarm and Signaling Code

7. ASHRAE

   a. ASHRAE Standard 90.4P, Energy Standard for Data Centers and Telecommunications Buildings

8. OSHA Standards and Regulations – all applicable

9. Local Codes and Standards – all applicable

10. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.

11. Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.

12. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.

F. City of Brantford Substitution Policy

1. This is a performance-based specification to provide exceptional solutions for all our facilities and departments. As such, substitution of specified products or systems named in this document is highly discouraged.

G. Contractor Qualifications

1. General

   a. Contractor shall hold designation in good standing with the Cabling Manufacturer with authorization to resell and install manufacturer products.

   b. Contractor shall have at least 5 years documented experience installing and testing structured cabling systems of similar type and size.

   c. Contractor shall employ at least one BICSI Registered Communication Distribution Designer (RCDD) to sign-off on all designs offered, including stamping the design with their current BICSI/RCDD stamp.

   d. Contractor shall have all necessary permits, licenses, and inspections required for the performance of data, voice, and fiber optic cable installations.

   e. Technicians installing low-voltage copper systems on the job shall have a current Certified Copper Technicians certificate.

   f. Technicians installing any Fiber Distribution Systems shall have a current Certified Fiber Technicians certificate.

   g. The Contractor shall provide a Project Manager to serve as the single point of contact to manage the installation, speak for the contractor and provide the following functions:

      - Initiate and coordinate tasks with the City of Brantford Project Manager and others as specified by the project schedule.
      - Provide day-to-day direction and-site supervision of Contractor personnel.
      - Ensure conformance with all contract and warranty provisions.
      - Acknowledge and remediate findings by the City of Brantford.

- This individual will remain Project Manager for the duration of the project. The contractor may change Project Manager only with the written approval of City of Brantford.

h. Contractor Project Manager on site shall have Structured Cabling Deployment training and hold certificates for both copper and fiber.

2. Termination of Services

a. City of Brantford reserves the right to terminate the Contractor's services if at any time it is determined the Contractor is not fulfilling their responsibilities as defined within this document and all associated project documentation.

b. Upon termination, the Contractor shall be restricted from the premises and compensated for the percentage of work completed satisfactorily.

c. Contractor's appearance and work ethic shall be of a professional manner. Dress shall be appropriate to the work being performed.

d. Conduct on City of Brantford property will be professional in nature.

e. Any person in the Contractor's employ working on a City of Brantford project considered by City of Brantford to be incompetent, disorderly, or for any other reason unsatisfactory or undesirable to IT infrastructure, such person shall be removed from the City of Brantford project.

3. Other Contractor Responsibilities

a. Confirmation of Pathway and Cable Manager sizing:

- Wherever cabling pathways or managers are installed, it is the Contractor's responsibility to confirm pathway or manager sizing to represent no more than 25% fill upon installation according to manufacturer's fill tables.
- Pathways deemed overfilled upon installation will not be accepted and shall be remedied at Contractor expense.

b. Contractor is responsible for the removal and disposal of all installation and construction debris created in the process of the job.

c. All work areas will be cleaned at the conclusion of the workday and no tools or materials shall be left in a manner as to pose a safety hazard.

d. Projects are not considered finished and will not be paid by City of Brantford until all debris, dust, etc. has been cleaned and removed to the satisfaction of City of Brantford.

e. Contractor shall remove all abandoned cable per Article 800 of the National Electrical Code and per TIA and BICSI standards, recycling these materials where possible. Removal of orphaned cable is mandatory. Contractors shall consider this when placing bids.

f. Contractor shall abide by all City of Brantford Security Policies pertaining to access and conduct while on City of Brantford property.

g. Contractor shall obey all posted speed limits and parking regulations at the City of Brantford facilities where the work is being performed.

H. Warranty

1. Contractor shall provide complete Warranty registration on all copper and fiber links and/or channels as per Manufacturers procedures.

2. Manufacturer warranty shall meet the following criteria.

   a. A guarantee that the installed cabling system will pass the Commercial Building Telecommunications Standards cited in this document.

   b. This warranty will cover all registered links and/or channels.

   c. Contractor shall indicate in warranty documentation whether registered links are to be link or channel.

   d. The communications Contractor will correct any problems and malfunctions that are warranty-related issues without charge for the entire warranty period.

   e. The warranty shall confirm continued coverage should the contractor no longer be in business; in such circumstances the manufacturer will recommend a certified contractor and assume costs to fulfill the obligations of the warranty.

   f. The Manufacturer will provide The City of Brantford confirmation of warranty registration and a warranty certificate.

   g. The warranty period shall commence following the final acceptance of the project by City of Brantford and written confirmation of warranty from the Manufacturer.

<END OF SECTION>

II. Subsystems and Components

A. Cabling Subsystem 1 – Horizontal Copper Cabling System

1. Installation Guidelines

a. Installation of horizontal cabling shall be compliant with most recent versions of all applicable standards, national and local codes, as well as the local Authority Having Jurisdiction (AHJ).

b. The cabling system and support hardware shall be installed so as not to obscure any valves, fire alarm conduit, boxes, or other control, security or life safety devices.

c. Contractor shall use the same Category of performance for both cable and connecting hardware through the entire horizontal channel.

d. Anywhere there is a conflict between standards, codes, installation specifications or project specific documentation contractor shall default to the most stringent.

e. If clarification is needed, contractor shall submit a written request for clarification to City of Brantford. Response from City of Brantford shall be in writing.

f. All cable pulled and terminated shall be Cat 6A unless specified otherwise in the project documentation.

g. Contractor is responsible for maintenance of maximum pulling tensions, minimum bend radius, and approved termination methods required by cited standards, as well as manufacturer's recommendations and industry accepted best practices.

h. Contractor shall use low to moderate force when pulling cable. Maximum tensile load may not exceed 25' lbs. maximum pulling force per 4 pair cable.

i. Bundles of cable shall be pulled using pulling socks to distribute the tensile force over all cables in the bundle.

j. Contractor shall take care not to knot, snag or otherwise deform the cable while pulling. The jacket on installed cable shall be continuous, free from pinholes, splits, blisters, burn holes or other imperfections. Damaged or deformed cable shall be removed and replaced at no cost to City of Brantford.

k. Bend radius on 4 pair cable shall never be below 4 times the cable outer diameter, or manufacturer's requirements, whichever is most stringent.

l. Cables shall not be attached to lighting support wires nor touch the drop-ceiling assembly. Any portion of the communications cabling making contact with ceiling structures shall be remedied at Contractor expense.

m. Cables shall be kept as far away from potential sources of EMI (electrical cables, transformers, light fixtures, etc.) as practical and in shall in no cases pass closer than recommended in cited TIA standards.

n. When using miniature horizontal cable or small diameter patch cables, the channel length shall be de-rated per manufacturer's recommendations.

o. Contractor shall take care to never deform the cable by over cinching with cable ties. All cable ties shall be cinched firmly, but not so firmly that the tie cannot be rotated or moved on the bundle by hand.

p. Cable bundles in lan room (rooms) shall be dressed using only hook and loop style cable ties. Plastic ties shall not be used in City of Brantford telecom rooms and shall be removed and replaced with hook and loop ties at Contractor expense.

q. Cable ties on all cable bundles shall be applied at random intervals to avoid harmonic effects.

r. All horizontal cabling installed shall include a cable slack loop of not less than 12 inches at the Equipment Outlet and not less than 36 inches in the horizontal telecom room.

s. Equipment outlet cable slack shall be stored in the box behind the faceplate if there is room to do so without violating the bend radius of the cable according to manufacturer's recommendations.

t. Contractor may affix 12 inch slack loop above ceiling using hook and loop cable ties if allowed in the project specific documentation or otherwise in writing from City of Brantford. Cable loops touching the drop ceiling shall not be accepted.

u. Service loops in the LAN room may be wall mounted or contained in pathways or racking systems if done according to manufacturer and industry best practices.

v. All terminations on new (Greenfield) City of Brantford projects shall be terminated using the T568A pin-out (wire map).

w. All terminations in existing City of Brantford facilities (Brownfield), shall match the pin-out and Category of the legacy cable plant, unless otherwise specified in the project documentation.

x. Contractor shall terminate twisted pairs so that the last twist is never more than ½ inch from the point of termination (insulation displacement clip). Maintaining the last twist closer than ½ inch is preferred.

y. Contractor shall maintain the cable jacket as close as possible to the connecting hardware. Twisted pair conductors deemed by City of Brantford to be unnecessarily exposed shall be re-terminated at Contractor's expense.

