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HOUSTON AIRPORT SYSTEM TECHNOLOGY SPECIFICATION
SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

(REV. 10-11-2023-BM)

PART 1 – GENERAL

1.01 PROJECT SCOPE SUMMARY

The installation of a complete grounding and bonding system to effectively and safely neutralize the potential differences between metallic components within Telecommunications Rooms by permanently connecting all communications systems, equipment, and metal conducting segments of communications pathway to earth in such a manner as to prevent potential electrical loops and transient voltages that can cause damage to telecommunications equipment and personnel.
(Designer shall provide a detailed narrative of the tasks to be performed under this specification section.)

1.02 SECTION INCLUDES

A. Grounding electrodes and conductors.
B. Equipment grounding conductors.
C. Bonding.
D. Communication system grounding.
E. Electrical equipment and raceway grounding and bonding.
F. Control equipment grounding.

1.03 REFERENCES

A. The following Houston Airport System Specification Sections that are not specifically covered in this section are incorporated by reference:
   1. Section 27 05 28: Interior Pathways for Communications Systems
   2. Section 27 05 43: Underground Ducts and Raceways for Communications
   3. Section 27 05 53: Identification for Communications Systems
   4. Section 27 11 00: Communications Equipment Room Fittings
   5. Section 27 13 00: Communications Backbone Cabling
   6. Section 27 15 00: Communications Horizontal Cabling
   7. Section 27 21 00: Data Communications Network Equipment
   8. Section 27 22 00: Data Communications Hardware
   9. Section 27 51 00: Distributed Audio-Video Communications Systems
   10. Section 28 10 00: Access Control
   11. Section 28 20 00: Video Surveillance

B. American Society for Testing and Materials (ASTM):
   1. B3-13(2018): Standard for Soft or Annealed Copper Wires
   2. B8-11(2017): Standard for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

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3. B33-10(2020)e1: Standard for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes

C. Institute of Electrical and Electronics Engineers (IEEE):
   1. 81-1983: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
   2. 142-2007: Recommended Practice for Grounding of Industrial and Commercial Power Systems
   3. 1100-2005: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems

D. Underwriters' Laboratories (UL):
   1. Standard 83, Edition 16: Thermoplastic-Insulated Wires and Cables
   2. Standard 96, Edition 6: Lightning Protection Components
   3. Standard 96A, Edition 13: Installation Requirements for Lightning Protection Systems
   4. Standard 467, Edition 10: Grounding and Bonding Equipment

E. National Fire Protection Association (NFPA):
   1. NFPA 780, Current Edition: Standard for the Installation of Lightning Protection
   2. NFPA 70, Current Edition: National Electrical Code (NEC)
      a. NEC Article 250 – Grounding and Bonding
      b. NEC Article 770 – Optical Fiber Cables
      c. NEC Article 800 – General Requirements for Communications Systems

F. American National Standards Institute / Telecommunications Industry Association / Electronic Industries Alliance (ANSI/TIA/EIA):
   1. ANSI J-STD-607-B Commercial Building Grounding and Bonding Requirements
   2. ANSI/TIA-607-C Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

G. Building Industry Consulting Services International (BICSI):
   1. Telecommunications Distribution Methods Manual (Latest Issue)
   2. Outside Plant Design Reference Manual (Latest Issue)
   3. 607-2011 Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
   4. N3-20 Planning and Installation Methods for the Bonding and Grounding of Telecommunications and ICT Systems and Infrastructure

H. National Electrical Manufacturer Association (NEMA):
   1. GR 1-2017: Ground Rod Electrodes and Ground Rod Electrode Couplings

I. International Standards Organization / International Electromechanical Commission (ISO/IEC)
   1. 30129: Telecommunications bonding networks for buildings and other structures

J. Local, county, state and federal regulations and codes in effect as of date of “notice to proceed” shall be complied with.

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K. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components which may be of foreign manufacture, if any, and the country of origin.

