DIGITAL CENTRAL OFFICE GROUNDING

ENGINEERING CONSIDERATIONS

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1. INTRODUCTION

1.01 This section provides the requirements for establishing a Single Point Ground Facility for operation of a DCO® system central office equipped with Local Line Switch (LLS). It is applicable to DCO systems without local line switch (LLS) and DCO systems with LLS. Systems with LLS require a system reference ground bar (SRGB) and have signal grounds (SG) terminated at the SRGB instead of at the ground window bar as is done at other DCO system installations.

2. RELATED INFORMATION

2.01 General.

A Sales and Instructional Literature Index of latest available publications can be obtained from your Stromberg-Carlson sales representative or from Publications Services, Stromberg-Carlson Corporation, 400 Rinehart Road, Lake Mary, Florida 32746.

2.02 Related Sections.

The following sections are recommended for use with this document:

01-010-25	Electronic Equipment Isolation and Insulation, Test Procedure
01-011-25	Electronic Office Ground Resistance, Test Procedure

2.03 Recommended References.

It is recommended that the following publications be available for reference with this section:

SPP-6C	1981 National Electrical Code Handbook

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NFPA-70	National Electrical Code – 1981
NFPA-78	Lightning Protection Code – 1980
REA TE&CM 810	Electrical Protection of Electronic Central Office Equipment

3. GENERAL INFORMATION

3.01 Electronic switching systems such as the SYSTEM CENTURY® Digital Central Office and other modern telephone central offices (COs) should not be subjected to excessive transient voltages or noise that could be injected into a ground system. Electronic switching type offices, or similar equipment, require a special grounding system that electrically isolates the equipment from the building steel, underfloor ducts, unassociated equipment, etc., except at one point. This one-point grounding arrangement is called a single-point grounding system. With this system, all equipment and facilities associated with the digital office complex have their respective grounds extended to the master ground bar (MGB).

3.02 In principle, the grounding requirements for a DCO system without LLS and for DCO offices equipped with LLSs are the same:

a. A low-resistance, man-made ground. Although the lower the resistance the better, it must not exceed 10 ohms.

b. Provision of a path to earth for the discharge of lightning strokes in a manner that protects the structure, its occupants, and the equipment inside.

c. Restrict the potential gradient in areas accessible to persons (approximately 6 feet) to a level below the hazardous threshold, even under lightning discharge or power fault conditions.

d. Assist in the control of noise in signal and control circuits by minimizing voltage differentials between signal references of separate facilities.

e. Provide a ground return path for signaling functions such as ringing, paystation operation, two- and four-party automatic number identification (ANI), interoffice dc signaling arrangements, etc.

3.03 The basic components of Stromberg-Carlsons plan for grounding the DCO system are the master ground bar (MGB), the ground window bar (GWB), and the systems reference ground bar (SRGB). Collectively, the arrangement and interconnections shown in figure 1 provide for equipment and personnel protection while maintaining a maximum of .010 ohms dc resistance between the master ground bar and all elements connected to it.

3.04 The combined length of cable from the master ground bar to the furthest ground termination should not exceed 150 feet.

4. DEFINITIONS

4.01 The following terms are defined as an aid to understand their usage within the context of this section. They are terms commonly utilized for describing ground systems. Different terms have been used by S-C and other individual manufacturers or operating companies. However, to provide a commonality of terms, this section utilizes terms defined in REA TE&CM 810 and/or the National Electrical Code (NEC), where applicable.

a. Ac Service Ground.
The current carrying conductor of the ac distribution system which is referenced to ground.

b. Buidling Structural Ground.
A ground bond connected to structural steel and/or reinforcing steel rods contained within the building walls, roofs, floors, footings, foundations, etc.

c. Cable Entrance Ground Bar (CEGB).
A ground bar provided for the purpose of terminating incoming cable shields at a common connection point.

d. Central Office Ground Field (COGF).
A man-made low resistive path to earth, generally provided in the form of a ground ring or other means such as a series of interconnected ground rods.

e. Green Wire Ground (GWG).
A noncurrent carrying conductor provided in ac distribution for the protection of personnel and equipment.