Contractor shall be responsible for using plenum cable, ties and appliances in any air-return (plenum) spaces as required by applicable codes, standards, and the local AHJ (Authority Having Jurisdiction)

2. Preferred Cabling Manufacturers

a. End to end cabling solution by preferred manufacturers are listed below.

i. CommScope

3. Copper Horizontal Cable

a. Copper cable shall have the following attributes:

- Category 6A
- 4 Pair
- 23 Conductor Gauge (AWG) U/UTP

- Plenum (CMP) Rated
- Blue Color

4. Equipment Outlet Copper Connectors (Jacks)

   a. Copper Connectors shall have the following attributes:

   - Category 6a
   - RJ45
   - Black Color

5. Equipment Outlet Appliances – Faceplates

   a. Faceplates shall have the following attributes:

   - Label Pockets
   - White Color

6. Copper Horizontal Patch Panels (Distributor A)

   a. Patch panels shall have the following attributes:

   - 1U 48 Port
   - Angled Patch Panel
   - Black Color

B. Cabling Subsystem 2 – Intrabuilding (Within Building) Fiber

1. Installation Guidelines (Applies to all Fiber Trunks)

   a. Fiber terminations shall be done according to recommendations of TIA, manufacturer's requirements, and accepted industry best practices.

   b. Fiber optic cabling system additions and upgrades to existing facilities (Brownfield) shall match the fiber type (OM/OS designation) of the system to which it is being installed. Contractor shall under no circumstances mix different OM/OS classes of cable or termination devices (connectors) within the same channel unless specifically instructed to do so within the project specific documentation.

   c. When installing fiber cable, Contractor shall maintain a minimum bend radius of 20 times the outer diameter of the cable when it is under load (being pulled).

   d. Fiber service loops shall be stored to maintain a minimum bend radius of 10 times the outer diameter of the cable.

   e. Optical fiber shall only be pulled using its internal strength member in conjunction with a properly rated multi-weave mesh grip and swivel pulling eye.

f. All unjacketed fiber shall be contained within appropriate fiber enclosures. Exposed tight-buffered, fan-out or loose-tube strands will not be tolerated and shall be remedied at Contractor's expense.

g. Direct connection of terminated fiber backbone links to equipment is not allowed. All fiber connections shall go through a fiber enclosure interconnect and connect to active equipment via fiber jumpers.

h. Contractor shall perform fiber testing of all strands according to guidelines in the "Testing and Acceptance" section of this document.

i. Service loop (slack) in lan rooms shall be at least 3 meters. Consult project documentation for length of service loops and storage method within a specific telecom room or space.

j. Slack shall be stored per manufacturer instructions inside the enclosure, or stored outside the enclosure using appliances built for that purpose. Consult project documentation for details on storage of service loops.

k. Fiber pulls using multiple pull points shall use the "figure-8" technique any time excess cabling is piled on the floor as slack to supply the next pull-point.

l. Cable shall be rolled off the spinning cable reel, not pulled off the end.

m. During all fiber cable pulls Contractor shall have one person at each end of the pull to ensure proper cable pay out and pile up without damage to the fiber.

n. Fiber backbone cables shall be installed separately from horizontal distribution cables. Under no circumstances may copper and fiber cables be pulled in common bundles.

o. In pathways containing fiber and copper cables, the fiber cable must either be of armored construction, or segregated in innerduct.

p. Where cables are housed in sleeves or conduits, the backbone and horizontal cables shall be installed in separate conduits or the fiber segregated in separate innerduct within the conduits.

q. Fiber shall be segregated within racks and patching systems unless instructed otherwise in the project documentation.

r. Where possible fiber enclosures shall be mounted at the top of equipment racks and the fiber cable kept separate from copper cable.

s. Contractor shall inspect fiber end faces with a fiber scope and clean the connectors (if needed) whenever plugging in a fiber connector.

2. Fiber Between LAN Rooms on the Same Floor

a. Backbone fiber cable between LAN rooms on the same floor within building shall have the following attributes:

- OM4 Multi-Mode
- Plenum (CMP) Rated
- Connector type - LC

3. Fiber Between LAN Rooms on Different Floors

   a. Backbone fiber cable between LAN rooms on different floors within building shall have the following attributes:

      - OM4 Multi-Mode
      - Plenum (CMP) Rated
      - Connector Type - LC

4. Intrabuilding Fiber Cable (Optical Multimode)

   a. Intrabuilding fiber cable between lan rooms on different floors within building shall have the following attributes:

      - OM4 Multi-Mode
      - Plenum (CMP) Rated
      - Connector Type - LC

C. Racks, Cabinets, and Cable Management

1. Installation Guidelines

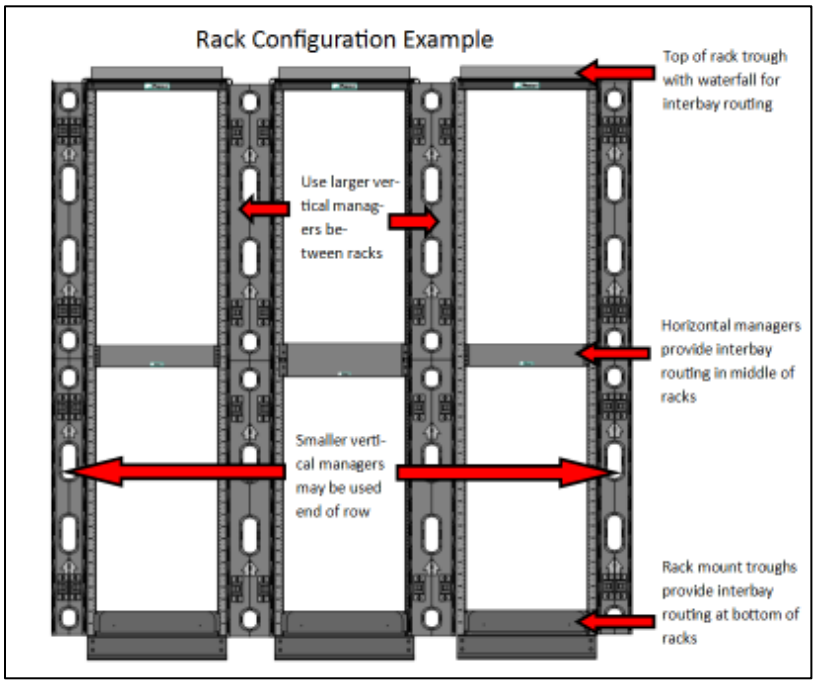
   a. Racks shall be securely attached to the floor using appropriate mounting hardware.

   b. All racks shall be grounded to the ground bus bar in accordance with cited standards the bonding and grounding section of this document.

   c. Rack mount screws (#12-24) not used for installing fiber panels and other hardware shall be bagged and left with the rack upon completion of the installation

   d. In LAN rooms with multi-bay rack rows, Contractor is responsible to include in design interbay routing pathways at the top, middle, and bottom of each rack to provide efficient and neat patch routing between any two points within rack rows.

e. See the 2-post rack configuration example below for general guidelines for pathways between ganged racks:



f. For bottom-of-rack interbay routing where cable quantities exceed capacity of interbay troughs, Contractor should substitute 4RU troughs.

