1. GENERAL

1.01 SUMMARY

.1 This Section covers the Specification and requirements for the grounding and bonding of communications systems and structured cabling infrastructures.

.2 Contractor shall provide all services, labor, materials, tools, and equipment required for the implementation of a complete and effective grounding and bonding System, as specified this Section.

.3 Contractor shall comply with all the requirements of Specification, Design Drawings, and all applicable Telecommunications Standards and Electrical Codes.

.4 Grounding and bonding System shall be designed, engineered, and installed to suit the Client's premises, communications systems, and cabling infrastructure.

.5 Grounding electrode system refers to all electrodes required by Electrical Code, including, telecommunications system grounding electrodes.

.6 The terms "connect" and "bond" are used interchangeably in this Specification and have the same meaning.

1.02 DEFINITIONS

.1 AWG – American Wire Gauge – The standardized system for gauging the diameter of round, solid, non–ferrous, electrically–conducting wire.

.2 BBC – Bonding Backbone Conductor – A telecommunications bonding connection which interconnects telecommunications bonding backbones. Formerly known as the grounding equalizer.

.3 BN – Bonding Network – A set of interconnected conductive structures that provides a low impedance path for the associated telecommunications infrastructure.

.4 EF – Entrance Facility – An entrance to a building for both public and private network service cables, including wireless, that includes the entrance point of the building and continues to the entrance room or space.

.5 ESD – Electrostatic Discharge – The sudden flow of electricity between two electrically–charged objects caused by contact, an electrical short, or dielectric breakdown.

.6 Mesh–BN – Mesh Bonding Network – A bonding network to which all associated equipment, such as cabinets, frames, racks, trays, and

pathways, are connected using a bonding grid that is connected to multiple points on the common bonding network.

.7 PBB – Primary Bonding Busbar – A busbar placed in a convenient and accessible location and bonded, by means of the Telecommunications Bonding Conductor (TBC), to the building's service equipment (power) ground. Formerly known as the Telecommunications Main Grounding Busbar (TMGB).

.8 RBB – Rack Bonding Busbar – A busbar within a cabinet, frame, or rack.

.9 RBC – Rack Bonding Conductor – A bonding conductor from the rack or Rack Bonding Busbar (RBB) to the Telecommunications Equipment Bonding Conductor (TEBC).

.10 SBB – Secondary Bonding Busbar – A common point of connection for telecommunications system and equipment bonding to ground, located in the distributor room. Formerly known as the Telecommunications Grounding Busbar (TGB).

.11 TBB – Telecommunications Bonding Backbone – The conductor that interconnects the Primary Bonding Busbar (PBB) to the Secondary Bonding Busbar (SBB).

.12 TBC – Telecommunications Bonding Conductor – A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground. Formerly known as the bonding conductor for telecommunications.

.13 TEBC – Telecommunications Equipment Bonding Conductor – A conductor that connects the Primary Bonding Busbar (PBB) or Secondary Bonding Busbar (SBB) to equipment racks or cabinets.

.14 TR – Telecommunications Room – An enclosed space for housing telecommunications equipment, cable terminations, and cross–connect cabling. It is the recognized location of the cross–connect between the backbone and horizontal facilities.

.15 UBC – Unit Bonding Conductor – A bonding conductor from equipment or a patch panel to a Rack Bonding Conductor (RBB) or a Rack Bonding Busbar (RBB).

1.03 REFERENCES

.1 Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this Specification to the extent referenced. Publications are referenced in the text by the basic designation only.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM-B1-13(2018) – Standard Specification for Hard-Drawn Copper Wire.

.2 ASTM B8-11(2017) – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

.3 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

.1 IEEE 81-2012 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

.4 Canadian Standards Association (CSA):

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.5 Telecommunications Industry Association (TIA): Latest Revision of Standards

.1 TIA-606 – Administration Standard for Telecommunications Infrastructure

.2 TIA-607 – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

.6 BICSI:

.1 Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria – Latest Revision

.2 Telecommunications Distribution Methods Manual (TDMM) – Latest Revision

.7 Underwriters Laboratories, Inc. (UL):

.1 UL 44 (19th Edition, 2018) – UL Standard for Safety Thermoset-Insulated Wires and Cables.

