GUIDELINES

HAS/PDC/DESIGN DIVISION PROJECT TITLE
HOUSTON, TEXAS PROJECT/CIP #

(These Guidelines 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.)

SECTION 270526
TELECOMMUNICATIONS GROUNDING & BONDING

(REV. 01-14-2020-TAB)

PART 1 GENERAL

1.01 PROJECT SCOPE SUMMARY

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. Related Specification Sections

Designer to insert Specification sections as required by the project scope, examples:

1. Section 270553 Identification and Labeling of Communication Infrastructure
2. Section 271100 Communication Cabinets and Equipment Rooms
3. Section 271300 Backbone and Riser Media Infrastructure
4. Section 271500 Horizontal Media Infrastructure
5. Section 272100 Data Communication Network Equipment
6. Section 272200 PC, Laptop, and Server Equipment
7. Section 270528 Internal Communication Pathways
8. Section 270543 External Communication Pathways

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

1. B 3 Soft or Annealed Copper Wires
2. B 8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft

(These Guidelines 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.)

3. B 33 Tinned Soft or Annealed Copper Wire for Electrical Purposes

C. Institute of Electrical and Electronics Engineers (IEEE):
   1. 142-82 Recommended Practice for Grounding of Industrial and Commercial Power Systems
   2. 383-2.5 IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.
   3. 1100 IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems.

D. Underwriters' Laboratories (UL):
   1. 83 Thermoplastic Insulated Wire and Cables
   2. 96 Lightning Protection Components
   3. 96A System Installation
   4. 467 Grounding and Bonding Equipment

E. National Fire Protection Association (NFPA):
   1. 780 Lightning Protection Code
   2. 70 National Electrical Code (NEC)
      a. NEC Article No. 250 - Grounding

F. American National Standards Institute/Telecommunications Industry Association/Electronic Industries Alliance (ANSI/TIA/EIA):
   1. J-STD-607-B Commercial Building Grounding and Bonding Requirements.
   2. Telcordia – Network Equipment Building Systems (NEBS) GR-1275.

G. Building Industry Consulting Services International (BICSI):
   1. Telecommunications Distribution Methods Manual (Latest Issue)
   2. Customer Owned Outside Plant Design Manual (Latest Issue)
   3. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

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

I. 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.

J. Reference attached Figure 1 for general grounding infrastructure layout and connectivity.

K. Conflicts:
   1. Between referenced requirements: Comply with the one establishing the more stringent requirements.

(These Guidelines 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.)

2. Between reference requirements and contract documents: Comply with the one establishing the more stringent requirements.

1.04 DESIGN REQUIREMENTS

A. Design grounding system following ANSI J-STD 607-B – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, BICSI Telecommunications Distribution Methods Manual, NECA/BICSI 607-2011, NEC Article No. 250 - Grounding, IEEE 1100 – Recommended Practices for Powering and Grounding Sensitive Electronic Equipment, and IEEE 142-82 - Recommended Practice for Grounding of Industrial and Commercial Power Systems, by a firm acceptable to Owner's insurance underwriter. All labeling shall follow standards set forth by ANSI/TIA/EIA-606 and Houston Airport System's Information Technology (HAS-IT) requirements.

B. Design Standards:
1. Completely protect above-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 Division 2 Sections), 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.

C. Radio Equipment
1. All Radio equipment/systems shall be grounded per Motorola Standard R56.

1.05 SUBMITTALS

A. Follow Section 01340 for the following:

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. Conformance Certificate and Quality Assurance Release: Signed by QAP Manager (Section 01450). Specifically identify products and include purchase order number, supplements, and item number where applicable. Indicate that requirements are met and identify approved deviations.
6. Include spares list to be approved by HAS IT Project Manager for approval.

(These Guidelines 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.)

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. Tests for Insulated Cable: Pass vertical tray flame test following IEEE 383-2.5.

C. HAS 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.

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 HAS.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cable Manufacturers/Suppliers:
1. Houston Wire and Cable Company
2. Okonite Company
3. Anixter
4. Graybar
5. CSC (Communication Supply Company)
6. Cablec Continental Cables Company
7. Pirelli Cable Corporation
8. Triangle Wire and Cable, Inc.

B. Ground Rod and Connector Manufacturers:

(These Guidelines 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.)

