## 1. GENERAL

### 1.1 Summary

.1 This Section covers system requirements for lightning protection.

.2 Design, supply, install, and test a complete lightning protection system. The design shall include a risk assessment as per CSA B72 and NFPA 780 for all the new structures. Statistical or statutory meteorological data must be consulted to make a proper determination of the protection level required.

.3 Building and structures shall be properly grounded to prevent damages from a lightning strike/discharge.

.4 System to consist of metallic air terminals, lightning conductors connecting air terminals to ground, and interconnected ground electrodes, and/or ground cables.

### 1.2 Standards

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

.1 ASTM B3 - Standard Specification for Soft or Annealed Copper Wire.

.2 ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

.3 ASTM B33 - Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

.2 Canadian Standards Association (CSA):

.1 CSA B72 - Installation Code for Lightning Protection Systems.

.2 CSA C22.1 - Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/WEB elsewhere in this document shall include reference to such amendments.

.3 CSA C22.2 No. 41 - Grounding and Bonding Equipment (Trinational standard with NMX-J-590-ANCE and UL 467).

.4 CSA C22.2 No. 269.1 - Surge Protective Devices – Type 1 – Permanently Connected.

.5 CSA C22.2 No. 269.2 - Surge Protective Devices – Type 2 – Permanently Connected.

.3 City of Winnipeg:

.1 Water and Waste Department Electrical Design Guide.

.2 Water and Waste Department Automation Design Guide.

.3 The Winnipeg Electrical By-law (WEB) and associated bulletins.

.4 Winnipeg amendments to the National Building Code of Canada (NBC).

.4 Institute of Electrical and Electronics Engineers (IEEE):

.1 IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.

.2 IEEE IA-18, No. 6 - Grounding Where Corrosion Protection Required.

.3 IEEE P81 - Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

.4 IEEE 80 - Guide for Safety in AC Substation Grounding.

.5 IEEE 837 - Standard for Qualifying Permanent Connections Used in Substation Grounding.

.6 IEEE 3002.3 - Recommended Practice for Conducting Short-Circuit Studies and Analysis of Industrial and Commercial Power Systems.

.7 IEEE 3003.1 - Recommended Practice for System Grounding of Industrial and Commercial Power Systems.

.8 IEEE 3003.2 - Recommended Practice for Equipment Grounding and Bonding in Industrial and Commercial Power Systems.

.5 National Fire Protection Association (NFPA):

.1 NFPA 780 - Standard for the Installation of Lightning Protection Systems.

.6 Lightning Protection International (LPI):

.1 LPI 175 - Standard for the Design – Installation – Inspection of Lightning Protection Systems.

.2 LPI 177 - Inspection Guide for Certified Systems.

.7 Underwriter Laboratories Canada (cUL):

.1 UL 96A - Standard for Installation Requirements for Lightning Protection Systems UL Lightning Protection Components.

## 1.3 Submittals

.1 Provide submittals in accordance with Sections 01 30 00 - Submittals and 26 05 00 – Common Work Results - Electrical.

.2 Manufacturer's descriptive literature for materials.

.1 Shop Drawings as outlined herein and contain all items within one complete submission.

.1 Submit Design Drawings stamped and signed by Professional Engineer registered or licensed in Manitoba, Canada.

.2 Drawings shall include a complete material list with Manufacturer, style, model number and quantities.

.3 Drawings shall indicate materials, methods of construction, attachment and anchorage points for conductors to air terminals and electrodes, erection diagrams, connections, explanatory notes, and other information necessary for completion of the Project.

.4 Submit datasheet of all components used, including make, model number, part number, physical details and measurements.

.5 Submit all pre-design and finalized installation ground continuity and all ground resistance system test results.

## 2. PRODUCTS

### 2.1 Manufacturers, Products, and Installers

.1 All lightning protective components shall be cULus listed to UL 96, or CSA certified to C22.2 No. 41. Installations shall be performed to CSA B72.

.2 Acceptable Manufacturers:

.1 Thompson Lightning Protection Inc.

.2 Dominion Lightning Rod Co. Ltd.

.3 Harger Lightning & Grounding

.4 Or approved equal.

.3 Acceptable Installers:

.1 Western Lightning Protection.

.2 Or approved equal.

### 2.2 Performance / Design Criteria

.1 Coordinate the design for the grounding system with Section 26 05 28 – Grounding Secondary and coordinate the submission for the onsite pre-design ground continuity test results.

.2 System Description and General Requirements

.1 All lightning protection system components shall be listed and approved for use as part of a lightning protection system, with the exception of basic hardware such as screws, bolts, washers, and nuts.

.2 Air terminals (Lightning Rods): Aluminum a minimum of 305 mm (12") to a maximum of 1200 mm (48") in height. Use of copper is restricted only to specific instances where galvanic interaction of dissimilar metals will cause corrosion and there is no other reasonable means to attach aluminum components.

.3 Conductors:

.1 Grounding and bonding conductors for all point locations, bare (un-insulated) and insulated type (Green), shall be annealed copper type conforming to ASTM B3, tinned in accordance with ASTM B33, stranded, with 98 percent conductivity.

.2 Unless noted otherwise, all conductors No. 8 AWG and larger shall be stranded, Class B in accordance with ASTM B8, tinned in accordance with ASTM B33.

.3 Where portions of the underground installation are in RPVC conduit for transition to bare conductor: use green jacketed RWU90 XLPE, Aluminum, size as indicated.

.4 Where portions of the installation are above ground and run in RPVC raceways and run on surfaces: use green jacketed RWU90 XLPE, Aluminum, size as indicated.