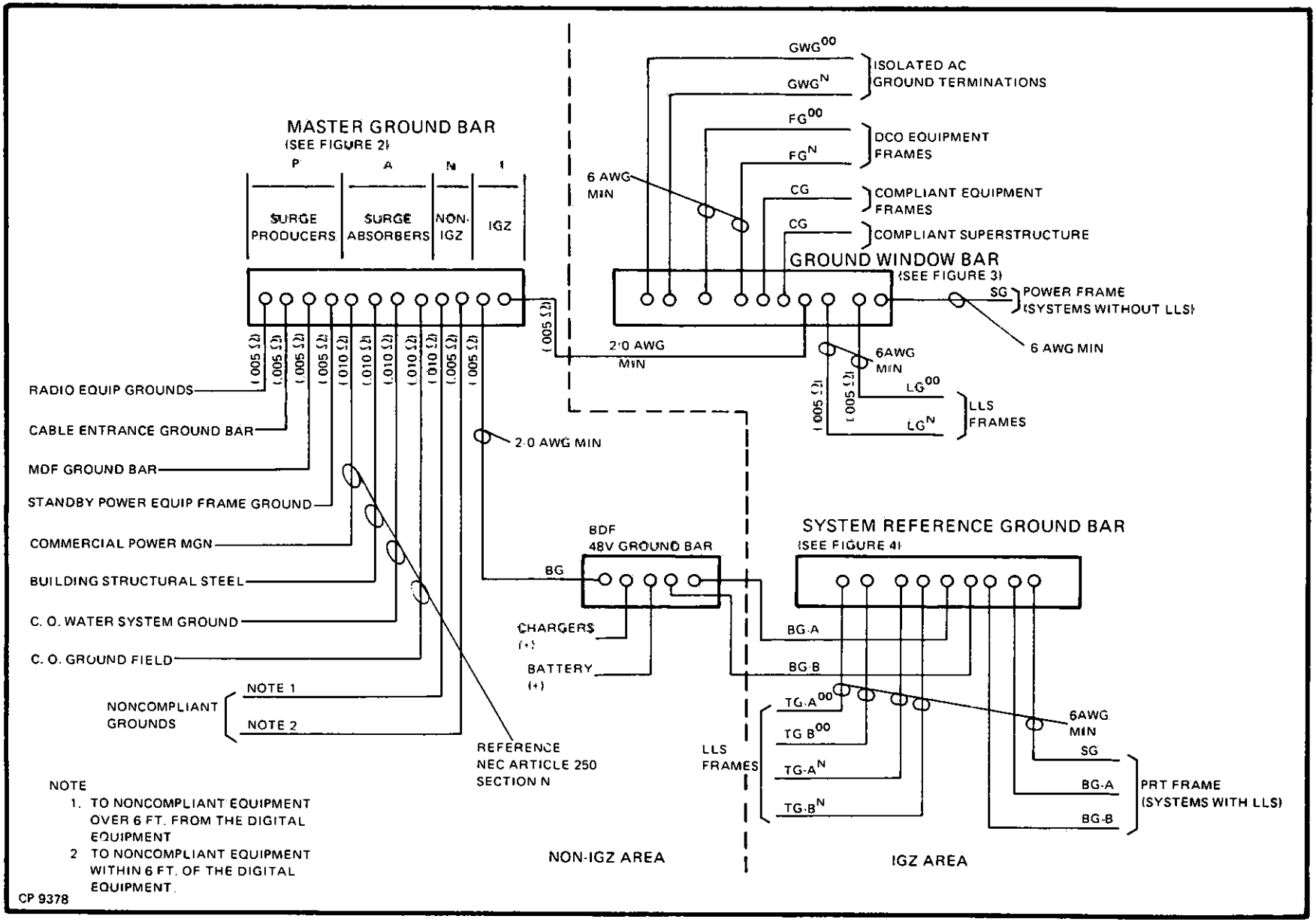


Figure 1. Grounding for DCO Systems

f. Ground Window Bar (GWB).

