

SECTION 16453 - DATA/TELECOMMUNICATION GROUNDING

PART 1 - GENERAL

A. RELATED DOCUMENTS:

1. Division-16 Basic Materials and Methods sections apply to work of this section.

B. DESCRIPTION OF WORK:

1. Extent of data/telecommunication grounding work is indicated by drawings and schedules.
2. Requirements of this section apply to data/telecommunication grounding work specified elsewhere in these specifications.

C. QUALITY ASSURANCE:

1. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings, of types and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, ground rods and plate electrodes, whose products have been in satisfactory use in similar service for not less than three years.
2. NEC Compliance: Comply with NEC requirements as applicable to materials and installation of data/telecommunication grounding systems, associated equipment and wiring. Provide grounding products which are UL-listed and labeled.
3. UL Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to data/telecommunication grounding and bonding.
4. IEEE Compliance: Comply with applicable requirements of IEEE Standard 1100 - 1992 pertaining to powering and grounding sensitive electronic equipment.
5. EIA/TIA Compliance: Comply with EIA/TIA-607A Standards and the BICSI Telecommunications Distribution Methods Manual (TDMM) for the installation of data/telecommunication grounding and bonding systems.
6. The installation of the data/telecommunication grounding system shall be performed under the direction and supervision of the Contractor's designated Project Registered Communications Distribution Designer (RCDD) under Specification Section 16751.

PART 2 - PRODUCTS

- A. Materials and Components: Except as otherwise indicated, provide data/telecommunication grounding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, terminals, compression lugs, grounding rods/electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE, and established industry standards for applications indicated.
1. The Telecommunication Main Ground Bus Bar (TMGB), unless noted otherwise shall be a Harger #GBI-14416TMGBKT or Associate approved equal.
 2. The Telecommunication Ground Bus Bar (TGB), unless noted otherwise shall be a Harger #GBI-14412TMGBTKT or Associate approved equal.
 3. Compression lugs and stainless steel hardware for terminating to equipment, unless otherwise noted shall be as follows, or Associate approved equal:
 - a. One-hole compression lug, #6 cable; Harger #GECLB6
 - b. Two-hole compression lug, #6 cable; Harger #GECLB62A
 - c. Two-hole compression lug, #2 cable, Harger #GECLB22C
 - d. Two-hole compression lug, #2/0 cable; Harger #GECLB2/02C
 - e. Two-hole compression lug, #4/0 cable; Harger #GECLB4/02C
 - f. 1/4 – 20 x 3/4" hex head cap screw; Harger #CS46S-100
 - g. 3/8 – 16 x 1" hex head cap screw; Harger #CS68S-100
 - h. 1/4 – 20 x 3/4" slotted round head machine screw; Harger #MS46S-100
 - i. 1/4" star washer; Harger #SW4S-100
 - j. 3/8" star washer; Harger #SW6S-100
 - k. 1/4 – 20 hex nut; Harger #N4205-100
 - l. 3/8 – 16 hex nut; Harger #N6165-100
 - m. Antioxidant joint compound, 1/2 oz. size; Harger #HCAJC1/2
 - n. Antioxidant joint compound, 8 oz. size; Harger #HCAJC8
 - o. See the Harger catalog for other appropriate stainless steel hardware and compression lug part numbers.

PART 3 - EXECUTION

- A. Grounding specifications for the data/telecommunication grounding system are issued in conjunction with and in addition to Electrical Grounding Specification, Section 16450. The Contractor shall furnish and install a data/telecommunication grounding system, providing a low AC impedance path to ground and a stable ± 0 volt to ground signal reference point for the data/communication systems equipment and infrastructures. The data/telecommunication grounding system shall comply with the EIA/TIA-607A "Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications" and the IEEE Standard 1100

"Recommended Practice for Powering and Grounding Sensitive Electronic Equipment." The data/telecommunication grounding system shall be as indicated on the detailed Engineering Drawings and documents, unless otherwise specified.

