Part 1 General

1.1 General

1.1.1 Summary

A. This section governs the products and execution requirements relating to furnishing and installing grounding and bonding for the communication systems.
B. Description of work:
1. Furnish and install a complete and fully-functioning grounding and bonding system. All cables, terminations, support hardware, and grounding and bonding hardware shall be furnished, installed, tested, labeled, and documented by the telecommunications subcontractor.
a) Coordinate with electrical contractor including pathways, termination points, busbar locations and connections to the main electrical service ground and electrical distribution panels.

1.1.2 Related Documents

A. The most recent versions of all related documents apply to this project.
B. The following codes shall be followed as required by law:
1. Ontario Electrical Safety Code (OESC)
2. Canadian Electrical Code (CEC)
C. The following standards shall be followed:
1. IEEE Std 1100 - IEEE Recommended Practice for Powering and Grounding Electronic Equipment (Emerald Book)
2. ANSI/NECA/BICSI--607 - Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
3. ANSI/TIA--607-B - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
4. ANSI/TIA/EIA-606-B - Administration Standard for Commercial Telecommunications Infrastructure
D. The following guidelines shall be followed:
1. BICSI, Telecommunications Distribution Methods Manual (TDMM)
2. BICSI, Information Transport Systems Installation Methods Manual (ITSIMM)
E. The following related project specifications shall be followed:
1. 27 05 00 Communications
2. 27 05 53 Identification for Communications Systems

1.1.3 Definitions

A. BCT – Bonding Conductor for Telecommunications -- A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground.
B. Bonding – The joining of metallic parts to form an electrically conductive path.
C. GE – Grounding Equilizer -- The conductor that interconnects elements of the telecommunications grounding infrastructure.

D. Ground – A conducting connection, whether intentional or accidental, between an electrical circuit (e.g., telecommunications) or equipment and the earth, or to some conducting body that serves in place of earth.
E. NRTL – Nationally Recognized Testing Laboratory
F. RBC – Rack Bonding Conductor -- A bonding conductor used to connect an equipment rack directly to the TMGB, or TGB.
G. RGB – Rack Grounding Busbar -- A busbar that is vertically mounted on an equipment rack.
H. TBB – Telecommunications Bonding Backbone -- A conductor that interconnects the telecommunications main grounding busbar (TMGB) to the telecommunications grounding busbar
I. TGB – Telecommunications Grounding Busbar -- A common point of connection for telecommunications system and equipment bonding to ground, and located in the telecommunications room or equipment room.
J. TMGB – Telecommunications Main Grounding Busbar -- A busbar placed in a convenient and accessible location and bonded by means of the bonding conductor for telecommunications, to the building service equipment (power) ground.

1.1.4 All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labelled, and documented by the Communications Contractor as detailed in this section.

1.1.5 Product specifications, general design considerations and installation guidelines are provided in this section.

1.1.6 The Communications Contractor shall meet or exceed all requirements for the cable system described in this section.

1.1.7 Grounding system shall include a local copper Telecommunications Grounding Busbar (by Division 16/26) in each entrance facility and equipment room bonded to a Telecommunications Grounding Backbone (by Division 16/26).

1.1.8 The TBB shall be bonded directly to the Telecommunications Main Grounding Busbar (by Division 16/26). The TMGB shall be bonded directly to the building entrance grounding system and meet all local codes and standards as noted above.

1.1.9 The grounding system shall be visually verifiable and adequately sized to handle expected currents safely.

1.1.10 All grounding conductors and busbars shall be made of copper.

1.1.11 The grounding system shall be intentional, visually verifiable, adequately sized to handle expected currents safely, and direct these currents away from network equipment. As such, grounding shall be purposeful in its design and installation.

1.1.12 Lugs, HTAPs, grounding strips, and busbars shall be UL Listed and CSA certified and made of premium quality tin-plated electrolytic copper that provides low electrical resistance while inhibiting corrosion. Antioxidant shall be used when making bonding connections in the field.

1.2 Lugs

1.2.1 Wherever possible, two-hole lugs shall be used. All lugs shall be irreversible compression and meet NEBS Level 3 as tested by Telcordia. Lugs with inspection windows shall be used in all non-corrosive environments so that connections may be inspected for full conductor insertion (battery rooms are an exception where windowless lugs may be used).

1.2.2 Die index numbers shall be embossed on all compression connections to allow crimp inspection.

1.3 Cable Assemblies

1.3.1 Cable assemblies shall be UL Listed and CSA Certified. Cables shall be a distinctive green or green/yellow in color, and all jackets shall be UL, VW-1 flame rated.