A ground bar provided for the common connection of all normally noncurrent carrying protective conductors from isolated equipment(s) located within the isolated ground zone.

g. Isolated Ground Zone (IGZ).

A dedicated area associated with the DCO equipment. This area, electrically isolated from other areas, typically extends approximately 6 feet in all directions from the DCO system and associated equipment, or until noncompliant equipment is encountered.

h. Main Distributing Frame (MDF).

A distributing frame where outside plant cables are terminated into lightning arrestors/protectors. It provides, among other things, terminals for cross-connections to IGZ area equipment.

i. Master Ground Bar (MGB).

A ground bar used to collectively terminate, as a single point of reference, surge producers, surge absorbers, and non-IGZ and IGZ equipment grounds.

j. MDF Ground Bar (MDFB).

A ground bar provided for the grounding of MDF protector assemblies and stub cable shields.

k. Single Point Ground.

A grounding electrode system which provides a single point of reference to earth ground.

l. Surge Absorbers (A).

Conductors providing a low impedance to earth ground. The three primary surge absorbers are:

1. Central office ground field

2. The ac service multigrounded neutral (MGN)

3. A metallic water system (ref. NEC 250.81a).

m. Surge Producers (P).

Conductors providing a metallic source of lightning and/or power surges.

n. System Reference Ground Bar (SRGB).

A ground bar which serves as a common point of reference for the operating ground distribution for the digital equipment of the DCO system. The conductors to the SRGB may carry current and are required for reliable system operation.

o. Battery Distribution Frame (BDF).

A power board which serves as the central point of distribution and reference for chargers, batteries, and load.

p. Power Frame (PF or PRT).

The focal point of −48Vdc and ac inverter power distribution for the DCO IGZ equipment. It also contains the ringing plant, test access network, and miscellaneous common equipments.

q. Battery Ground (BG).

A +48V conductor which provides current return for main system power that, in turn, is referenced to 0 volts.

r. Compliant Equipment.

All metal work in the IGZ that is completely isolated from all grounds other than the GWB.

s. Non-Compliant Equipment.

Any equipment or metal work having electrical contact to any ground other than the GWB.

t. Talk Ground (TG).

The battery return for talk battery current(s) in a DCO local line switch frame; it provides a secondary protection return path.

u. Lightning Ground (LG).

The protection path for secondary protectors provided in line switch frames.

v. Signal Ground (SG).

The digital logic reference ground for the DCO system.

5. APPLICATIONS

5.01 The single point ground system allows considerable flexibility in actual applications. The following application guidelines are to be followed for assurance of the best possible protection.

5.02 Routing of grounding cables is generally determined by the floor plan but may be left to the discretion of the installation department provided specific requirements for cabling to the system reference

ground bar (SRGB) are met. These requirements and recommendations for sizing of cables to other ground bars are provided in paragraph 6 following.

5.03 The single point of earth or 0-volt reference for all equipment associated with a DCO system equipped with LLS frames is the master ground bar (MGB). Cable terminations to this bar should be grouped in the same relative positions as shown in figure 2.

5.04 Figures 3 and 4 show the relative positions where specific cable terminations should be made on the ground window bar (GWB) and on the SRGB, respectively.

5.05 All normally noncurrent carrying protective conductors associated with equipment within the IGZ must utilize the GWB as a common point of reference. Termination of ac protective grounds (GWGs) and the associated cable sizing must meet the National Electric Code (NEC); refer to paragraph 7 for more details on ac distribution.