L. Conflicts:
   1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
   2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements

M. Exhibit A Figure 1 for general grounding infrastructure layout and connectivity.

1.04 DESIGN REQUIREMENTS

A. Design grounding system following:
   1. ANSI J-STD-607-B Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
   2. Telecommunications Distribution Methods Manual-BICSI (latest issue).
   3. NECA/BICSI 607-2011.
   4. NEC Article 250 Grounding and Bonding.
   5. IEEE 1100-2005 Recommended Practice for Powering and Grounding Electronic Equipment.
   6. IEEE 142-2007 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
   7. By a firm acceptable to Owner's insurance underwriter.
   8. All labeling shall follow standards set forth by ANSI/TIA/EIA-606 and the Houston Airport System (HAS) Technology Infrastructure requirements.

B. Design Standards:
   1. Completely protect above and/or below surface structures and equipment.
   2. Calculate system on the basis of existing soil resistivity.
   3. If cathodic protection for underground sewer pipe is installed (see applicable Sections under Division 02 00 00 Existing Conditions), ensure the pipe is not connected to the general grounding system, either directly through grounding cable or indirectly through grounded electrical devices connected to the pipe. Electrically isolate electrical devices from sewer pipe.
   4. This specification is a living document. The criteria contained in this specification are subject to revisions and updating as warranted by advances in building construction techniques, telecommunications technology, and Houston Airport System requirements.

C. Radio Equipment
   1. All Radio equipment/systems shall be grounded per Motorola R56: Standards and Guidelines for Communications Sites.

1.05 SUBMITTALS

A. Follow Division 01 33 00 Submittal Procedures.

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B. Product Data:
   1. Manufacturers catalog data and applicable special fabrication and installation details.
   2. Installation, terminating and splicing procedures.
   3. Instructions for handling and storage.
   4. Dimensions and weights.
   5. Specifically identify products and include purchase order number, supplements, and item number where applicable.
   6 Indicate that requirements are met and identify approved deviations.

C. Include spares list to be approved by HAS Technology for approval.

1.06 QUALITY ASSURANCE

A. Furnish products of latest proven design, new and in current production. Do not use obsolete components or out-of-production products.

B. The Houston Airport System retains the right to inspect all work during the entire duration of the project and any items that do not adhere to the reference, contract, bid, or project documents will be corrected immediately at the expense of the contractor.

C. Tests for Insulated Cable: Passes Vertical-Tray Flame Tests: IEEE 383, IEEE 1202, and UL 1685.

1.07 SHIPPING AND HANDLING

A. Ship on manufacturer's standard reel sizes of one continuous length. Where cut lengths are specified, mark reel quantity accordingly.

B. Protect wire wood lagging or suitable barrier across the traverse of reels. Provide heat-shrink self-sealing end caps on cable.

C. Equipment shall be delivered in original packages with labels intact and identification clearly marked. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other containments. Equipment damaged prior to system acceptance shall be replaced at no cost to the Houston Airport System (HAS).

PART 2 - PRODUCTS

2.01 GENERAL

A. Where grounding and bonding pathways as well as grounding components are not specifically shown in contract drawings, all components shall be sized in accordance with the requirements of BICSI and the NEC.

2.02 MATERIALS

(These Specifications are basic minimum criteria to be met in preparing the final specifications for this section, which is the responsibility of the Designer/Contractor/Installation Team.)

A. MANUFACTURERS

1. Cable Manufacturers/Suppliers:
   a. Houston Wire & Cable Company
   b. The Okonite Company, Inc
   c. Anixter
   d. Graybar
   e. CSC (Communication Supply Company)
   f. Continental Wire & Cable Company

2. Ground Rod and Connector Manufacturers:
   a. Copperweld
   b. ABB/Thomas & Betts
   c. Erico
   d. Galvan Industries, Inc

3. Exothermic Connector Manufacturers:
   a. nVent Erico (Cadweld®)
   b. Burndy (BURNDYWeld®)
   c. O-Z/Gedney
   d. Alltec (TerraWeld®)

4. Grounding Connector Manufacturers:
   a. ABB/Thomas & Betts
   b. Burndy
   c. O-Z/Gedney
   d. Panduit

5. Telecommunications Grounding Busbars:
   a. nVent Erico
   b. Cooper (B-Line)
   c. Chatsworth Products (CPI)
   d. Panduit