1.4 Telecommunications Grounding Busbar

1.4.1 The Telecommunications Grounding Busbar (TGB) shall be supplied and installed by Division 16/26.

1.5 Telecommunications Bonding Backbone Requirements

1.5.1 The Telecommunications Grounding Busbar within each telecommunications space shall be bonded to the building ground riser with a Telecommunications Bonding Backbone. The TGB and the TBB shall be supplied and installed by Division 16/26.

Part 2 Product

2.1 Equivalent Products

2.1.1 All grounding and bonding products specified in this section shall be manufactured by Panduit, and shall meet all applicable codes and standards. Equivalent products may be considered where the Communications Contractor requests approval in writing from the Communications Consultant.

2.2 Grounding Clamps

2.2.1 Where a grounding conductor is routed through a metal conduit, the Communications Contractor shall use a #6 AWG copper conductor with green or green/yellow jacket to bond the conduit to the grounding conductor routed through the metal conduit. Series GPL grounding clamps shall be used to bond to the conduit and series HTWC HTAP with clear cover shall be used to bond to the grounding conductor.

2.3 Communications Grounding and Bonding Conductor Label Kit

2.3.1 Telecommunications Grounding and Bonding Conductor Label Kits shall be supplied and installed by the Communications Contractor at every rack and cabinet as well as one for every Telecommunications Grounding Busbar.

Specified Product:
Panduit LTYK

2.4 Code Conductor, Two-Hole, Long Barrel With Window Lug

2.4.1 Where lugs are required for bonding, the Communications Contractor shall supply and install Code Conductor, Two-Hole, Long Barrel with Window Lugs.

2.4.2 Code Conductor, Two-Hole, Long Barrel with Window Lugs shall be supplied and installed by the Communications Contractor as required.

2.4.3 Lugs shall be tin plated, irreversible compression, have NEMA hole sizes and spacing and shall meet NEBS Level 3.

2.5 Code/Flex Conductor HTAP

2.5.1 Code/Flex Conductor HTAPs shall be supplied and installed by the Communications Contractor as required.

2.6 Clear Covers for HTCT HTAP

2.6.1 Clear Covers for HTCT HTAPs shall be supplied and installed by the Communications Contractor (each HTAP requires one clear cover).

2.7 Grounding Clamp, U-Bolt, Bronze

2.7.1 Each conduit entering/leaving a telecommunications space/room shall be bonded to the grounding system using a Series GPL Bronze U-Bolt Grounding Clamp.

2.8 Ladder Tray / Basket Tray Grounding

2.8.1 Bonding network jumpers shall be supplied and installed by the Communications Contractor to bond the tray to the grounding system.

2.9 Antioxidant

2.9.1 Antioxidant shall be used by the Communications Contractor when making bonding connections.

2.10 Bonding Screws

2.10.1 Bonding screws shall have serrations on the bottom of screw to remove paint from patch panel to bond patch panel to rack or cabinet rails.

2.10.2 Bonding screws shall be thread-forming to remove paint from threaded rack or cabinet rail holes to bond patch panel to rack or cabinet rails.

2.10.3 The Communications Contractor shall supply and install four (4) screws for every patch panel (copper and optical fibre) as well as for every Client supplied switch (assume 48 port switches).

Specified Product:

Panduit	RGTBSG-C	#12-24 screws
Panduit	RGTBS1032G-C	#10-32 screws
Panduit	RGTBSM6G-C	M6 screws
Panduit	RGTBSM5G-C	M5 screws

2.11 Paint Piercing Washers

.1 Series RGW paint piercing washers shall accommodate 3/8” stud size and shall have an outside diameter of 0.875”.

.2 Series RGW paint piercing washer kits shall come complete with 0.16 oz (5cc) of antioxidant.

.3 Series RGW paint piercing washers shall be supplied and installed by the Communications Contractor where rack elements bolt together.

.4 Series RGW paint piercing washers shall be supplied and installed by the Communications Contractor where vertical cable managers are manufactured of metal.

.5 Two paint piercing washers shall be supplied and installed by the Communications Contractor for every nut/bolt set.

Specified Product:
Panduit RGW-24-1Y

2.11.2 Rack Grounding Strip

.1 Series RGS grounding strip shall be 78.65” long, 0.67” wide, 0.05” thick, have EIA Universal mounting hole pattern and shall be made of high conductivity, low resistance wrought copper and tin plated.

.2 Series RGS grounding strip kits shall come complete with 0.16 oz (5cc) of antioxidant and thread-forming screws.

.3 One series RGS rack grounding strip shall be supplied by the Communications Contractor for every two post rack. The rack grounding strip shall be mounted to the rear of the side rail of each rack.