.2 UL 83 (16th Edition, 2017) – UL Standard for Safety Thermoplastic-Insulated Wires and Cables.

.3 UL 467 (11th Edition, 2022) – UL Standard for Safety Grounding and Bonding Equipment.

.4 UL 486A-486B (3rd Edition, 2018) – UL Standard for Safety for Wire Connectors.

.8 International Annealed Copper Standard (IACS)

1.04 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 and Section 27 05 00.

.2 Action Submittals: Product Data for each type of product (PBB, SBB, RBB, 2–Hole Lugs, etc.)

.3 Shop Drawings:

.1 Sufficient information, clearly presented, shall be included to determine compliance with latest TIA-607 Standard and this Specification.

.2 Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

1.05 CLOSEOUT SUBMITTALS

.1 Submit closeout documents in accordance with Section 27 05 00.

.2 As–Built Data: Submit plans showing as–built locations of grounding and bonding infrastructure, including the following: PBB, SBB, RBB and routing of their bonding conductors.

.3 Test Reports: Provide test reports of ground resistance to each primary or secondary bonding busbar (PBB/SBB) located in each telecommunications space impacted by the work.

2. PRODUCTS

2.01 MANUFACTURERS

.1 Hubbell.

.2 nVent Erico.

.3 Panduit.

.4 Thomas & Betts.

2.02 GENERAL REQUIREMENTS

.1 Contractor shall provide a comprehensive and effective telecommunications grounding and bonding infrastructure for the protection of personnel and equipment, in compliance with the current Canadian Electrical Code, the latest TIA-607 Standard, and all applicable codes of Authority Having Jurisdiction (AHJ).

.2 Grounding and bonding infrastructure shall follow the latest TIA-607 design methodology, whereby within a building the generic telecommunications bonding infrastructure originates at the facility's electrical entrance ground and extends throughout the building. The infrastructure shall comprise the following major components:

.1 Primary bonding busbar (PBB).

.2 Telecommunications bonding conductor (TBC).

.3 Telecommunications bonding backbone (TBB).

.4 Secondary bonding busbar (SBB).

.5 Backbone bonding conductor (BBC).

.3 All cables shall be plenum rated FT6.

.4 External Grounding Electrodes:

.1 The grounding electrode system shall be designed to have a resistance to earth of 25 ohms or less for a single grounding electrode, conforming to the latest version of the Ontario Electrical Safety Code.

.2 For sites that are critical in nature (e.g., public safety facilities, military installations, data centers, web hosting facilities, central offices) the grounding electrode system shall be designed to have a resistance of less than 10 ohms – ideally less than 5 ohms.

2.03 BONDING BUSBARS

.1 Bonding busbars shall be provided in each telecommunications space (room/closet) and in each equipment rack/cabinet, as specified in this Section. Bonding busbars shall provide connection or termination points for the telecommunications space's bonding conductors.

.2 The types of bonding busbars specified in the infrastructure comprise:

.1 Primary Bonding Busbar (PBB).

.2 Secondary Bonding Busbar (SBB).

.3 Rack Bonding Busbar (RBB).

2.04 PRIMARY BONDING BUSBAR (PBB)

.1 The PBB shall be placed in a convenient and accessible location in the telecommunications entrance room or space. Typically, there should be a single PBB per building.

.2 The PBB shall be bonded, by means of the telecommunications bonding conductor (TBC), to the building's service equipment (electrical) ground.

.3 The PBB serves as the dedicated extension of the building grounding electrode system for the telecommunications infrastructure. It also serves as the central attachment point for the Secondary Bonding Busbars (SBB) through the Telecommunications Bonding Backbone (TBB).

.4 The PBB shall be:

.1 Pre-drilled with mounting holes to accommodate matched listed lugs and hardware.

.2 Made of copper, or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).

.3 Of minimum dimensions of 6.35 mm (0.25 in) thick x 100 mm (4 in) wide and variable in length to accommodate design requirements.

.4 UL Listed.