B. Grounding Conductors: Bare or insulated copper AWG wire following ASTM-B3, B8, and B33, of following sizes:
   1. A minimum of 6 AWG, stranded, green insulated, copper conductor shall be used for communications to accommodate different code requirements and allows for future changes.
   2. Metallic cable shield shall NOT be used as a Telecommunication Bonding Backbone (TBB).
   3. Interior water piping system shall NOT be used as a TBB

C. Grounding Connectors: It is recommended that connectors should be one of the following:
   1. Tin-Plated Copper
   2. Copper
   3. Copper Alloy

D. Ground Rods: A minimum of 10 feet long, 3/4-inch diameter, stainless steel

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E. Where single conductor insulated grounding conductors is required, furnish green color insulation rated for 600 volts.

F. Telecommunications Main Grounding Busbar / Primary Bonding Busbar (TMGB / PBB):
   1. The TMGB / PBB shall be a predrilled copper busbar that complies with NEMA Standards for bolt hole sizing and spacing for the type of connectors to be used. (Both holes in two-holed lugs shall be attached to busbar).
   2. The TMGB / PBB shall be sized for the immediate requirements and allow for 100% growth.
   3. The minimum busbar dimensions are .25" thick x 4" wide x 20" long.
   4. This busbar shall be electro-tin plated for reduced contact resistance.

G. Telecommunications Grounding Busbar / Secondary Bonding Busbar (TGB / SBB):
   1. The TGB / SBB shall be a predrilled copper busbar that complies with NEMA Standards for bolt hole sizing and spacing for the type of connectors to be used. (Both holes in two-holed lugs shall be attached to busbar).
   2. The TGB / SBB shall be sized for the immediate requirements and allow for 100% growth.
   3. The minimum busbar dimensions are .25" thick x 2" wide x 12" long.
   4. This busbar shall be electro-tin plated for reduced contact resistance.

H. Rack Bonding Busbar (RBB):
   1. The RBB shall be a predrilled copper busbar that complies with NEMA Standards for bolt hole sizing and spacing for the type of connectors to be used. (Both holes in two-holed lugs shall be attached to busbar).
   2. The TGB shall be sized for the immediate requirements and allow for 100% growth.
   3. The minimum busbar dimensions are 3/16" thick x 3/4" wide x 19" long.
   4. This busbar should be electro-tin plated for reduced contact resistance.

PART 3 - EXECUTION

3.01 GENERAL

A. Complete site preparation and soil compaction before trenching and driving ground rods for underground use.

B. Verify exact location of stub-up points for grounding of equipment, fences and building or steel structures.

C. Verify wiring for lighting systems is single conductor cable in conduit and each conduit contains a green-color insulated equipment-grounding conductor connected to lighting system. If no ground conductor is present, install conductors as required.

D. Copper and copper alloy connections shall be cleaned prior to connection.

E. In new construction, the electrical contractor must provide accessible means to a direct electrical service ground, which is one of the best points for grounding communications

systems. NEC Section 250.94 and 800.100 requires an intersystem bonding connection accessible at the electrical service equipment, such as:

1. Approved external connection on the power service panel. The NEC allows direct connection to a provided minimum 6 AWG copper conductor. Reference Chart 1.
2. Exposed metallic service raceway (using an approved bonding connector).
3. Grounding electrode conductor.
4. For connectivity between buildings and rooms, all bonding conductors are to be placed in conduit end to end and conduit shall be properly grounded. 3/0 conductor to be placed in 2" (two inch) conduit and minimum 6 AWG to be placed in a 1" (one inch) conduit run.

TBB Conductor Size vs. Length	
TBB/GE Linear Length in Feet (Meters)	TBB/GE Size (AWG)
Less than 13' (4)	6
14–20' (4 -6)	4
21–26' (6–8)	3
27–33' (8–10)	2
34–41' (10–13)	1
42–52' (13–16)	1/0
53–66' (16–20)	2/0
37–84' (20–26)	3/0
85–105' (26–32)	4/0
*Reference ANSI-J-STD-607-B for more information.	

Chart 1

3.02 INSTALLATION

A. Install work following drawings, manufacturer's instructions and approved submittal data.

B. Bonding conductors shall be routed with minimum bends or changes in direction, shall be made directly to the points being bonded and shall be continuous with no splices.