1. Copperweld
2. Thomas & Betts
3. Blackburn

C. Exothermic Connector Manufacturers:
1. Erico Products (Cadweld)
2. Burndy Corporation (Therm-O-Weld)
3. OZ Gedney

D. Grounding Connector Manufacturers:
1. Thomas & Betts
2. Burndy Corporation
3. O.Z. Gedney
4. Panduit

E. Telecommunications Busbars:
1. Erico Products
2. Cooper B-Line
3. CPI Chatsworth
4. Panduit

2.02 MATERIALS

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

B. Grounding Connectors: It is recommended that connectors should be one of the following:
1. Tin-plated copper.
2. Copper.
3. Copper alloy.

C. Ground Rods: A minimum of 10 feet long, 3/4-inch diameter, copper-clad steel.

D. Where single conductor insulated grounding conductors is required, furnish green color (or tape marking) insulation rated for 600 volts.

E. Telecommunications Main Grounding Busbar (TMGB):

(These Guidelines 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.)

1. The TMGB shall be a predrilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors to be used. (Both holes in two holed lugs must be attached to busbar)
2. The TMGB 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. The busbar shall be electrotin plated for reduced contact resistance.

F. Telecommunications Grounding Busbar (TGB):
1. The TGB shall be a predrilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors to be used. (Both holes in two holed lugs must 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 .25" thick x 2" wide x 12" long.
4. The busbar shall be electrotin plated for reduced contact resistance.

G. Rack-Mounted Grounding Busbar (RMGB):
1. The RMGB shall be a predrilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors to be used. (Both holes in two holed lugs must 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 19" wide x 3/4" long.
4. The busbar shall be electrotin plated for reduced contact resistance.

PART 3 EXECUTION

3.01 PREPARATION

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.

(These Guidelines 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.)

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. See 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 inch conduit and minimum 6 AWG to be placed in a 1 inch conduit run.

TBB Conductor Size vs. Length	
TBB/GE Linear Length	TBB/GE Size
Feet (m)	(AWG)
Less than 13' (4) 6	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

(These Guidelines 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. Install work following drawings, manufacturer's instructions and approved submittal data.

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

C. Bonding connections shall be made by using:
   1. Double crimp connectors only for all horizontal runs (cabinets trays etc.). Use listed hardware that has been laboratory tested. For double crimp connectors use 2 hole type connector.
   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 to be used on the Telecommunications Bonding Backbone (TBB) conductor for all connections.

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

E. Drive grounding rods vertically, so at least 8 feet of rod is in contact with the soil. All connections shall be 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 No. 3/0 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 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 located in the same room, as the

(These Guidelines 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.)

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 "jumpers" around raceway expansion joints and across cable tray joints parted to allow for expansion and hinged cable tray connections. Provide copper bonding straps for steel conduit.

J. Telecommunications Grounding and Bonding Infrastructure:

1. Install the TMGB in the Telecommunications Entrance Facility (TEF) or Main Distribution Frame (MDF) as close to the panel-board 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 panel-board is not installed in the TEF or MDF, locate the TMGB near the backbone cabling and terminations. *Designer responsible for proper placement of busbar within room.*
3. The TMGB shall be insulated from its support with a recommended separation of 2 inches.
4. Connect the TMGB to the electrical service ground and telecommunications primary protectors.
5. The minimum Telecommunications Bonding Backbone (TBB) conductor size shall be No. 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 TGBs in the telecommunications closets and equipment rooms as close to the panel-board 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 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 the design documentation (see 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.

(These Guidelines 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.)

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 (ex. 750 KCM to 500 KCM to 1/0, etc.).
14. C-Taps from Aisle equalizer to a frame can be the same gauge (ex. E.g., 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/Telecommunications equipment shall have their framework bonded and grounded to the Telecommunications grounding system with a minimum #6 AWG grounding conductor. Example includes switch frames, power plants frames, battery stands, storage cabinets and other metallic objects, etc. "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.

M. 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 jumpering 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 "doughnut" CTs 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.

(These Guidelines 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.)

3.04 TESTING

A. Follow Section 01450.

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.

D. Test system resistance at each test well using "Fall of Potential" method Per IEEE Standard No. 81-1983) with a maximum resistance of 5 ohms.