.5 Cleaned with an antioxidant applied prior to fastening connectors to the busbar.

.6 Insulated from its support using an insulator that is listed for the purpose by a nationally recognized testing laboratory (NRTL).

.7 Installed a minimum of 50 mm (2 in) from the finished wall to allow access to the rear of the busbar.

.8 Sized for current applications and future growth.

.5 The primary protector grounding conductor shall be connected to the PBB. This conductor is intended to conduct lightning and AC fault currents from the telecommunication primary protectors.

2.05 <u>SECONDARY BONDING BUSBAR (SBB)</u>

.1 The SBB shall be placed in a convenient location of the telecommunications room/closet. The SBB shall form a common bonding connection point for telecommunications systems and equipment in the area served by the telecommunications room/closet.

.2 The SBB shall be:

.1 Pre-drilled with mounting holes to accommodate matched UL Listed lugs and hardware.

.2 Made of copper, or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).

.3 Of minimum dimensions of 6.35 mm (0.25 in) thick x 50 mm (2 in) wide and variable in length.

.4 cUL Listed.

.5 Cleaned with an antioxidant applied prior to fastening connectors to the busbar.

.6 Insulated from its support using an insulator that is listed for the purpose by a nationally recognized testing laboratory (NRTL).

.7 Installed at a minimum of 50 mm (2 in) from the finished wall to allow access to the rear of the busbar.

.8 Sized for current applications and future growth.

2.06 RACK BONDING BUSBAR (RBB)

.1 The RBB is a grounding busbar within a cabinet, rack, or frame.

.2 The RBB shall be provided in cabinets and racks that support multiple equipment bonding conductors to serve as an extension of the PBB or SBB for the equipment in the cabinet.

.3 The RBB shall meet the following requirements:

.1 Manufactured from copper alloy.

.2 cUL Listed.

.3 Horizontal Busbars shall be at least 19 mm (0.75 in) wide, 483 mm (19 in) long, and 5 mm (0.1875 in) thick.

.4 Have a minimum of 14, factory–provided #12–24 threaded holes.

.5 Have pre–punched EIA 310 D standard rack mounting holes.

.6 Vertical Busbars shall be at least 17 mm (0.67 in) wide, 2 m (78.65 in) long, and 1.27 mm (0.05 in) thick, and shall come in threaded rail and cage nut versions.

2.07 BONDING CONDUCTORS

.1 The following common requirements apply to all types of bonding conductors specified in this Section:

.1 All bonding conductors shall be made of stranded copper wire with a green jacket (or per CE Code depending on size), run as a continuous conductor.

.2 Bonding conductors may be insulated. If insulated they shall be cUL Listed for the application.

.3 Bonding conductors shall be protected from physical and mechanical damage.

.4 Bonding conductors shall be sized to meet the ANSI/TIA-607-D requirements.

.2 Telecommunications Bonding Backbone (TBB)

.1 The TBB is a conductor that bonds the Secondary Bonding Busbars (SBB) to the Facility's Primary Bonding Busbar (PBB).

.2 The TBB shall meet the following requirements:

.1 The TBB shall be sized to meet the requirements of ANSI/TIA-607-D and shall be as straight as practicable avoiding bends. The TBB minimum conductor size shall be AWG 6.

.2 Bonding and grounding conductors may be insulated or un–insulated and shall not decrease in size as the grounding path moves closer to earth.

.3 Connections (bonds) between the telecommunications grounding network and associated electrical panels shall be done by a qualified electrician in accordance with guidelines in the latest TIA-607 and applicable electrical codes.

.4 Bonding Conductors should be continuous (splices not allowed) and routed in the shortest possible straight-line path, avoiding changes in elevation and sharp bends.

.5 TBB grounding conductors routing through ferrous metal conduit should be avoided, but if it is necessary due to building constraints, any grounding conductor running through ferrous conduit longer than 3 feet shall be bonded at the end using appropriately sized conduit grounding clamps as described TIA-607.

.6 Bonding the TBB to the PBB and each SBB shall be performed with a UL listed irreversible compression (crimp) dual-lug connector.