.5 Conductors on roof: copper, stranded, insulated jacket (Green), of minimum sizes required for the Class of structure. Provide compatible connection when splicing dissimilar conductors to prevent galvanic interaction between dissimilar metals.

.1 Use Aluminum compatible conductors, terminals, connectors and fastenings for aluminum sheathed and non-aluminum sheathed buildings, or equipment.

.6 Down conductors: Tinned copper, stranded, insulated jacket (Green), minimum size#2 AWG for Class 1 installations, and a minimum of #2/0 AWG for Class 2 installations. Provide and install the required number of down conductors for each zone, minimally spaced in parallel for the calculated bonding distance. Provide compatible metal connection when splicing dissimilar conductors to prevent galvanic interaction of dissimilar metals.

.4 Fastening and attachment straps: Aluminum.

.5 Ground Rod electrode:

.1 Tinned copper, minimum 19 mm diameter, and minimum length of 3 m. Should the design require two (2) ground rods connected to form a 6 m long ground rod, the rod shall come with cone-shaped point on the first section, connected through a threadless compression coupling.

.2 The design shall include a minimum of two (2) ground wells, minimum a 305 mm deep, 205 mm diameter well with flush lid for accessibility and inspection of compressed connections. The inspection well material shall be suitable to withstand light traffic, tin/galvanised inspections wells are not acceptable.

.6 Grounding conductor electrode:

.1 All underground outdoor portions of the installation shall be direct burial in contact with bare earth: bare Aluminum (i.e., unjacketed), with a minimum size of 4/0 AWG.

.7 Ground plate electrode:

.1 Plate electrodes shall only be used in areas where bedrock prevents the use of vertical Rod electrodes. Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Minimum copper surface area 2 m², 2 mm thick.

.8 Concrete encased electrode:

.1 Copper conductor: minimum 6.0 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.

.2 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails.

.3 Bonds between Aluminum and lead in concrete, galvanized steel in concrete, and galvanized steel in concrete is acceptable. Bonds between Aluminum and steel in concrete is unacceptable.

.9 Connections:

.1 Where possible, all connections shall be formed by an exothermic weld process. For Aluminum connections, exothermic weld connections are required. For other connections, use compression connections (compression tap or CT).

.2 Where several ground rods are connected to the underground electrode they shall be equally spaced. Splicing and use of ground clamps are unacceptable.

.10 All connectors and splicers shall be of suitable configuration and type for the intended application and shall be of the same material as the conductor or of electrolytically compatible materials. When dissimilar materials are in contact their combined electro-chemical potential shall be less than 0.6V, when dissimilar metals may be in the presence of an electrolyte their combined electro-chemical potential shall be less than 0.2V.

## 3. EXECUTION

### 3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

### 3.2 Examination

.1 Verification of Conditions: verify conditions of substrates and facilities previously installed under other Sections or Contracts are acceptable for the lightning protection installation in accordance with design and Manufacturer's written instructions.

.2 Visually inspect substrate in presence of Contract Administrator. Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

.3 The Contractor shall be responsible for compaction of substrate to native soil conditions in order to install ground electrodes.

.4 Include inspection of facilities and buildings for compliance of the installed lightning protection system with building code. All penetrations shall be sealed, insulation and vapor barrier maintained, fire seals complete etc.

**3.3 Installation**

.1 Provide and install lightning protection to CSA B72, UL 96A, and NFPA 780 standards for a permanent, complete, and functional system.

.2 Coordinate the installation for the grounding system with Section 26 05 29 – Grounding Secondary.

.3 Install loop type, low impedance, grounding system interconnecting all components so at least two grounding connections are provided for each major item of equipment. Ensure that severing of any single grounding conductor in this system does not remove grounding protection on any major item.

.4 Provide and install ground electrodes. Protect exposed grounding/bonding conductors from mechanical injury during and after construction.

.5 Paint buried ground connection with a bitumastic paint.

.6 Completed connection or joint shall be equal or larger in size than the conductors joined and have the same current-carrying capacity as the largest conductor. Arrange conductors and connectors so no strain on connections.

.7 Air terminal layout and placement position with at least 2 directional paths to ground.

.8 Protect all objects elevated above the normal roof height and with a surface thinner than 4.7 mm (3/16”). This includes exhaust fan housings, air handling units, masts, exhaust vents and ducting, etc.

.9 Metallic objects having a thickness greater then 4.7 mm (3/16”) shall serve as strike termination devices without the addition of air terminals provided they are not an equipment or material that may be damaged from such a strike. These bodies shall be made a part of the lightning protection system by connection and bonding fittings with 2000 mm² (3 in²) of surface contact area.

.10 Attachment of cable secured to air terminals, and building shall be secured along the cable run and attachment shall not be more than 915mm apart.

.11 Penetrations and connections to roof systems shall be done in accordance with the roofing contractor’s recommendations and requirements. Connection to the roofing system shall in no way compromise the integrity or warranty of the roof system.

.12 Structural elements and design features shall be used whenever possible to minimize the visual impact of exposed conductors.

.13 Cable down conductors shall be protected and concealed using rigid PVC conduit (RPVC).

.14 Bond discharge conductors to service mast and all other metallic non-current-carrying electrical parts

## 3.4 Inspection

.1 Obtain inspection certificate certifying that the installation is compliant with applicable codes and standards from an LPI-IP Certified Field Inspector for the system. Submit to the Contract Administrator.

.2 Protect installed products and components from damage during construction. Repair damage to adjacent materials caused by lightning protection installation.

**END OF SECTION**