- B. The data/telecommunication grounding and bonding system infrastructure shall originate with a low impedance connection to the electrical service entrance equipment (MDP) intersystem bonding termination point or ground bus, and extend as an independent ground system throughout the building.
- C. The connection to the electrical service entrance intersystem bonding termination point or ground bus shall be equal in size to the electrical service entrance ground conductor or a maximum #4/0 AWG (whichever is smaller) copper conductor to the Telecommunication Main Grounding Bus bar (TMGB), located in the telecommunication entrance facility or data/telecommunications equipment room, adjacent to the data/telecommunication service entrance equipment as required.
- D. A data/telecommunication grounding system backbone cable shall be provided, tying all data/communication wiring closets, cabinets, etc. to a common ground point as shown. The Telecommunication Bonding Backbone (TBB) shall be equal to the electrical service entrance ground or a minimum of a #2 AWG (whichever is larger) copper conductor unless noted otherwise.
- E. The Telecommunication Bonding Backbone (TBB) shall terminate on the Telecommunication Grounding Bus bar (TGB), in the intermediate wiring closets and/or on appropriate welded ground studs/lugs in data/communication cabinets. Bonding and grounding conductors shall originate from the ground distribution bus bars, to all data/communication equipment, racks, raceways, service entrance protection, surge protection, local power distribution panels, building structural steel, etc.
- F. All bonding conductors and connectors shall be UL listed for the purpose intended. All bonding conductors shall be insulated stranded copper, minimum conductor size of #6 AWG, and colored green.
- G. Bonding and grounding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in ferrous metallic conduit, the conduit shall be bonded to the grounding conductor, for conduits that exceed 3'-0" in length, the conduits shall be bonded at each end to the conductor with a #6 AWG sized copper conductor minimum.
- H. Whenever two or more vertical Telecommunication Bonding Backbone (TBB) are required up through and within a multi-story building, the backbone cables shall be bonded together with an equivalent sized Grounding Equalizer (GE) at the top and bottom floors, and at a minimum of every third floor in between.
- I. The data/telecommunication grounding system backbone cables and bonding conductors shall be installed without splices whenever possible. Where splices

are necessary, they shall be minimal in quantity, accessible and located in data/telecommunication spaces only. All splices shall be approved by the Associate.

- J. Joined segments of data/telecommunication grounding system shall be connected using only irreversible compression-type connectors, exothermic welding, bronze or stainless steel bolt, star washer and nut connections or equivalent.
- K. The Contractor shall provide oxide inhibiting joint compound on all compression, nut and bolt, and mechanical type terminations.
- L. Bronze or stainless steel machine screws, nuts, bolts and star washers shall be used for all grounding hardware and fasteners.
- M. Common zinc-clad or nickel-plated steel hardware fasteners are not acceptable. Replace all zinc-clad/nickel-plated hardware with specified bronze or stainless steel hardware.
- N. Bronze or stainless steel star washers shall be utilized, split ring washers are not acceptable (except on the ground bus bar as part of the ground bus bar kit). The star washer to be located under the nut.
- O. Setscrew type and/or box lug type terminations and split-bolt type connectors are not acceptable for the data/telecommunication grounding system, replace with irreversible compression type connectors and lugs unless otherwise noted.
- P. All connections, joints and conductors shall be adequately supported and protected.
- Q. All ground distribution bus bars and grounding, and bonding conductors shall be labeled and provided with a "WARNING" legend plate of engraved phenolic, green letters of 3/16" and 1/8" in height on a white background, sized 3" wide x 1-1/2" high, reading "WARNING - If connectors or cables are loose or must be removed - Please call the facility Telecommunication Manager."
- R. Grounding and bonding conductors shall be provided to all individual pieces of equipment. Daisy chaining of ground bonding conductors shall be minimized and shall be limited to similar pieces or types of infrastructure elements.
- S. Bonding conductors shall be provided between equipment elements in lieu of the unreliable physical electrical continuity through mounting means.
- T. A bonding cable shall be lugged and connected to each section of supporting cable tray, where the cable tray utilized is not U.L. listed and/or not installed as "classified as suitable as an equipment grounding conductor".

- U. Mechanical connection points to trays, ladders, frames, chassis, enclosures, etc. shall be neatly burnished on both sides to remove the finishes and expose bare metal for a positive electrical connection.
- V. Mechanical ground connections to trays, ladders, frames, chassis, enclosures, conduits, etc. shall be made using dedicated grounding hardware to the main equipment structure. Multi-purpose use of equipment structure hardware or attachment to equipment accessories or sub-structures (i.e. gussets, brackets, hangers, mounting brackets, etc.) is not acceptable.
- W. All grounding and bonding conductors shall be insulated stranded copper, colored green or clearly marked with green tape, minimum conductor size #6 AWG. Bare copper conductor shall only be utilized when exposed in plenum or riser rated areas or buried below grade.
- X. Where required by local code interpretation, the data/telecommunication grounding system backbone and bonding conductors shall be bare stranded copper conductor in lieu of an insulated conductor when installed in open cable trays, and/or exposed in a return air plenum space or riser rated space, Contractor to verify requirements and coordinate with the Associate.
- Y. Where indicated on the Engineering Drawings, an equipment ground bar shall be mounted on the rear side of the indicated 19" equipment racks, at the top of the rack, unless noted otherwise. All active equipment (i.e. hubs, switches, concentrators, etc.) and shielded cable grounding towers or frames, etc. on the indicated rack shall be bonded to the rack ground bar. In turn, the rack ground bar shall be bonded with a #6 ground to the "TGB/TMGB". The equipment rack ground bar kit shall be a Harger #RGBHKIT14119.25B14 or Associate approved equal.
- Z. All grounding and bonding conductors shall be maintained as short and straight as possible, with the maximum radius bends practical (20x conductor dia.), in no case should the minimum bend radius be less than 10x the conductor diameter. Daisy chaining of grounding and bonding conductors shall be prohibited.
- AA. All grounding and bonding conductors shall be free from loops and coils (either partial or full), no bend should be greater than 90°.
- AB. All grounding and bonding conductors shall be protected from physical damage, the conductor shall not be run exposed across the floor or strung from item to item without intermediate support. Route grounding and bonding conductors to provide physical protection and support or route in conduit as required.
- AC. Grounding and bonding conductors shall be provided to all items and equipment elements in lieu of the unreliable physical mounting means for electrical continuity.