g. All racks shall be outfitted with a vertical grounding busbar along one rail, with all equipment bonded to ground according to the Bonding and Grounding Standards cited in this document. See Bonding and Grounding section of this document for details.

h. Cabinets should be positioned to create aisle widths able to accommodate the movement and installation of the largest equipment anticipated. Consult project documentation for clearance requirements on a specific job.

i. Minimum aisle width is 3 feet clearance in the front of the cabinet and not less than 2 feet of clearance in the rear. Consult project documentation for clearance requirements on a specific job.

j. Cabinets shall be secured to the building structures according to the manufacturer's instructions and in compliance with applicable codes, standards, and the requirements of the local AHJ. Please also refer to project-specific documentation as appropriate.

k. Racks and cabinets shall be individually electrically bonded to the communications earthing system according to the manufacturer's instructions and in compliance all applicable standards, codes and the requirements of the local AHJ.

l. All cabinets shall be clearly identified at both the top and bottom of the in both the front and back of each cabinet with a large label (not less than 1" in height). Labels must be visible with the cabinet doors open or closed.

m. Empty horizontal spaces in cabinets in equipment rooms may be blanked with panels or blanking shades to facilitate hot/cold aisle cooling strategies. Consult project documentation for blanking requirements.

n. Cable entrances in tops of cabinets shall be sealed using preinstalled brushes or using the appropriate sized cool boot seals.

2. Rack-mounted Cable Management – Vertical Managers

a. Contractor shall size vertical cable managers to represent not more than 25% fill by manufacturer tables based on worst cast density estimates.

b. Contractor shall use larger vertical cable managers between racks as described elsewhere in this section.

3. Rack-mounted Cable Management – Horizontal Managers

a. Contractor shall size horizontal cable managers to represent not more than 25% fill by manufacturer tables based on worst cast density estimates.

D. Communications Grounding Network

1. Installation Guidelines

a. Contractor is responsible for bonding to ground all newly placed equipment and installed racks or cabinets per the TIA Standards.

b. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the entrance facility or distributor (telecom) rooms shall be grounded to the respective PBB (Primary Bonding Busbar otherwise known as TMGB – Telecommunications Main Grounding Busbar) or SBB (Secondary Bonding Busbar otherwise known as TGB – Telecommunication Grounding Busbar) using a minimum #6 AWG stranded copper bonding conductor and compression connectors.

c. Metallic panels attached to the rack or cabinet shall be bonded to the rack or cabinet using a green thread forming screw.

d. The copper conductor size shall be upgraded based on the largest power conductor feeding any rack-mount equipment.

e. All jacketed wires used for telecommunications grounding purposes should be identified with green or green with yellow stripe insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape.

f. All cables and busbars shall be identified and labeled in accordance with the labeling standards cited in the Regulatory References section of this specification.

g. The TBB (Telecommunications Bonding Backbone) shall adhere to the recommendations of the ANSI/TIA grounding and bonding standards cited in the Regulatory References section of this document, and shall be installed in accordance with cited standards and best industry practices.

h. Installation and termination of the main bonding conductor to the building service entrance ground shall be performed by a licensed electrical contractor.

2. Room Busbars

a. All LAN rooms and distributor rooms shall have installed an appropriately sized wall-mount busbar with BICSI hole spacing that bonds to the building bonding backbone.

3. Bonding to the Service Equipment (Power) Ground

a. The bonding conductor for telecommunications shall bond the PBB (Primary Bonding Busbar) to the service equipment (power) ground and building steel.

4. Distributor (Telecommunications) Rooms

a. Within the lan rooms and data centers all pathways and racks shall be grounded and bonded as indicated in the diagram below.

b. Contractor is responsible for properly grounding all network equipment, racks and cabinets and bonding them to the wall mounted busbars as described in the TIA 607 series of standards.

c. All newly installed racks and cabinets shall have installed a vertical strip mounted along one equipment rail to serve as a clean, low-resistance bonding place for equipment grounding jumpers used to bond equipment such as chassis switches, that come equipped with a designated grounding pad, back to the rack.

d. Smaller equipment without an integrated grounding pad shall be bonded to the vertical busbar through the use of a thread-forming grounding screw that is anodized green and includes serrations under the head to cut through oxidation or paint on the equipment flange.

e. Larger equipment (chassis switches) with a designated grounding terminal shall be bonded to the vertical busbar with an EBC (equipment bonding conductor) kit built to that purpose.

f. Contractor shall take care to clean (wire brush, Scotch Brite pads) any metallic surface to be bonded down to bare metal and apply a film of anti-oxidation paste to the surfaces prior to effecting the bond.

g. All bonding lugs on racks and busbars shall be of two-hole irreversible compression type. Mechanical lugs and single-hole lugs will not be accepted and shall be removed and replaced at Contractor's expense.

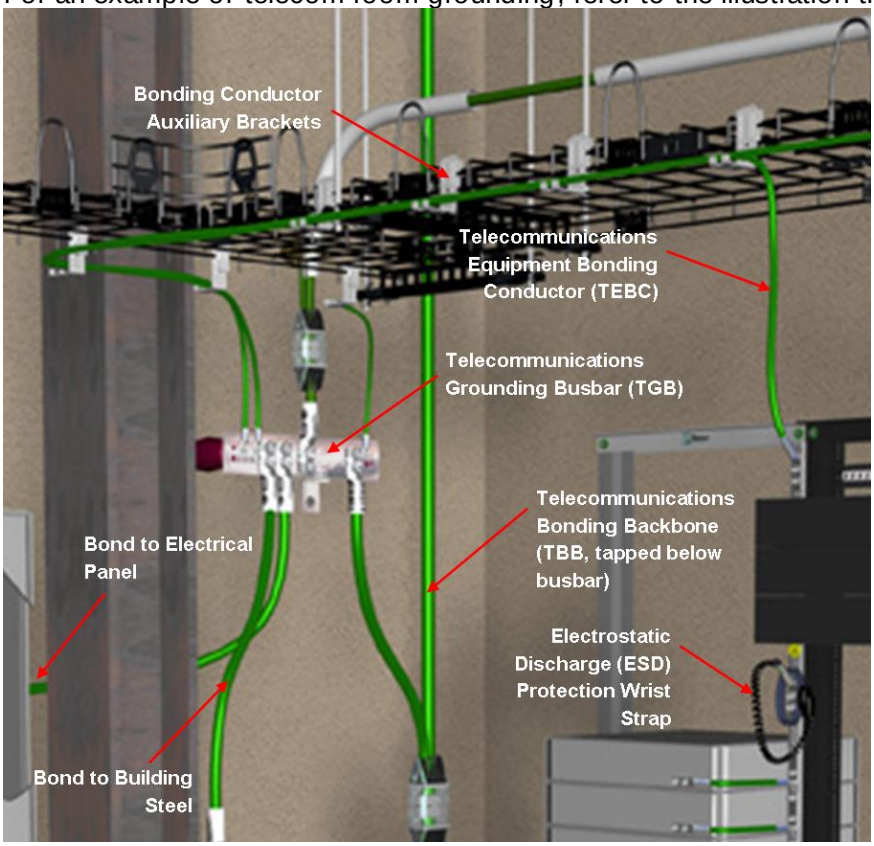
h. Every rack or cabinet shall have an individual bonding conductor into the grounding network, serially connecting (daisy-chaining) of racks is expressly forbidden and will not be accepted.

i. Rack Bonding Conductors (RBC) may tap into an overhead or underfloor aisle ground, or may run to the wall-mounted grounding busbar in smaller LAN rooms containing 5 racks or less.

j. A minimum of every other rack or cabinet shall be outfitted with a properly installed and bonded ESD (electro-static discharge) port along with a wrist strap and lead to be used by any technicians servicing network equipment. On four post racks and cabinets these ESC ports and straps shall be provided on front and back to be accessible and able to reach any active equipment needing servicing.