6. RECOMMENDATIONS AND REQUIREMENTS

6.01 General.

The maximum allowable resistance of any cable (identified in figure 1) dictates the size of cable required. Since the routing of cables is flexible, the size of the required cable is dependent exclusively upon its required length. Using table 1, the cable size can be determined directly if the length of the ground cable is known. Where applicable, specific minimum cable sizes and/or maximum dc resistance values are identified on the associated conductors in figure 1.

6.02 Ground Bars.

Each ground bar should be one electrically continuous piece, with a maximum end-to-end resistance of 0.0001 ohm (0.1 milliohm).

6.03 Surge Producing Leads.

The maximum resistance recommended for cables from the MGB to the connection point of all surge producers is 0.005 Ω. Cabling of any ac ground surge producer must also conform to NEC requirements. After the lengths of these cables have been determined, table 1 can be used for cable sizing.

6.04 Surge Absorber Leads.

The maximum resistance of cables from the MGB to the connection point of all surge absorbers is 0.010Ω. The minimum size of these cables is #6 AWG.

6.05 Other MGB Leads.

a. The +48-volt battery ground (BG) cable connected to the N area of the MBG from the BDF ground bar should be sized as a surge producing lead since it is the return path for lightning and power surges induced to the DCO system.

b. Cabling from the I area of the MBG to the GWB must be a minimum of 2/0 AWG cable.

6.06 GWB Terminations.

Terminations to the GWB from within the IGZ should be #6 AWG or larger and not exceed 0.005 ohms. Termination of ac protective grounds (GWG leads) and sizing of these cables should meet the National Electric Code; refer to paragraph 7 for more details on ac distribution.

6.07 SRGB Terminations.

a. Talk battery ground (TG-A and TG-B) and signal ground (SG) cables terminating at the SRGB must be at least #6 AWG. The SG cable should be sized to 500 CM per linear running feet where as the talk battery ground leads should be sized to 2000 CM per linear feet.

b. Battery ground (BG) cables must be sized to meet the following maximum allowable loop voltage drops between the PRT frame and the BDF by way of the SRGB and provide for consistent current densities over all portions of the loop.

Length of −48 Volt Portion of Loop	Voltage Drop
to 60 feet	0.25 volts
60 to 120 feet	0.50 volts
over 120 feet	0.75 volts