Specified Product:

Panduit	RGS134-1Y	

2.12 Cabinet Grounding Strip Kit

.1 Series RGS grounding strips shall have EIA Universal mounting hole pattern and shall be made of high conductivity, low resistance wrought copper and tin plated.

.2 Series RGS grounding strip kits shall come complete with four (4) grounding strips, 0.16 oz (5cc) of antioxidant and bonding studs.

.3 One series RGS rack grounding strip kit with four (4) grounding strips shall be supplied by the Communications Contractor for every cabinet. Each grounding strip shall be mounted to each cabinet equipment rail.

Specified Product:

Panduit	RGS13445-4-1	for #12-24 or M6 mounting hole rails
Panduit	RGS13445A-4-1	for #10-32 or M5 mounting hole rails
Panduit	RGS13445B-4-1	for cage-nut rails

2.12.2 Grounding Busbar Kit

.1 The Grounding Busbar shall be made of high conductivity, low resistance wrought copper and tin plated.

.2 One Cabinet Grounding Busbar kit shall be supplied and installed by the Communications Contractor for every cabinet.

Specified Product:

Panduit	RGRB19U

2.12.3 Front to Back Rail Jumper Kit

.1 The Front to Back Rail Jumper Kit shall be made of #6 AWG green or green/yellow jacketed copper conductors to bond the rear cabinet rails to the front cabinet rails.

.2 The Front to Back Rail Jumper Kit shall come complete with thread-forming screws or bonding studs.

.3 One Panduit series CGJ Front to Back Rail Jumper Kit shall be supplied and installed by the Communications Contractor for each cabinet.

Specified Product:

Panduit	CGJ630U	for #12-24 or M6 holes and a 36” deep cabinet
Panduit	CGJ640U	for #12-24 or M6 holes and a 42” deep cabinet
Panduit	CGJ630UA	for #10-32 or M5 holes and a 36” deep cabinet
Panduit	CGJ640UA	for #10-32 or M5 holes and a 42” deep cabinet
Panduit	CGJ630UB	for cage-nut rails and a 36” deep cabinet
Panduit	CGJ640UB	for cage-nut rails and a 42” deep cabinet

2.12.4 Common Bonding Network Jumper

.1 The Common Bonding Network Jumper shall be made of #6 AWG green or green/yellow jacketed copper conductor 96" long with one end factory terminated to lug.

.2 The Common Bonding Network Jumper kits shall come complete with 0.16 oz (5cc) of antioxidant and thread-forming screws.

.3 One Common Bonding Network Jumper shall be supplied and installed for every rack. Do not bond racks serially.

Specified Product:
Panduit RGREJ696Y

.4 Where a Common Bonding Network has not been specified the Communications Contractor shall supply and install a Code Conductor Two Hole Long Barrel with Window Lug to bond the Common Bonding Network Jumper directly to the Telecommunications Grounding Busbar.

Specified Product:
Panduit LCC6-14JAW-L

.5 Where a Common Bonding Network has been specified the Communications Contractor shall supply and install a Code/Flex Conductor HTAP Kit to bond the Common Bonding Network Jumper to the Common Bonding Network.

Specified Product:
Panduit HTWC250-2-1

2.12.5 Electrostatic Discharge Port

.1 The Electrostatic Discharge Port shall accommodate a standard ESD wrist strap 4mm plug.

.2 The Electrostatic Discharge Port kits shall come complete with an ESD protection sticker, 0.16 oz (5cc) of antioxidant and thread-forming screws.

.3 The Communications Contractor shall supply and install two Electrostatic Discharge Ports for every rack. One ESD port shall be mounted directly to the rack grounding strip on the back of the rack at approximately 48" AFF, and the other shall be mounted directly to the vertical mounting rail of the rack in the front at approximately 48" AFF.

Specified Product:

Panduit	RGESD2-1	Kit c/w #12-24 and M6 screws
Panduit	RGESD2A-1	Kit c/w #10-32 and M5 screws

Part 3 General

3.1 General

A. Locate TMGB and TGBs so that they are accessible to telecommunications personnel.

B. At a minimum, follow all manufacturer instructions. In case of discrepancy between manufacturer and contractor requirements, the more stringent shall apply. In the case of conflicting instructions, report any discrepancy to the Design Engineer in a timely fashion so as not to impact the construction timeline.

C. At a minimum, provide exothermic welds as identified on the drawings or required in the specifications. For all other connections, irreversible compression connections are sufficient.