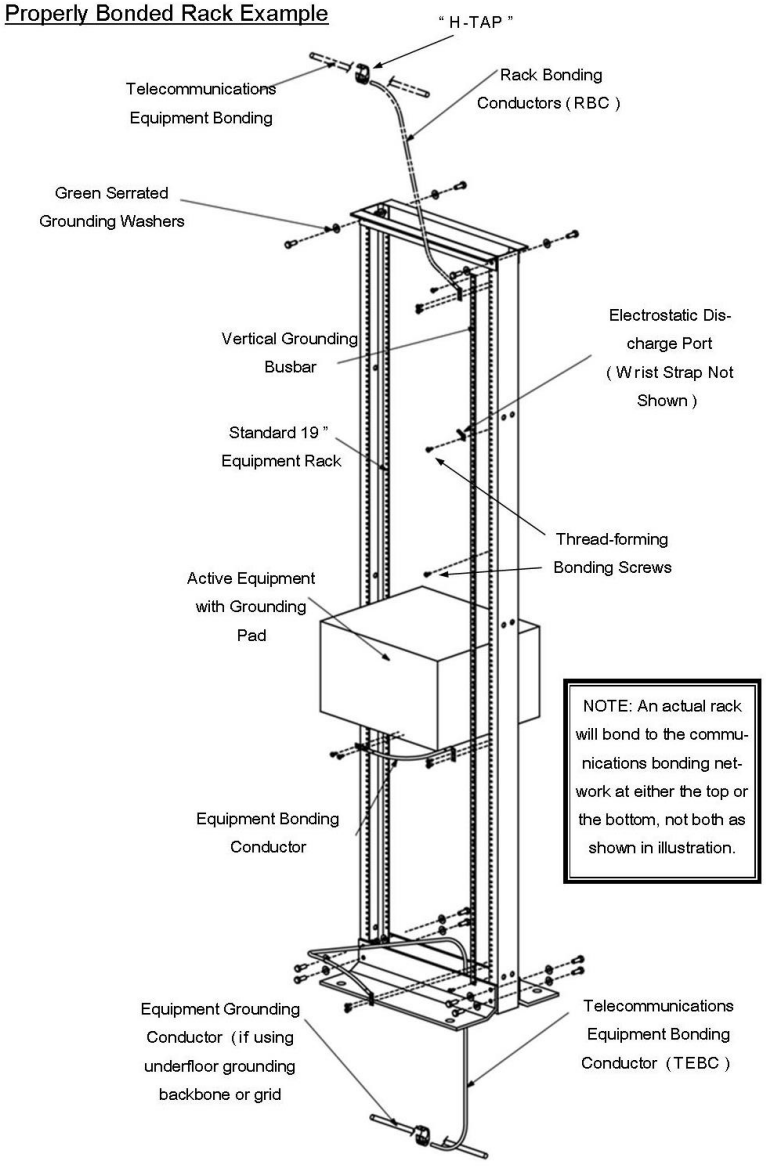
k. Armored cables shall be properly bonded to the earthing system on both ends with a kit built to that purpose.

l. For an example of telecom room grounding, refer to the illustration that follows:

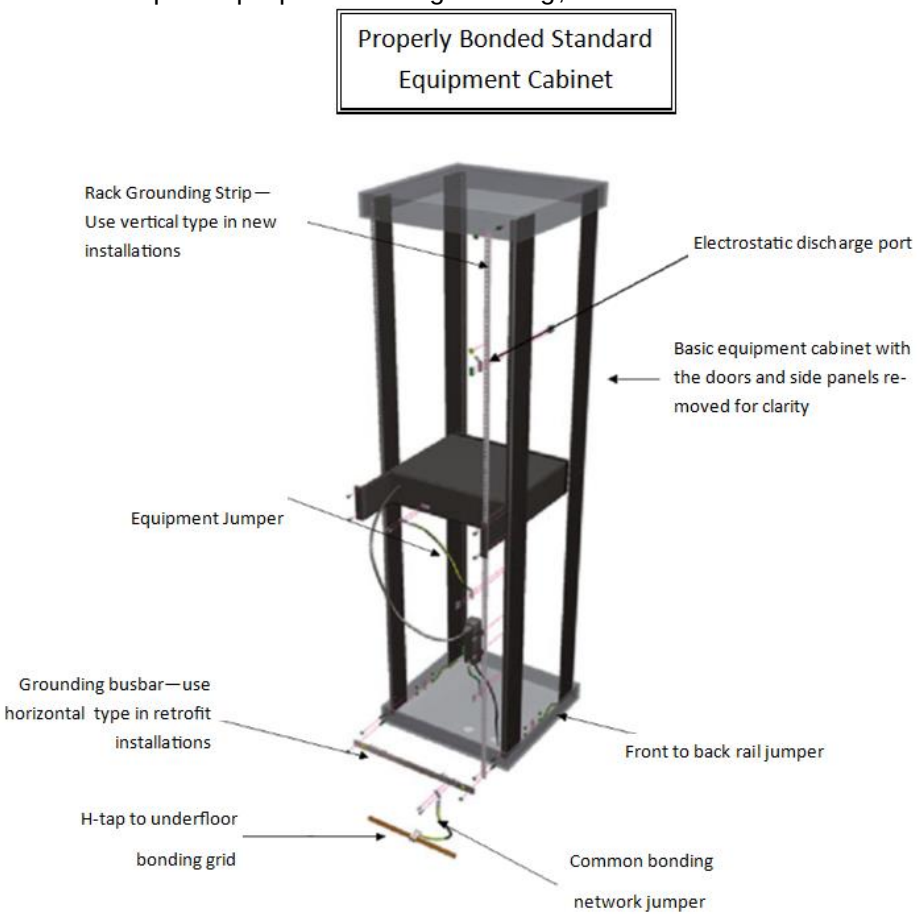


m. For an example of proper rack grounding, see the illustration below:

Properly Bonded Rack Example



n. For an example of proper cabinet grounding, see the illustration below:



E. Cable Pathways

1. Installation Guidelines

a. All cable pathways they create shall follow building lines and allow access to cabling from hallway and open area locations and not be placed over other end user offices.

b. Installation of cable pathways shall be compliant with most recent versions of all applicable standards, national and local codes, as well as the local Authority Having Jurisdiction (AHJ).

c. Anywhere there is a conflict between standards, codes, installation specifications or project specific documentation contractor shall default to the most stringent.

d. If further clarification is needed, contractor shall submit a written request for clarification to City of Brantford. Response from City of Brantford shall be in writing.

2. Wyr-Grid

   a. Metallic pathway shall have the following attributes:

      - TBD

3. FiberRunner

   a. Plastic Fiber Duct shall have the following attributes:

      - TBD

4. J-Hooks

   a. J-Hook system shall have the following attributes:

      - TBD

5. J-Mod

   a. J-Mod system shall have the following attributes:

      - TBD

6. J-Pro

   a. J-Pro system shall have the following attributes:

      - TBD

7. Surface Mount Raceway

   a. Surface mount raceway shall have the following attributes:

      - TBD

F. Network Infrastructure Labeling

1. Installation Guidelines

   a. Questions or comments regarding labeling strategies at City of Brantford may be sent to Manager of IT Infrastructure Services and Support at City of Brantford.

   b. All newly installed cable and associated apparatus shall be labeled according to the guidelines in ANSI/TIA 606-C or the most the most recent revision of this standard.

   c. Additions to brownfield (legacy) systems within City of Brantford facilities shall match the labeling convention in place at that location unless otherwise instructed by the project documentation.

   d. Labels shall be legible and placed in a position that ensures ease of visibility.

e. All newly installed cables shall be labeled within 3 inches at both ends using a permanent self-laminating cable labels built to that purpose, and designed to outlive the cable to which they attach.