C. Bonding connections shall be made by using:
   1. Double crimp connectors only for all horizontal runs (cabinets, trays, etcetera). Use listed hardware that has been laboratory tested. For double crimp connectors use 2-hole lug type connector with inspection window.
   2. Exothermic welding (per NEC) within the ground electrode system, for parts of a grounding system that are subject to corrosion or that must carry high currents reliably, or for locations that require minimum maintenance. Exothermic weld shall be used on the Telecommunications Bonding Backbone (TBB) conductor for all connections. The

Technology AHJ shall perform the hammer test on each exothermic weld per their discretion.

D. Install main ground loop minimum 18" (eighteen inches) below ground surface.

E. Drive grounding rods vertically, so at least 8' (eight feet) of rod is in contact with the soil. All connections shall be of exothermic weld. Install additional ground rods as required to pass resistance test.

F. Make connections only to dry surfaces with paint, rust, oxidation, scales, grease, dirt or other foreign material is removed. Ensure proper conductivity.

G. Make above-grade grounding connections with exothermic weld.
   1. Ground small groups of isolated equipment with 3/0 AWG minimum insulated conductor connected to the main loop.

H. Equipment Grounding:
   1. Make grounding connections to electrical equipment, vessels, mechanical equipment, equipment enclosure, relay racks, and ground rods in accordance with the NEC.
   2. Make grounding connections to tanks and vessels to integral structural supports or to existing grounding lugs or pads, and not to the body of the tank or vessel.

I. Telecommunications Raceway and Support Systems Grounding:
   1. Bond and ground raceway, cable rack or tray and conduit together and permanently ground to the equipment grounding busbar. Connection to conduit may be with grounding bushing.
   2. Connect ladder-type cable tray to grounding electrode system. Telecommunications cable tray that is in the same room, as the TGB shall be connected to the TMGB.
   3. Bond and ground raceway at low voltage motor control centers or other low voltage control equipment, except conduit which is effectively grounded to sheet metal enclosure by bonding bushing or hubs need not be otherwise bonded.
   4. Where only grounding conductor is installed in a metal conduit, bond both ends of conduit to grounding conductors.
   5. Provide flexible bonding jumpers and/or straps around raceway expansion joints and across cable tray joints specifically parted to allow for expansion and hinged cable tray connections.

J. Telecommunications Grounding and Bonding Infrastructure:
   1. Install the TMGB in the Telecommunications Entrance Facility (EF) or Main Distribution Frame (MDF) as close to the panelboard as possible. The TMGB shall also be located so that the bonding conductor is as short and straight as possible. Maintain clearances required by applicable electrical codes.
   2. If a panelboard is not installed in the EF or MDF, locate the TMGB near the backbone cabling and terminations. *Designer is responsible for the proper placement within the room.*
   3. The TMGB shall be insulated from its support with a recommended separation of 2" (two inches).
   4. Connect the TMGB to the electrical service ground and telecommunications primary protectors.

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5. The minimum Telecommunications Bonding Backbone (TBB) conductor size shall be 2 AWG. The TBB originates at the TMGB and extends throughout the building using the telecommunications backbone pathways, and connects to the TGB(s) in all telecommunication closets and equipment rooms.
6. Install the TGB's in the telecommunications closets and equipment rooms as close to the panelboard as possible. The TGB shall also be located so that the bonding conductor is as short and straight as possible. Maintain clearances required by applicable electrical codes.
7. The TGB shall be insulated from its support with a recommended separation of 2" (two inches).
8. Properly bond and ground all communications cabinets, equipment racks, raceway, cable rack or tray, and conduit directly to TMGB or TGB. Daisy chaining of equipment is not permitted
9. Refer to the Telecom Grounding diagram in this specification (Exhibit A, Figure 1).
10. Preparation: Copper and copper alloy connections shall be cleaned prior to connecting.
11. Bonding conductors shall be routed with minimum bends or changes in direction and shall be made directly to the point being bonded. Change of direction shall be taken over as wide a radius as possible with a minimum radius of one foot.
12. Make connections only to dry surfaces with paint, rust, oxides, scales, grease and dirt removed. Ensure proper conductivity.
13. Grounding conductors, by gauge, shall be continuous, with splices, from a larger gauge feeder to the last frame or component served by the grounding lead (example: 750 KCM to 500 KCM to 1/0, etcetera).
14. C-Taps from Aisle equalizer to a frame can be the same gauge (example: 6 AWG to 6 AWG).
15. Cable to Cable taps shall be made with exothermic weld, or listed compression connectors.
16. No aluminum conductors or connectors shall be used in any bonding and grounding system.
17. Ground bars not supplied as part of a standard assembly shall be copper or tinned copper.
18. Refer Telecommunications Grounding drawings for additional information.
19. Both ends of the grounding conductors shall be equipped with a printed destination label recording the far end termination. The label shall be applied within 6 inches of the termination and be visible from the floor.
20. All metallic items that interact electro-magnetically with Network / Communications equipment shall have their framework bonded and grounded to the communications grounding system with a minimum 6 AWG grounding conductor. Example includes switch frames, power plants frames, battery stands, storage cabinets and other metallic objects, etcetera. "Daisy Chaining" or frame to frame connecting of these conductors is not permitted.
21. TMGB and TGB shall be stenciled and labeled per HAS requirements.