D. Identification

1. All telecommunications grounding and bonding conductors shall be labeled within 6" of each end. Labels shall be nonmetallic and read as follows:

Computing and Communications Services (CCS)
Toronto Metropolitan University
350 Victoria Street, Toronto

E. Testing
1. All grounding connections shall be tested for continuity and resistance after installation but prior to substantial completion. ***The telecommunications contractor is to invite the Design Engineer and ITS representative to witness a portion of this testing while it is being performed.***
2. The test performed shall use an earth ground resistance tester that is configured for a continuity test otherwise known as a two-point test or a “dead earth” test. Tests shall be conducted between the electrical entrance ground and the TMGB as well as at each TGB. This resistance shall be less than 0.05 Ohms.

IF THIS CONNECTOR OR CABLE IS
LOOSE OR MUST BE REMOVED,
PLEASE CALL THE BUILDING
TELECOMMUNICATIONS MANAGER

3.2 TMGB
A. All metallic raceways for telecommunications cabling located within the same room or space as the TMGB shall be bonded to the TMGB.
B. Insulate the TMGB 2” from the wall.
C. For outside plant cables entering a building with a cable shield isolation gap, bond the cable shield (on the building side of the gap) to the TMGB. Outside plant protectors shall be bonded to the TMGB with a No. 6 AWG conductor.
D. Connections to the busbar shall be made with 2-hole lugs.
E. Connections hall be made by cleaning the area of connection on the busbar and on the two-hole lug and then applying a thin coating of anti-oxidant compound.

3.3 TGB
A. All metallic raceways for telecommunications cabling located within the same room or space as the TGB shall be bonded to the TGB.
B. Insulate the TGB 2” from the wall.
C. Connections to the busbar shall be made with 2-hole lugs.
D. Connections hall be made by cleaning the area of connection on the busbar and on the two-hole lug and then applying a thin coating of anti-oxidant compound.

3.4 BCT
A. Route BCT in conduit from telecommunications service entrance room to the main electrical service ground connection.
1. Label conduit at telecommunications service entrance with tag or adhesive label that states “Building Conductor for Telecommunications (BCT) to Main Electrical Service Ground Connection”.
2. Label conduit at main electrical service ground connection with tag or adhesive label that states “Building Conductor for Telecommunications (BCT) to Telecommunications Main Grounding Busbar (TMGB)”.
3. BCT shall not be run in a metallic conduit and shall not be completely encircled by metallic clamps.

3.5 TBB
A. Where following the same routing as cable tray, attach TBB on the outer side of the cable tray to minimize contact with communications cabling.
B. Size the TBB according to the following cable:

SIZING OF THE TBB	
TBB Length in Linear meters (feet)	TBB Size AWG
Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
20-26 (66-84)	3/0
26–32 (85 – 105)	4/0
32–38 (106 – 125)	250 kcmil
38–46 (126 – 150)	300 kcmil
46–53 (151 – 175)	350 kcmil
53–76 (176 – 250)	500 kcmil
76–91 (251 – 300)	600 kcmil
Greater than 91 (301)	750 kcmil

3.6 General Bonding Conductors or Jumpers
A. General bonding conductors or jumpers are to be utilized in each telecommunications room between the TMGB/TGB and the following components:
1. The communications building entrance protectors.
2. Electrical panel board (if in same room as TMGB/TGB).
3. Building steel (if available in same room as TMGB/TGB).
4. Telecommunications ladder rack and cable tray.
a) Bonding jumpers may be utilized to ground adjacent pieces of ladder rack and cable tray together, reducing the need to a single conductor back to the TMGB/TGB.
b) In cases where ladder rack or cable tray is painted, it is assumed that the paint will need to be removed at the connection point to ensure a completely bonded connection. If this is not the case, submit documentation from manufacturer indicating NRTL testing was done in regards to grounding without removal of the paint.
5. Telecommunications equipment racks and cabinets.
a) Each cabinet and rack shall be bonded to the TMGB/TGB directly with a #6 AWG RBC from the Rack Grounding Busbar (RGB).
b) In cases where equipment racks or cabinets are painted, it is assumed that the paint will need to be removed at the connection point of the RGB to ensure a completely bonded connection. If this is not the case, submit documentation from manufacturer indicating NRTL testing was done in regards to grounding without removal of the paint.

3.7 Grounding Lugs
A. Wires shall be inserted to the full depth of the lug.
B. Space between wire insulation and the body of the compression lug shall be kept to a maximum of 1/4 inch.
C. Lug must agree with wire size.
D. To assure proper die is used with the specified connector, manufacturer's embossed coding systems shall be adhered to.
E. Connectors shall not be modified in any way.

F. Daisy chaining and stacking (piggy backing) of ground lugs is prohibited.
G. Bolts, nuts, washers used to secure ground connections shall match the diameter of the hole.

End of Section 27 05 26