f. Contractor is responsible for ordering the correct self-laminating cable labels appropriate to the cable outer diameter.

g. The end of each cable shall have the same label.

h. All labels shall be machine printed, bold font and centered at the highest point that can fit all characters legibly.

i. Each end of the cable shall have the same label.

j. The same identifier shall be contained in one line and repeated to be visible from all sides without having to rotate the cable to read it.

k. It is not necessary to include every part of an identifier on a label; omitting unnecessary repetition where possible makes shorter, more realistic designators that will more easily fit on a label field. Information obvious to the user may be omitted. For instance, when printing a rack label, it is not necessary to include the building number, floor, and telecom space number since the person knows in what building and room they are in.

l. This labeling strategy shall, at a minimum, clearly identify all components of the system: racks, cables, panels and outlets, grounding, pathways and spaces like lan rooms, per requirements in standards cited herein.

m. Labeled cabling elements shall use designators (names) that identify their location within the cable system infrastructure.

n. Contractor shall record all labeling information on the as-built drawings, and all test documents shall reflect the appropriate labeling designators

o. Hand written labels will not be accepted and must be remedied at Contractors expense.

p. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure.

q. Outlet, patch panel, and wiring block labels shall be installed on, or in, the space provided on the device.

r. Machine-generated labels shall be installed behind the clear lens or cover on any device that provides such an option.

s. All labels will be permanently affixed to all labeled elements, including, but not limited to, all installed cables, patch panels, racks, cabinets, and enclosures.

t. Conduit shall be marked indicating the identification of the cable within.

u. All test documents shall accurately reflect the labeling scheme.

v. Information contained in the designator (element name) shall be crafted to contain location information to facilitate circuit tracing and trouble-shooting. The information necessary depends upon the size of the facilities being labeled.

w. Consult project specific documentation for the labeling scheme for a particular project.

x.

The table below outlines various labeling terminology:

Labeling Term	Description
Element	"Element" is the generic term for parts of a cabling system and associated infrastructure that must be labeled. For instance, LAN Rooms are elements. Telecommunications Grounding Busbars are elements. Cabling Sub-system 1 (horizontal) are elements.
Component	An infrastructure "component" is an individual device in the cabling system or associated infrastructure that must be named and labeled with a unique identifier.
Identifier	An "identifier" is the name given to an element that is used on labels, in records and reports. Ideally an identifier should "encode" and incorporate information on the element location, and its relationship to other spaces and elements in the system. An identifier may also be referred to as the component's name or "designator".
Records	"Records" are collection of information about the system identifiers, how the system is laid out, and may contain other information like link test results.
LAN Room	"LAN Room" is the name for a room containing cabling patch systems. Often referred to in documentation as a "LR" (LAN Room) or "LR" (lan room).
Telecommunications Distributors	"Distributor" is a copper or fiber optic patching devices. These are usually patch panels in the case of copper. Optical patch fields usually have boxes or enclosures mounted behind the patch field to contain slack.
Equipment Outets	The term "Equipment Outlet" (EO) is synonymous with Work Area Outlet and is usually a mounting appliance for connections, either faceplates or surface boxes.

The table below outlines the classes of facilities to be administered:

Facility Class	Description
General	• The ANSI/TIA 606-C labeling standard divides facilities into four "Classes" of dependent upon size and complexity. This allows for the systematic listing of all components that must be labeled in each size, or "Class" of facility. • Classes range from single floor, single telecom space installations, to multiple campuses located in different cities. • Standards compliant labeling should ideally be able to scale as premises grow from smaller class facilities to larger class facilities, without having to rework the naming and labeling conventions originally put in place prior to growth. • The description for each Class include the components to be labeled, identifiers, and records are listed below.
Class 1 Facilities	• Class 1 addresses the administration needs of a premise that is served by a single lan room (LR) containing communications equipment. • Required in Class 1 administration are identifiers for the LR, the main grounding busbar (TMGB), and all elements of the horizontal links. • For a copper horizontal link, the elements to be labeled include: — The connecting hardware (e.g., patch panel port or the section of a punchdown block

Facility Class	Description
	terminating a four-pair horizontal cable, or fiber patch fields in the case of fiber-to-the-desk). — A four-pair horizontal cable, or fiber horizontal cable. — A communications outlet/connector terminating a four-pair horizontal cable or fiber cable in the work area. • If a consolidation point (CP) is present, the elements to be labeled include: — The segment of four-pair horizontal cable extending from the TS to the CP connecting hardware. — The CP connecting hardware or section of a punchdown block terminating a four-pair horizontal cable. — The segment of four-pair horizontal cable extending from the CP connecting hardware to the outlet/connector of a multi-user communications outlet assembly (MUTOA) or to the work area outlet. • If a MUTOA is present, the elements to be labeled include: — A communications outlet/connector in the MUTOA. • For an optical fiber horizontal link, the elements include: — A pair of optical fiber terminations on a patch panel in the TS. — A pair of optical fibers in the fiber cable. — A pair of optical fiber terminations in the work area (equipment outlet). — A communications outlet/connector terminating a pair of optical fibers in the work area. • If a consolidation point (CP) is present, the elements to be labeled include: — The segment of optical fiber cable extending from the LR (lan room) to the CP connecting hardware. — The CP connecting hardware or section terminating a pair of optical fibers. — The segment of optical fiber cable extending from the CP connecting hardware to the outlet/connector of a multi-user communications outlet assembly (MUTOA) or to the work area outlet.
Class 2 Facilities	• Class 2 administration provides for communications infrastructure administration needs of a single building or tenant that is served by a single or multiple TSs within a single building. • Class 2 administration includes all elements of Class 1 administration, plus identifiers for: — Backbone cabling. — Multiple-element grounding and bonding systems. — Firestopping.
Class 3 Facilities	• Class 3 administration addresses the needs of a campus, including its buildings and outside plant elements. • Class 3 administration includes all elements of Class 2 administration, plus: — Identifiers for buildings and interbuilding cabling. — Administration of pathways and spaces. — Outside plant elements.
Class 4 Facilities	• Class 4 administration addresses the needs of a multi-site system. • Class 4 administration includes all elements of class 3 administration, plus: — An identifier for each site. — Identifiers for wide area network connections.

y.

2. LAN Rooms

a.General

- Contractor shall assign an identifier to each LR (LAN Room) that is unique within the building.
- The LR identifier should follow the TIA 606 suggested format “FS” where F represents the floor number and S represents the room (space) identifier.
- An example in the FS (floor/space) format is shown below:

  4B

- In this example, 4 indicates the 4th floor in the building, while B is the space identifier.
- Other acceptable formats are:

  4LR

- Interpreted as “LAN Room on the 4th floor”. Another example is depicted below:

  302

- Which simply means “room 302”.

b.The space identifier shall be clearly displayed on a permanent sign affixed to the right of the door to the LR.

3. Identifiers for Racks and Cabinets

a.General

- Contractor shall use one of two methods for identifying racks and cabinets in LAN Rooms (1) the grid method, or (2) the row / number method
- These two methods are detailed in the next section.
- Consult project documentation for which identification method do use on specific projects.

b.Grid Method for Rack/Cabinet Identification

- Component (racks, cabinets) locations are determined using an “X-Y coordinate system” that is usually based on the floor tile system in the equipment room space.
- Grid labeling systems use alphabetic designations on one axis of the room and numerical designations on the other axis of the room create a series of alphanumeric designations that can be established for each floor tile in a data center space.