1. The utilization of conduit fittings, mounting hardware, support hardware or the attachment hardware for providing grounding and bonding in lieu of a grounding and bonding conductor is not acceptable.
- AD. A grounding bushing shall be utilized on each unbonded conduit to bond the conduit to ground, discard the setscrew type clamp provided and bolt the compression type ground lug directly to the bushing using a bronze or stainless steel machine screw and star washer.
- AE. Grounding bushings shall be utilized on each conduit and shall be bonded to the grounded enclosure by means of properly installed conduit nuts, one on each side of the enclosure panel and properly tightened such as to cut through the panel paint and make bare metal to metal contact.
- AF. Where a grounding bushing has not been installed on an existing conduit and can not be installed due to existing installed cable base, a U.L. listed, bonding and grounding wedge shall be installed on the end of the conduit adjacent to the existing bushing fitting. Attach the compression type ground lug to the bonding and grounding wedge using a bronze or stainless steel machine screw and star washer.
- AG. Two (2) hole compression lugs only shall be utilized on the grounding system backbone cables where attached to the grounding system distribution bus bars, and the electrical service entrance equipment (MDP) intersystem bonding termination point or ground bus bar (#2 AWG or greater conductor).
- AH. Two (2) hole lugs shall be utilized when attaching an external building ground grid to the Telecommunications Main Grounding Bus bar (TMGB).
- AI. When an isolated external building ground grid is utilized, the ground grid shall attach to the Telecommunication Grounding Main Bus bar (TGMB) with two (2) separate (redundant) leads originating from separate ground rods. The ground grid shall attach directly to the Telecommunication Grounding System only at the main distribution bus bar (TMGB), unless noted otherwise.
- AJ. The data/telecommunication bonding system shall be extended to and through all data/communication raceways such as cable trays, cable channels, ladder systems, metallic surface mounted raceways, etc. For raceways the bonding system shall be extended by means of extending a #6 AWG minimum bonding conductor through the length of the raceway system and lugging to each section of raceway, lugging at 8 foot maximum intervals along the length of the raceway, and lugging twice to all sections of raceway in lieu of the installation of individual bonding jumpers between each raceway section.
1. The tray or raceway shall not be utilized as the TBB.

- AK. Where a bare copper Telecommunication Bonding Backbone (TBB) conductor or bonding conductor is routed through a cable tray system, the conductor shall be routed in CMR/CMP rated innerduct to maintain isolation from the raceway.
- AL. Extend bonding jumpers to all pull boxes and/or transition fittings along the raceway system. The bonding conductor shall be extended through conduit or conduits connecting sections of cable tray, channel, ladder or metallic raceway systems.
- AM. Unless otherwise noted, individual continuous "zone" conduits shall be bonded to ground at the "home" end, with a bonding jumper installed to and through all pull boxes. Bond at the "zone" end to building steel as available.
- AN. Exposed grounding and bonding conductors entering cabinets and enclosures shall be provided with a large rubber grommet or chase nipple and bushing. Install grommets or bushings as required.
- AO. Wherever possible, a two-hole compression lug shall be bolted down using two (2) bolts. When the two-hole compression lug can only utilize one-hole, always utilize the hole nearest the compression fitting, cut-off excessive tang length.
- AP. The data/telecommunication grounding system shall meet and exceed NEC Article 250 & 800 requirements. Contractor shall bond individual electronic components and equipment to the grounding system as per the equipment manufacturer's recommendations and instructions.
- AQ. The Contractor shall inspect and verify all the existing grounding systems to which attachments are being made, which shall include but not be limited to the following:
1. Electrical Service Entrance Grounding
 2. Telephone Service Entrance Grounding
 3. Electrical System(s) Grounding
 4. Structural Building Steel Grounding
 5. Conduit and Raceway System(s) Grounding
 6. Natural Gas Line Grounding
 7. Ground Connection to the Source Side of Water Meter and the Water Meter Bonding Jumper
- AR. Existing grounding systems shall be checked for requiring to be cleaned, re-tightened and/or re-made with a suitable anti-oxidant applied, as required to bring them up to code and standards. Discrepancies in existing systems shall be brought to the attention of the Associate in writing, for additional corrective action as required.
- AS. The Contractor shall include a written report with the system grounding Test Form #1. The written report shall detail the inspection, service required or performed

and verification procedures of the existing grounding systems performed by the Contractor and shall detail the findings and any actions taken (e.g. existing #4 ground conductor from main tel-brd and ground clamp removed from service side of water meter, all connections cleaned and burnished, anti-oxidant applied, reassembled and tightened).