.7 Metallic cable shield(s) and cabling pathways, including metallic conduits, shall not be used as a TBB.

.8 Whenever two (2) or more TBBs are used within a multistory building, the TBBs shall be bonded together with a BBC at every third floor as a minimum, and at the top floor.

.9 Conductor sizing depends upon the Project specification, and shall be determined based on the TBB length as stipulated in TIA-607. Contractor shall ensure TBB sizing complies with the TIA-607 guidelines outlined in the Table below:

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 (67-84)	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 Telecommunications Bonding Conductor (TBC)

.1 The TBC connects the telecommunications bonding infrastructure to the building's service equipment (power) ground (formerly known as the bonding conductor for telecommunications).

.2 The TBC shall have at a minimum the same size as the largest TBB.

.3 The TBC shall bond the PBB to the service equipment (power) ground.

.4 Backbone Bonding Conductor (BBC)

.1 The BBC (formerly known as the grounding equalizer) is a bonding conductor which interconnects telecommunications bonding backbones.

.2 The BBC shall have at a minimum the same size as the largest TBB to which it is bonded.

.5 Telecommunications Equipment Bonding Conductor (TEBC)

.1 The TEBC is a bonding conductor which connects the cabinets and racks in a telecommunications room/closet to the local primary or secondary bonding busbar (PBB or SBB).

.2 The TEBC shall have a minimum size of AWG 6.

.3 Metallic objects and pathways shall not be used as a replacement for the TEBC.

.4 The TEBC may be routed inside cable trays. It shall be secured at maximum intervals of 0.9 m (3 ft).

.5 The TEBC shall be separated a minimum of 50.8 mm (2 in) from other cable groups, such as power or telecommunications cables.

.6 The TEBC shall be connected to the cabinets/racks, to a Rack Bonding Conductor (RBC) or to a vertical/horizontal Rack Bonding Busbar (RBB).

.7 Connections to the TEBC shall be made with UL Listed irreversible compression connectors, suitable for multiple conductors, and with the rack bonding conductors (RBCs) routed toward the PBB/SBB.

.6 Rack Bonding Conductor (RBC)

.1 The RBC is a bonding conductor from the cabinet or Rack Bonding Busbar (RBB) to the Telecommunications Equipment Bonding Conductor (TEBC).

.1 The RBC shall have a minimum size of AWG 6.

.2 The RBC shall be bonded to the Telecommunications Equipment Bonding Conductor (TEBC) using UL Listed irreversible compression (crimp) connectors.

.1 Where connected to a server cabinet, the RBC extends to the bottom of the server cabinet allowing Equipment Bonding Conductors to be attached at any point in the cabinet.

.2 Where connected to a network rack/cabinet, the Rack Bonding Conductor (RBC) is bonded to the Rack Bonding Busbar (RBB) via a UL Listed two-hole compression lug.

.2 Unit Bonding Conductor (UBC)

.1 The Unit Bonding Conductor (UBC) connects individual equipment in a cabinet or rack to the Rack Bonding Conductor (RBC) or Rack Bonding Busbar (RBB).

.2 The UBC shall also be used for bonding cable tray sections to the Telecommunications Equipment Bonding Conductor (TEBC).

.3 The UBC shall have a minimum size of AWG 6.

.4 Bonding.

.1 Where used in a server cabinet, UBC shall be bonded to the Rack Bonding Connector (RBC) using UL Listed irreversible compression (crimp) connectors and to IT equipment via a UL Listed two-hole compression lug. (Some IT equipment may require one-hole lugs.)

.2 Where used in a network cabinet/rack, UBC shall be bonded to the Rack Bonding Busbar (RBB) via a UL Listed two-hole compression lug and to IT equipment via a UL Listed two-hole compression lug. (Some IT equipment may require one-hole lugs.)

.3 Where used as a cable tray bonding conductor connecting cable tray sections, UBC shall be bonded to each adjoining section of the cable tray using UL Listed two-hole compression lugs.