	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT
01																				
02																				
03																				
04																				
05																				
06																				
07																				

- The cabinet/rack location is based on which floor tile the right front corner of the cabinet/rack rests upon.
- A typical cabinet/rack label would have the following scheme:

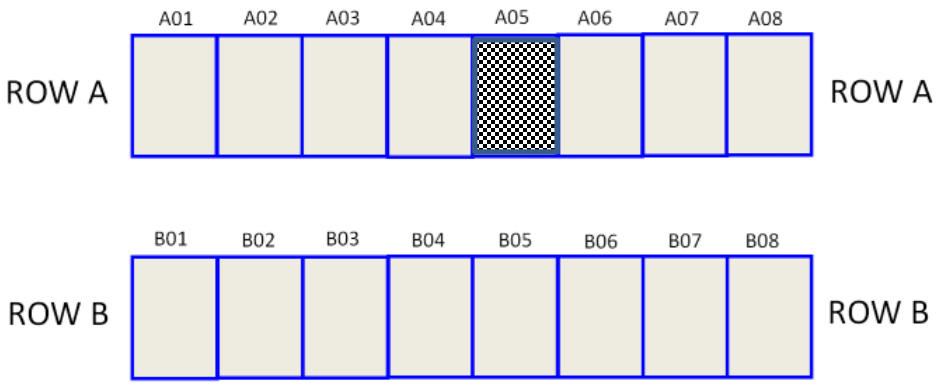
  AY15

- This identifier would define that the cabinet/rack is located with its right front corner at the intersection of row AY and column 15.

- Cabinets and racks should have location labels applied to the top and bottom of both the front and rear to have a label easily visible from any position around the rack or cabinet.
- These labels should be visible whether or not doors are closed or opened on the cabinets.

c.Row/Number Method for Computer Rooms

- Another way to designate specific rack/cabinets in smaller computer/equipment rooms is the Row/Number method.
- In the Row/Number method, rows are given alpha designations and racks/cabinets are numbered as show below.



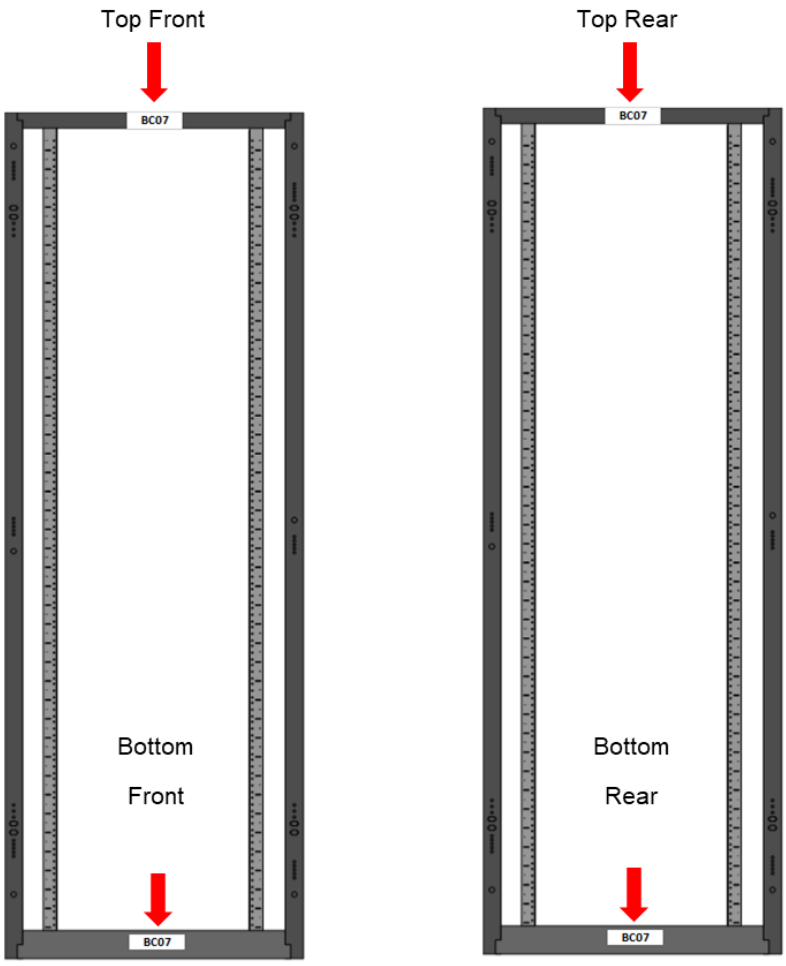
- In the example above the cabinet designator would be:

  A05

- This stands for cabinet #05 in row A.

d.Rack/Cabinet Label Position

- Contractor shall affix rack/cabinet labels depicting the unique identifier at both the top and bottom of the front and back of each rack/cabinet.
- Cabinet labels shall be visible whether cabinet doors are opened or closed.



Place labels at the top and bottom, both front and rear of racks/cabinets

4. Patch System Labeling

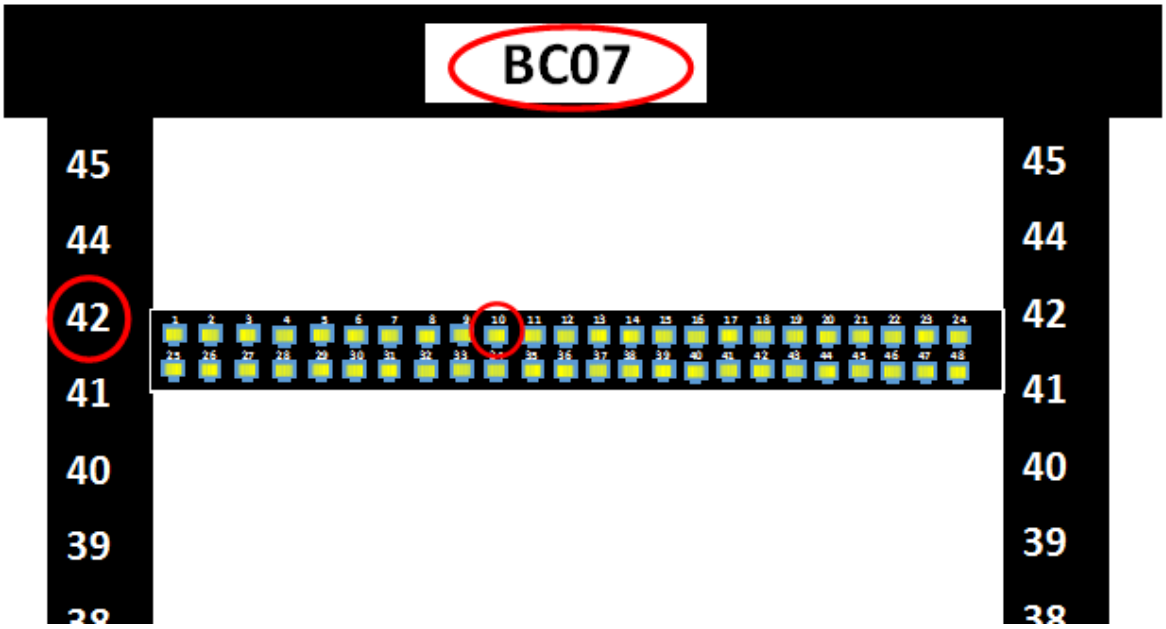
a.General

- Once the cabinet/rack identifiers are established, the various distributors (patch panels) and patch ports in the cabinet/rack should be identified.
- Identifiers for patch panels and patch ports may utilize the pre-printed rack units and panel port numbers, or they may be assigned and affixed as printed labels. Each approach is detailed below.

b.Using Existing Pre-Printed Numbers for Identification

- When rack units (positions) are used as patch panel identifiers, the patch device shall assume as an identifier the rack unit number in which the top left mounting screw lands.

- A simple way to identify ports using the pre-printed numbers is shown below.