AT. Items to be bonded to the data/telecommunication grounding system at the ground distribution bus bars shall include, but not be limited to the following:

1. Telephone equipment (e.g. PBX's, KSU's, ISDN equipment, etc.)
2. CATV equipment
3. Equipment racks and cabinets
4. Cable ladders, trays and channels
5. Surface mounted metallic raceways and wireways
6. Metallic conduit systems
7. Service entrance protected terminals
8. Telecommunications and fiber optic splice enclosures
9. Interbuilding cable sheaths and messengers
10. Coupled bonding conductors
11. Paging and access control systems

AU. The positioning of ground terminators on the data/telecommunication ground bus bar shall be specific to the grounding function. Starting at one end of the ground bar, terminate across the ground bar as follows:

1. The first group on the starting end should be the branch circuit non-isolated equipment grounds.
2. All fault current dissipation paths are to be grouped next (i.e. panel grounds, feeder circuit grounds, etc.).
3. All transient sources are to be grouped next.
4. The main grounding backbone (TBB) conductors are to be terminated in the middle.
5. All isolated equipment grounds are to be grouped next.
6. All signal reference grounds are to be grouped at the finishing end (i.e. dedicated grounds to cable shield grounding towers, dedicated grounds to equipment ground lugs isolated from the power cord ground pin, etc.).

PART 4 - SYSTEM TESTING

A. Upon completion of the installation of the data/telecommunication grounding system and/or servicing of the existing grounding systems, the Contractor shall perform approved standard ground resistance tests with an Associate approved ground resistance test unit (i.e. stakeless clamp-on ground resistance tester, two-point and three-point fall of potential tester), using approved procedures as noted in this specification.

- B. **"CAUTION"** - Never assume a ground wire is electrically dead without first testing to be sure. Always test for and record, the voltage and ground current on the ground conductor at the test point prior to measuring ground resistance. Erroneous ground resistance measurements will result if the ground current exceeds 2 Amps AC. Contractor shall identify sources of high ground current (greater than 1 Amp AC) before proceeding with ground testing.
- C. **NOTE:** By measuring at several points and comparing the readings, (for voltage, ground current and resistance) it is possible to identify neutral/ground loops, utility grounds and central office grounds. The tests are effective and accurate because the ground window is connected to the utility ground at only one point, according to standard practices and code. A reading of less than 0.1 Ohms generally indicates that the cable is continuous with itself, providing an acceptable ground path, which can be usually confirmed by comparatively nominal to high ground current readings. The source of a ground current may be obtained when readings are taken at multiple locations around the plane. A good low impedance ground may have very high AC ground current flow, depending upon the type of equipment being grounded.
- D. The Contractor shall inspect, service and verify all of the grounding systems as per this specification section. Failures of the existing grounding systems to meet the intent of Specification Section 16450 and this section shall be brought to the attention of the Associate and Owner in writing.
- E. The Contractor shall perform Telecommunication Grounding System Testing as follows:
1. Measure ground current and ground resistance readings on all Telecommunications Bonding Backbone (TBB) conductors at each "TMGB/TGB".
 2. Measure ground current and ground resistance readings on all bonding jumpers at each "TMGB/TGB".
 3. Record all readings on Test Form #1. Contractor to reproduce Test Form #1 as required.
 4. Where test results indicate a ground current of 1 Amp or greater, the Contractor shall take appropriate action to identify and reduce the ground current to less than 1 Amp. The Contractor shall notify the Associate in writing of the excessive ground current, the source and action taken to reduce the current.
- F. The Contractor shall demonstrate by testing that the data/telecommunication grounding system to earth resistance value is 5 Ohms or less, utilizing a "clamp-on" or 3 point fall of potential tester.
- G. The Contractor shall be able to demonstrate by test that the data/telecommunication grounding system resistance from any grounded non-

current carry conductor in the system to the electrical service entrance neutral/ground bonding conductor is less than 0.1 Ohms.

- H. The Contractor shall record the test results on Test Report Form 1 included herein, and provide a description of the testing procedures for submission to the Associate for approval.
- I. Contractor shall include copies of the completed and approved test report in the cabling system instruction manuals.

END OF SECTION 16453