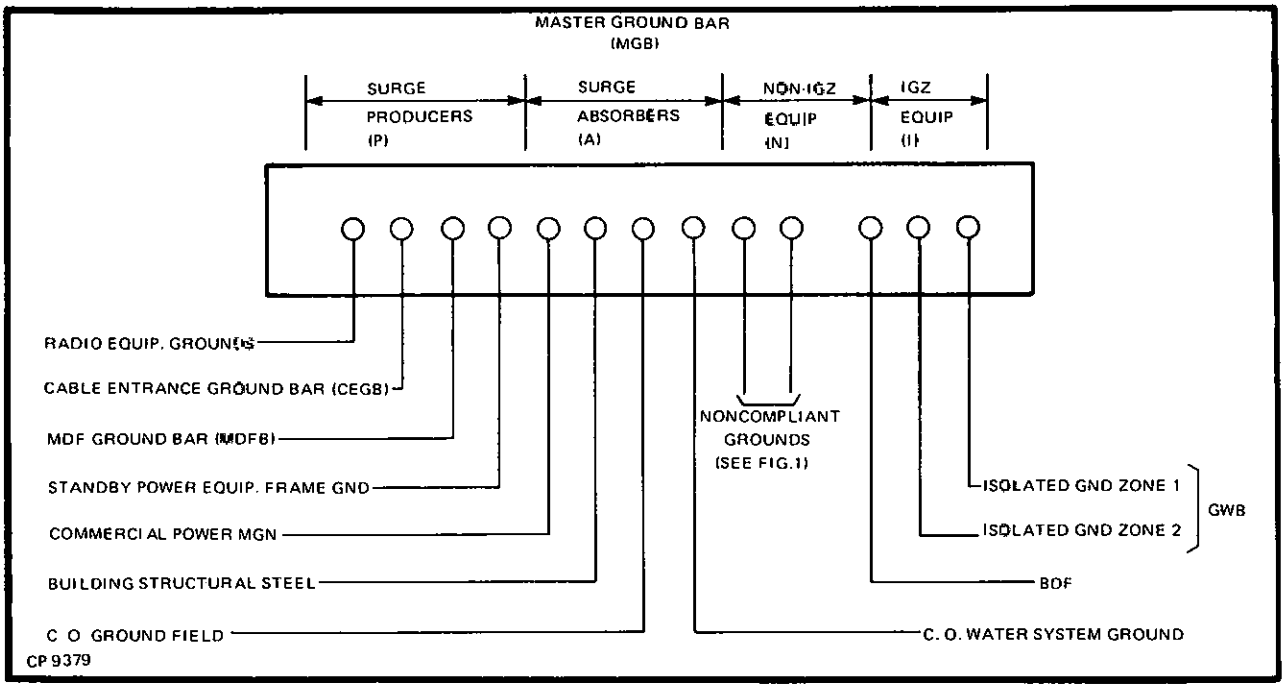


Figure 2. Master Ground Bar Terminations

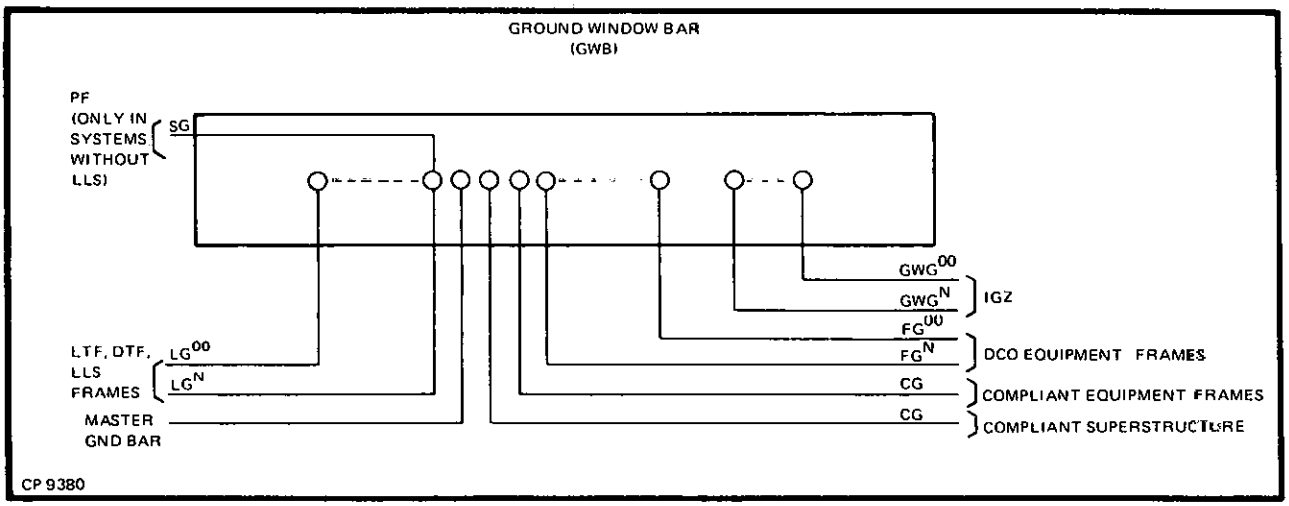


Figure 3. Ground Window Bar Terminations

7. AC DISTRIBUTION REQUIREMENTS

7.01 Ac Service Main and Distribution.

a. The facility ac service-main and its distribution system must meet the requirement of NEC Article 250, Section H, Grounding Electrode System, as applicable. All ac power distribution associated with the DCO system must follow the requirements of the National Electrical Code. (NFPA 70).

b. The ac service distribution serving both the DCO system isolated area and the DCO equipment outside of the isolated area must have lightning surge protection in the form of an arrestor with peak voltage rating of 1500V.