K. Fences and Gates in the equipment rooms:
   1. Ground fences, fence posts and gates to nearest TMGB or TGB.

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L. Telecommunications Cable Armored and/or Shielded:
   1. Terminate and ground shield of shielded control cable at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables. Maintain shield continuity by bonding the ground shield across connection point where it is broken at junction boxes or other splice points.
   2. Connect ground wire in power cable assemblies at each terminal point to a ground bus, if available, or to the equipment enclosure. Do not extend these ground wires through Zero Sequence Current Transformers (Z-CT/donut CT) used for ground fault relaying but do extend ground leads from stress cones. Ground power cable armor and shield at each terminal point.
   3. Bond and ground exposed cable shields and metallic sheaths according to the manufacturer's guidelines. They shall also be grounded as close as possible to the point of entrance.
   4. Intra-building telecommunications cabling that is armored or has a metallic shield must be bonded to the building grounding system at each end.

3.03 GROUNDING UNDERGROUND DISTIBUTION COMPONENTS

A. Grounding Manholes and Handholes: Provide a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4" (four inches) will extend above finished floor. Protect ground rods passing through concrete floor with a double wrapping of pressure sensitive insulating tape or heat shrunk insulating sleeve from 2" (two inches) above to 6" (six inches) below concrete. Seal floor opening with waterproof, non-shrink grout.

B. Grounding connections to manhole or handhole components: Bond exposed metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields with each manhole or handhole to the TGB within the Manhole or handhole. Main connections between the Ground Rod and the TGB shall be bonded by exothermic weld. Make remaining connections to the TGB with minimum 6 AWG, Stranded, Copper bonding conductor. Route bonding conductor(s) level and/or plumb around corners and fasten to walls as needed.

3.04 TESTING

A. Follow Division 01 45 00 Quality Control.

B. Test grounding system before grid trenches are back-filled. Test for ground resistance after installation of underground grid and grounding connections.

C. Install ground access test wells at locations as required for testing, using a pipe surrounding the rod and connections with a cover placed on top at grade level.

M. Test system resistance at each test well using "Fall of Potential" method per IEEE 81-1983 with a maximum resistance of 5Ω (five ohms).

N. Upon completion of the electrical system, including all grounding, the Electrical Contractor shall test the system for stray currents, ground shorts, etcetera. Approved instruments, apparatus, service, and qualified personnel shall be utilized. If stray currents, shorts, etcetera are detected, eliminate or correct as required. Testing procedure should

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incorporate at least one of the most appropriate of the following testing techniques whereas the Ground Impedance shall not exceed 5Ω (five ohms):

1. Soil Resistivity Test
2. Fall-of-Potential
3. Stake-less
4. Selective

O. Failed systems shall be re-tested after correction of all ground shorts is complete with recorded results.

P. All testing procedures used shall provide the recorded results of the test performed with dates and signature of person preforming the tests.