E. Upon completion of the electrical system, including all grounding, the Electrical Contractor shall test the system for stray currents, ground shorts, etc. Approved instruments, apparatus, service, and qualified personnel shall be utilized. If stray currents, shorts, etc., are detected, eliminate or correct as required. The test procedure shall be as follows:
   1. Open all main disconnects for the system being tested.
   2. Disconnect the system neutral from the service entrance or step-down transformer neutral connection.
   3. Connect a DC ohmmeter across the system neutral and equipment ground.
   4. An ohmmeter reading in excess of 100 ohms shall indicate that the system neutral and equipment ground are properly isolated.
   5. An ohmmeter reading less than 100 ohms shall indicate that the system contains ground shorts (stray currents) at some point along the system neutral.
   6. Grounded neutrals may be identified by disconnecting individual neutral conductors from the system, one at a time, while monitoring the ohmmeter.
   7. The systems shall be re-tested after correction of all ground shorts is complete.

END OF SECTION

(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.)

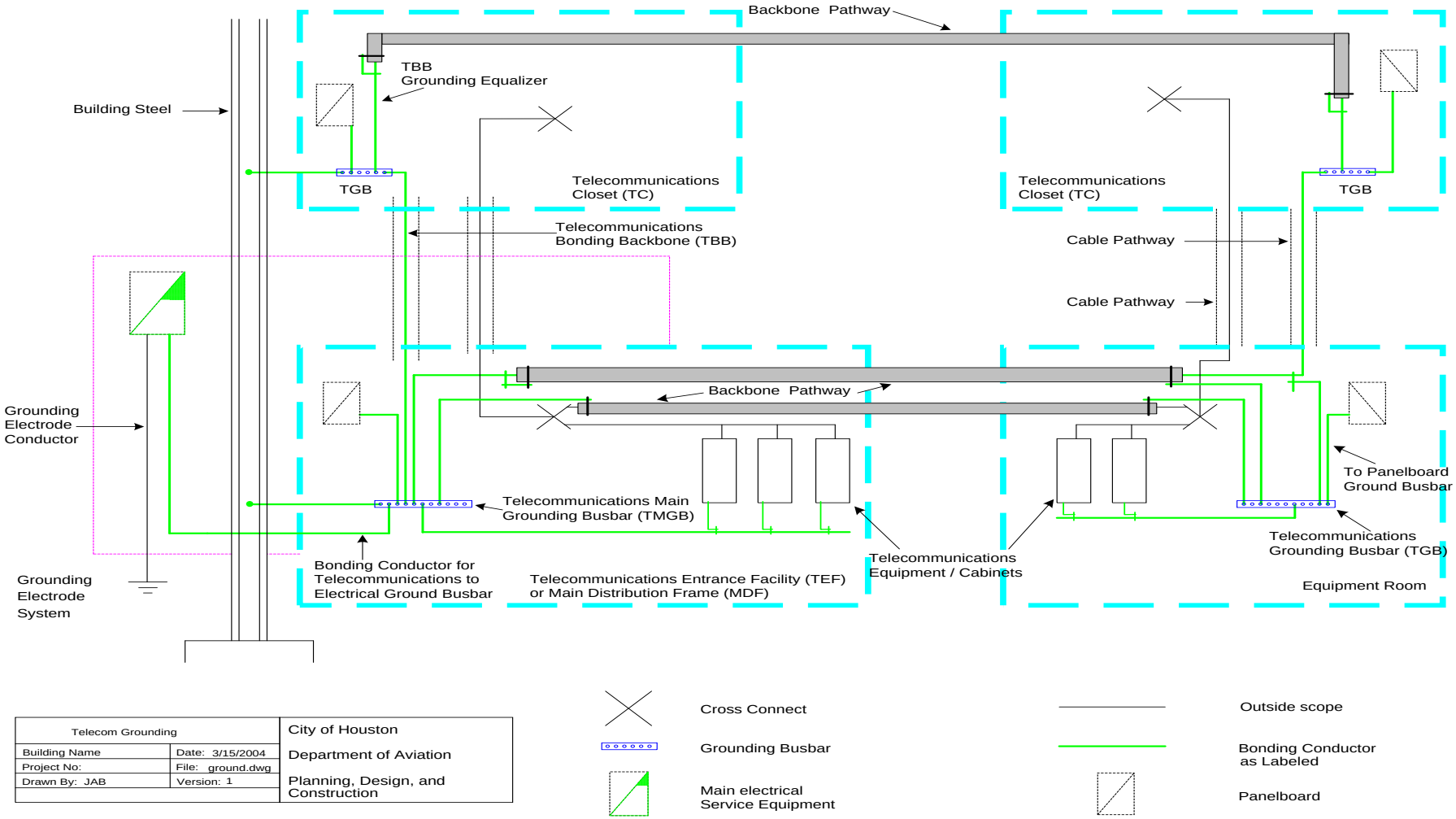

Figure 1