.4 Where used as a cable tray bonding conductor connecting cable tray sections to the Telecommunications Equipment Bonding

Conductor (TEBC), UBC shall be bonded to the TEBC using UL Listed irreversible compression (crimp) connectors and to the cable tray via a UL Listed two-hole compression lug.

3. EXECUTION

3.01 GENERAL

.1 Ground in compliance with the CE Code, the latest TIA-607 Standard, and as specified in this Section and the Drawings.

.2 Components of the telecommunications bonding system shall be installed and connected using materials and techniques as specified in the latest TIA-607 Standard.

.3 Follow equipment manufacturer's grounding instructions.

3.02 EXAMINATION

.1 Contractor shall check the AC grounding electrode system and equipment grounding for compliance with the requirements for maximum ground–resistance level, and other conditions affecting performance of grounding and bonding of the telecommunications system.

.2 Inspect the test results of the AC grounding system.

.3 Prepare written report listing all conditions detrimental to the performance of the Work.

.4 Proceed with Work only after unsatisfactory conditions have been corrected.

3.03 CORROSION INHIBITORS

.1 When making ground and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

.2 PBB and SBB shall always have tinned surfaces to restrain oxidation and shall be cleaned and have an antioxidant paste applied to both bonding surfaces prior to fastening conductors.

3.04 TELECOMMUNICATIONS SYSTEM GROUNDING

.1 Bond the telecommunications grounding system to the electrical grounding electrode system.

.2 Provide dedicated telecommunications grounding busbars for the following locations/spaces:

.1 Telecom entrance facility rooms

.2 Server rooms

.3 IT rooms/closets

.3 Provide bonding to all telecom cabinets, racks, metallic cable shields, junction/pull boxes, enclosures, and communications/security equipment, as required by Standards and Code.

.4 Provide bonding to all metallic cable trays and conduits to building ground.

.5 Bond incoming carrier armor sheath to building ground.

.6 Furnish and install all busbars and bonding conductors required to properly ground and bond all communications raceways, cable trays, metallic cable shields, and equipment, in compliance with design, Codes and Standards.

.7 Bonding jumpers/conductors shall be continuous with no splices. Use the shortest possible length of bonding jumper.

.8 Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milliohms or less.

.9 Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding conductors, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.

.10 Bonding Conductors:

.1 Use insulated ground wire of the size and type shown on the Drawings or use a minimum of #6 AWG insulated copper wire.

.2 Assemble bonding jumpers using insulated ground wire terminated with compression connectors.

.3 Use compression connectors of proper size for the specified conductors. Use connector manufacturer's compression tool.

.11 Bonding Jumper Fasteners:

.1 Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.

.2 Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.

.3 Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.

.4 Strut Channel and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

3.05 RACEWAY GROUNDING

.1 Conduit: Use insulated #6 AWG bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.

.2 Cable Tray: Use insulated #6 AWG bonding jumpers to ground metallic cable tray at:

.1 Each end

.2 All intermediate metallic enclosures/boxes

.3 All cable tray section junctions

3.06 IDENTIFICATION AND ADMINISTRATION

.1 Provide complete grounding system labeling in accordance with the requirements of:

.1 ANSI/TIA–606, Latest Revision.

.2 Section 27 05 53 – Identification for Communications Systems.

.2 Primary Bonding Busbar (PBB): Label with “PBB”.

.3 Secondary Bonding Busbar (SBB): Label with “SBB”.

.4 Telecommunications Bonding Backbone (TBB): Label with “WARNING! TELECOMMUNICATIONS BONDING BACKBONE. DO NOT REMOVE OR

DISCONNECT" Labels shall be affixed at both ends and at accessible intermediate points.

3.07 TESTING

.1 Perform tests as specified in BICSI Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.

.2 Perform two-point bond testing to be preformed by qualified technicians.

.3 Conduct continuity tests to verify that all metallic pathways and pathway sections are bonded to PBB or SBB.

.4 Conduct electrical continuity test to verify that PBB is effectively bonded to the facility grounding electrode conductor.

.5 Perform resistance tests to ensure rack and cabinet bonding connection resistance measures less than 4 Ω to PBB or SBB.

.6 Provide a complete test report to Consultant and Owner.

End of Section