END OF SECTION 27 05 26

EXHIBIT A

HAS TECHNOLOGY DIVISION
HOUSTON, TEXAS

PROJECT TITLE
PROJECT/CIP #

(NOTE TO DESIGNER SPECIFIER: These Guidelines are basic minimum criteria to be met in preparing the final specifications for this Section, which is the responsibility of the Designer.)

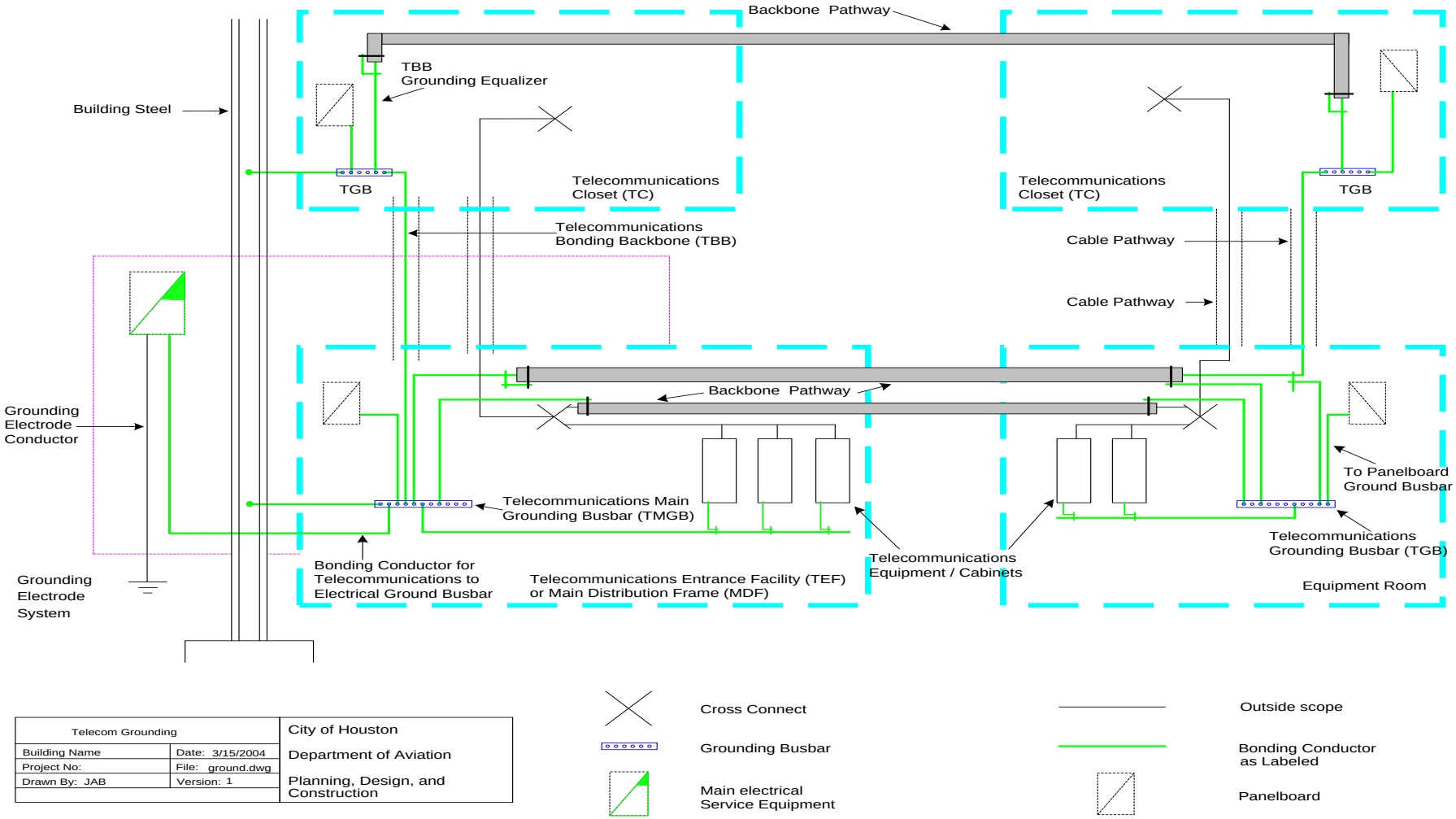

Figure 1