- The port in this example is identified as:

  BC07-42:10

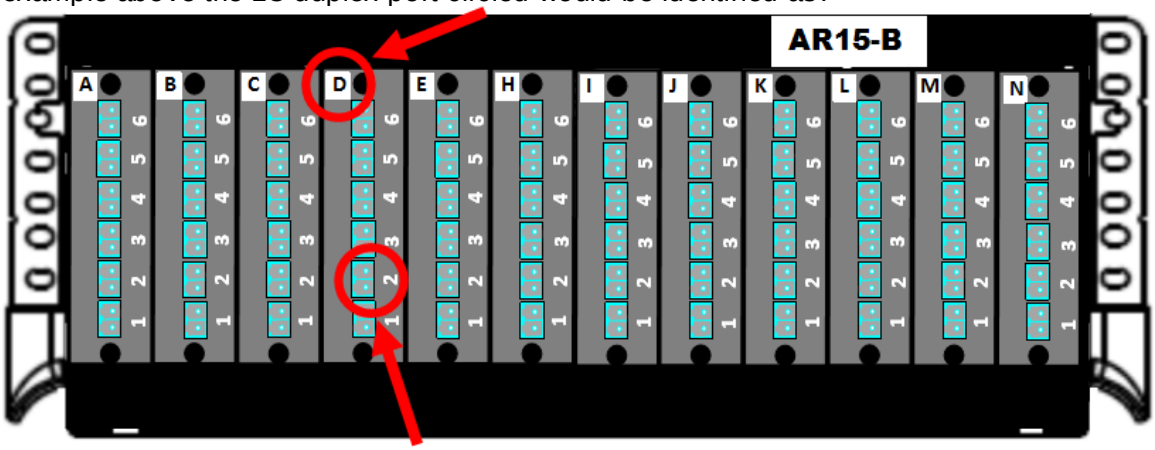
- This number defines port #10 in the patch panel located in the patch panel installed in rack position 42, in rack BC07.

c.Using Assigned Patch Panel and Port Identifiers

- It is also possible to assign identifiers to patch panels and patch ports. This may be necessary on elements that have no pre-printed numbers, or be desirable for easier addition or movement of panels later.
- An example of a typical panel label using assigned identifiers is shown below:

- The example above depicts an assigned patch panel identifier in a fiber enclosure with subpanels in the form commonly called “fiber adapter panels”. Here optical patch enclosure “B” is in rack/cabinet “AR15” and will retain that identifier regardless of where it is moved within cabinet AR15.

  Individual ports within the optical enclosure/patch field shall be assigned unique identifiers. In the example above the LC duplex port circled would be identified as:



  AR15-B:D2

- This identifier translates as port 2, in subpanel D in patch panel (enclosure) B, in cabinet AR15.

5. Patch Cord Labeling

   a. If indicated in project documentation, patch cords may be included in the administration system.

   b. Patch cords shall be labeled at either end with the following format:

   BC07-42:10\BC07-46:5

   c. This identifier indicates a patch cord originating from port 10 in panel 42 in rack BC07, connecting to port 5 in panel 46, also in rack BC07.

d. In patch cord identifiers, the first and second ports are separated by backslash "\" as shown in the example above.

e. In patch cord labeling, whichever port is closest to the system core (main cross-connect) shall be listed first in the identifier.

6. Copper UTP Cables Between Patch Panels

a. Cables terminated between patch fields (such as those on the back of patch panels) shall be labeled with identifiers indicating the associated ports at both ends of the cable.

b. An example for a copper patch panel is shown below:

CE16-12:9/DA07-32:6

c. This example is interpreted at the cable connecting to the termination field in the back of port 9, in panel 12 in rack CE16, going to the termination field in the back of port 6 in panel 32 in rack DA07.

d. In permanent cables between patch panels, the identifiers for the first and second ports are separated by forward slash "/" as shown in the example above.

e. In permanent cables between patch panels, whichever port is closest to the system core (main cross-connect) shall be listed first in the identifier. If both are equidistant to the core, then the lowest alphanumeric identifier shall be listed first.

7. Multi-Strand Fiber Assemblies

a. In modular fiber cassette "plug and play" systems, multi-fiber (MPO) trunk between cassettes shall have identifiers that list the ports associated with the strands at either end as shown in the example below:

RF11-C:B ports 01-06/AE10-D:A ports 01-06

b. This example is interpreted as LC duplex ports 1 through 6, in cassette B, in panel C in rack RF11, connecting to LC duplex ports 1 through 6, in cassette A in panel D in rack AE10.

c. In multi-stand fiber (MPO) assemblies between cassette enclosures, whichever port is closest to the system core (main cross-connect) shall be listed first in the identifier. If both are equidistant to the core, then the lowest alphanumeric identifier shall be listed first.

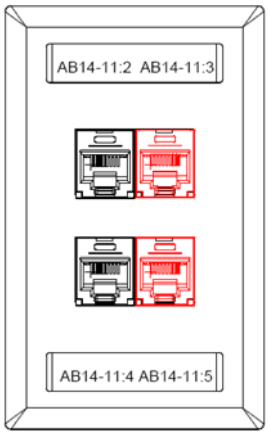
8. Equipment Outlet Labels

a. General

- Equipment outlets do not necessarily need a unique identifier for the work area appliance (faceplate or surface box), but may instead simply label the equipment outlet ports with the patch port to which it connects in the LR (LAN Room).
- Identifying the EO port by its associated patch port makes sense since a link failure is nearly always first noticed by the end user at the EO, who can then guide the technician where to begin troubleshooting in the TS by simple reading off the number above the EO port.

b. EOs in Class 1 Facilities

- Identifying EO ports by the identifiers of the patch ports. An example of this labeling is shown below:

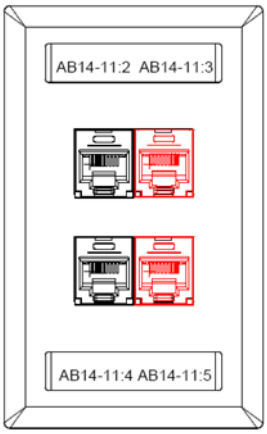


- Here the identifier on the black port indicates that it connects back to port 2, patch panel 14 in rack AB14.

9. EO Labeling in Class 2 and Above Facilities

a. In facilities with multiple LAN Rooms (LR), it may be helpful to also include the LR information on the equipment outlet (EO) to speed trouble shooting.

b. An example for an EO faceplate that includes LR identification is shown below:



c. In this example the identifiers show that the upper left port of the faceplate connects to port two, in patch panel 11 in rack/cabinet AB14, which is found in LAN Room (LR) B on the 4th floor.

d. Consult project documentation for exact EO identifications strategies on a specific project.

e. Pathways

- Cable Pathways are identified with information that defines routing of the cables contained in a pathway.
- This information is useful to determine which pathway connects between whichlan rooms.

- Locating the proper pathway is necessary to remove, add, or repair a cable in the infrastructure.

- A typical pathway label would have information in the following scheme:

  4B/4C

- This identifier would be decoded to define that the pathway connects between lan rooms B and C on floor 4.

f. Grounding Systems

- Labeling of the grounding and bonding system involves the identification of the main grounding busbar, grounding busbars, conductors connecting busbars, conductors connecting devices to busbars, and equalizing conductors.
- The typical scheme for the main grounding busbar would be:

  1-B301-TMGB

- This identifier can be decoded to define that this is the main grounding busbar located on floor 1 in space B301.
- The typical scheme for a grounding busbar would be:

  2-R201-TGB

- This identifier can be decoded to define that this is the grounding busbar on floor 2 in space R201.
- The typical scheme for the busbar connections would be:

  1-B301-TMGB/2-R201-TGB

- This identifier can be decoded to define that this is the conductor that connects the main grounding busbar located on floor 1 in space B301 to the grounding busbar on floor 2 in space R201.

g.Firestopping

- Each firestopping location shall be labeled at each location where firestopping is installed, on each side of the penetrated fire barrier, within 12 inches (300mm) of the firestopping material.

- A typical firestopping label would have information in the following scheme:

  1-FSL01(2)

- This identifier would be decoded to define that this is firestopping location number 01 on the first floor and that the firestopping has a two-hour rating.

h. Some portions of City of Brantford networks require additional physical security devices. These take three forms:

- Devices that block-out copper and fiber ports in patch fields and faceplates that require a special tool for removal.
- Devices that lock-in copper patch cords and require a special tool for removal of those patch cords.
- Devices that temporarily or permanently block USB ports on laptops and computers.

i. Areas where such devices are required will be called out in the project documentation.

<END OF SECTION>

III. Testing and Acceptance

A. General

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions.

2. All copper pairs or optical fibers of each installed cable shall be tested and verified prior to system acceptance.

3. Any defect in the cabling system performance or installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors or fibers in all cables installed.

4. All cables shall be tested in accordance with this document, the ANSI/TIA Standards, the Manufacturer warranty guidelines, and industry best practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

B. Copper Channel Testing

1. All twisted-pair copper cable links shall be tested for compliance to the requirements in ANSI/TIA for the appropriate Category of cabling installed using a test unit meeting a minimum IEC IIIe level of accuracy.

2. All testers used must have been factory calibrated by the manufacturer within one year of use or according to factory calibration recommendations, whichever is more stringent.

3. Contractor shall set references according to manufacturer's recommendation prior to each day's testing and reset references anytime the tester unit shuts down due to inactivity.

4. Resetting references shall also be done whenever test results become sporadic or the tester demonstrates a consistent deterioration of test measurement performance.

5. Testing of any links that include field-terminated plugs shall follow the Manufacturers procedures and guidelines.

C. Fiber Testing

1. All installed fiber shall be tested for link-loss in accordance with ANSI/TIA standards cited in this document.

2. For horizontal cabling system using multimode optical fiber, attenuation l should be measured in at least one direction, according to customer requirements, at either 850 nm (nanometer) or 1300 nm using an appropriate light source and power meter.

3. Fiber testing must be performed using reference grade test leads. Test results from tests using test leads that are not reference grade will not be accepted and must be retested at the Contractor's expense.

4. Backbone multimode fiber cabling should be tested at both 850 nm and 1300 nm (or 1310 and 1550 nm for singlemode) in both directions.

5. Test set-up and performance shall be conducted in accordance the Method B (One Jumper Method).

6. Where links are combined to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. Only basic link loss testing (OLTS) is required, not OTDR testing. OTDR testing is optional as a secondary test method but, by itself, is not a valid means by which links or channels can be certified.

7. Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.

8. Qualification of the reference cords shall be completed after each reference and the insertion loss of the reference connectors shall be saved and presented as part of the testing documentation.

9. Contractor shall perform end face inspection, cleaning if necessary then re-inspection before connecting any fiber end faces together in a link. This complete process should be performed BEFORE any OLTS testing takes place. Contractor shall further inspect, clean and re-inspect the Reference Lead connector end faces anytime testing shows inconsistent results. If this does not correct accuracy, contractor shall re-certify (test) the reference leads and replace them if necessary.

D. System Documentation

1. Documentation During Installation Phases

   a. City of Brantford will provide floor plans in paper and electronic (DWG, AutoCAD) formats on which as-built construction information can be added. These documents will be modified accordingly by the contractor to denote as-built information and returned to City of Brantford.

   b. Documentation shall be submitted within ten (10) working days of the completion of each testing phase. This is inclusive of all test results and draft as-built drawings. The Contractor shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD) form.

   c. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

   d. It is mandatory that the test results from each phase be delivered in the tester native format. At the request of the City of Brantford project lead, the contractor shall provide copies of the original test results.

   e. The As-Built drawings are to include cable routes and outlet locations. Their sequential number as defined elsewhere in this document shall identify outlet locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided.

2. Documentation at Project Completion

a. A final, complete set of all documentation shall be provided in electronic format within three weeks after the completion of the project.

b. All documentation shall be clearly marked with the words “Project Test Documentation” plus the project name, and the date of completion.

c. The test documentation shall detail the test methods used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

d. The test results shall further include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s).

e. The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document.

3. The project lead from City of Brantford may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above.

4. If retest findings contradict the documentation submitted by the contractor, additional testing can be requested to the extent determined necessary by the Project Lead, including a 100% re-test. This re-test shall be at no additional cost to City of Brantford.

E. Inspection and Acceptance

1. During Installation

a. The City of Brantford Project Lead will make periodic inspection of the project in progress.

b. One inspection will be performed at the conclusion of cable pulling, prior to closing of the drop ceiling, to inspect the method of cable routing and support, and the firestopping of penetrations.

c. A second inspection will be performed at completion of cable termination to validate that cables were dressed and terminated in accordance with ANSI/TIA recommendations for jacket removal and pair untwist, compliance with Manufacturer’s minimum bend radius, and that cable ends are dressed neatly and orderly.

2. Final Inspection

a. Upon completion of the project, the City of Brantford Project Lead will perform a final inspection of the installed cabling system with the Contractor’s project foreman.

b. The final inspection will be performed to validate that all horizontal and backbone cables were installed as defined in the drawing package, and that the installation meets the technical performance and aesthetic expectations of the City of Brantford.

3. Live System Performance Verification

a. During the three-week period between final inspection and delivery of the test and as-built documentation, City of Brantford will activate and validate operation of the cabling system.

4. Final Acceptance

a. Final acceptance is possible after completion of the installation, in-progress and final inspections, receipt of the test results, receipt of the as-built documentation, and receipt of the manufacturer's system performance warranty and successful performance of the system for a three-week period.

b. Acceptance of the installed system by City of Brantford must be in writing to be valid

<END OF SECTION>

IV. Appendix A – Materials List

Product Category	Part Number	Manufacturer	Part Description
Copper Cabling Products			
Fiber Cabling Products			
Racks, Cabinets, and Cable Management			
Bonding and Grounding			
Cable Pathways			
Network Labeling			
Other Cabling Accessories			

<END OF APPENDIX A>

V. Appendix B – Building Code

Ontario Building Code

3.1.5.18. Wires and Cables

(1) Except as permitted by Sentence (2) and Articles 3.1.5.19. and 3.1.5.21., optical fibre cables and electrical wires and cables with combustible insulation, jackets or sheathes are permitted in a building required to be of noncombustible construction, provided,

(a) the wires and cables exhibit a vertical char of not more than 1.5 m when tested in conformance with the Vertical Flame Test – Cables in Cabletrough in Clause 4.11.4. of CSA C22.2 No. 0.3, “Test Methods for Electrical Wires and Cables”, (FT4 Rating),

(b) the wires and cables are located in,

(i) totally enclosed noncombustible raceways,

(ii) concealed spaces in walls,

(iii) concrete slabs,

(iv) a service room separated from the remainder of the building by a fire separation having a fire-resistance rating not less than 1 h, or

(v) totally enclosed nonmetallic raceways conforming to Clause 3.1.5.20.(1)(b), or

(c) the wires and cables are communication cables used at the service entry to a building and are not more than 3 m long.

(2) The requirement in Clause (1)(a) is considered to be met where the wires and cables exhibit a flame-spread of not more than 1.5 m, a smoke density of not more than 0.5 at peak optical density and a smoke density not more than 0.15 at average optical density when tested in conformance with the Flame and Smoke Test in the Appendix to CSA C22.2 No. 0.3, “Test Methods for Electrical Wires and Cables”, (FT6 Rating).

3.1.5.20. Nonmetallic Raceways

(1) (b) the wires and cables in the raceways do not meet or exceed the requirements of Clause 3.1.5.18.(1)(a), the nonmetallic raceways exhibit a vertical char not more than 1.5 m when tested in conformance with with the Vertical Flame Test (FT4) – Conduit or Tubing on Cable Tray in Clause 6.16 of CSA C22.2 No. 211.0, “General Requirements and Methods of Testing for Nonmetallic Conduit”.

<END OF DOCUMENT>