7.02 Lighting for Isolated Ground Zones.

Overhead lighting with the isolated area may be connected in the conventional manner to the ac distribu-

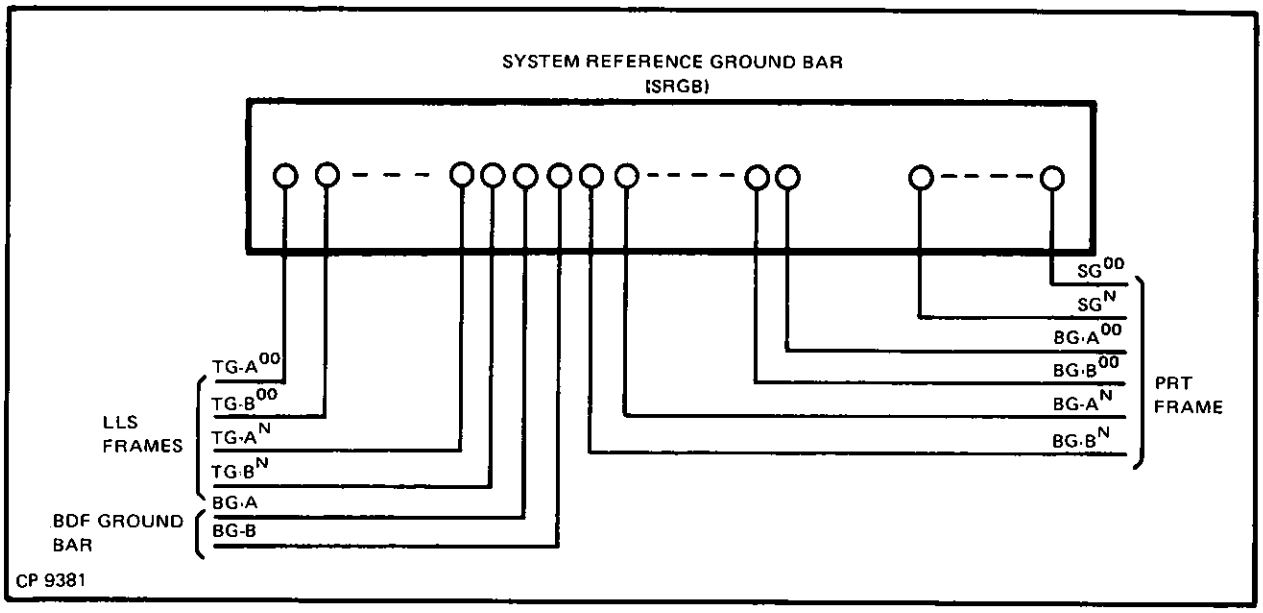


Figure 4. System Reference Ground Bar Terminations

tion panel per NEC 250 *provided* that there is *no* electrical contact with any part of the equipment in the IGZ area. If overhead lighting fixture *grounds* are connected to the ground window bar for the IGZ area, they must be electrically isolated from building structural steel and reinforced concrete members.

7.03 Utility Receptacles for Isolated Ground Zones.

All utility receptacles must be connected to ground per NEC Article 250-74 (exception 4) and 384-27 (exception 1) and provide for green wire termination to the GWB. Conduit for utility receptacles must be nonconductive when exposed, but may be conductive if physically covered (concealed).

7.04 Internal Ac Distribution.

Ac distribution internal to the DCO system must meet the requirements of NEC Article 250-74 (exception 4) and 384-27 (exception 1) and use isolated ground receptacles.

8. IDENTIFICATION AND WARNING TAGS

8.01 Identification Tags.

Identification tags, labels, or stenciling should be provided on or adjacent to each ground bar, identifying it by name. These include:

a. Master ground bar.

b. Ground window bar.

c. System reference ground bar.

d. Cable entrance ground bar.

An identification tag should also be attached to each cable terminating at these ground bars. These tags should identify the size of cable and its origination.

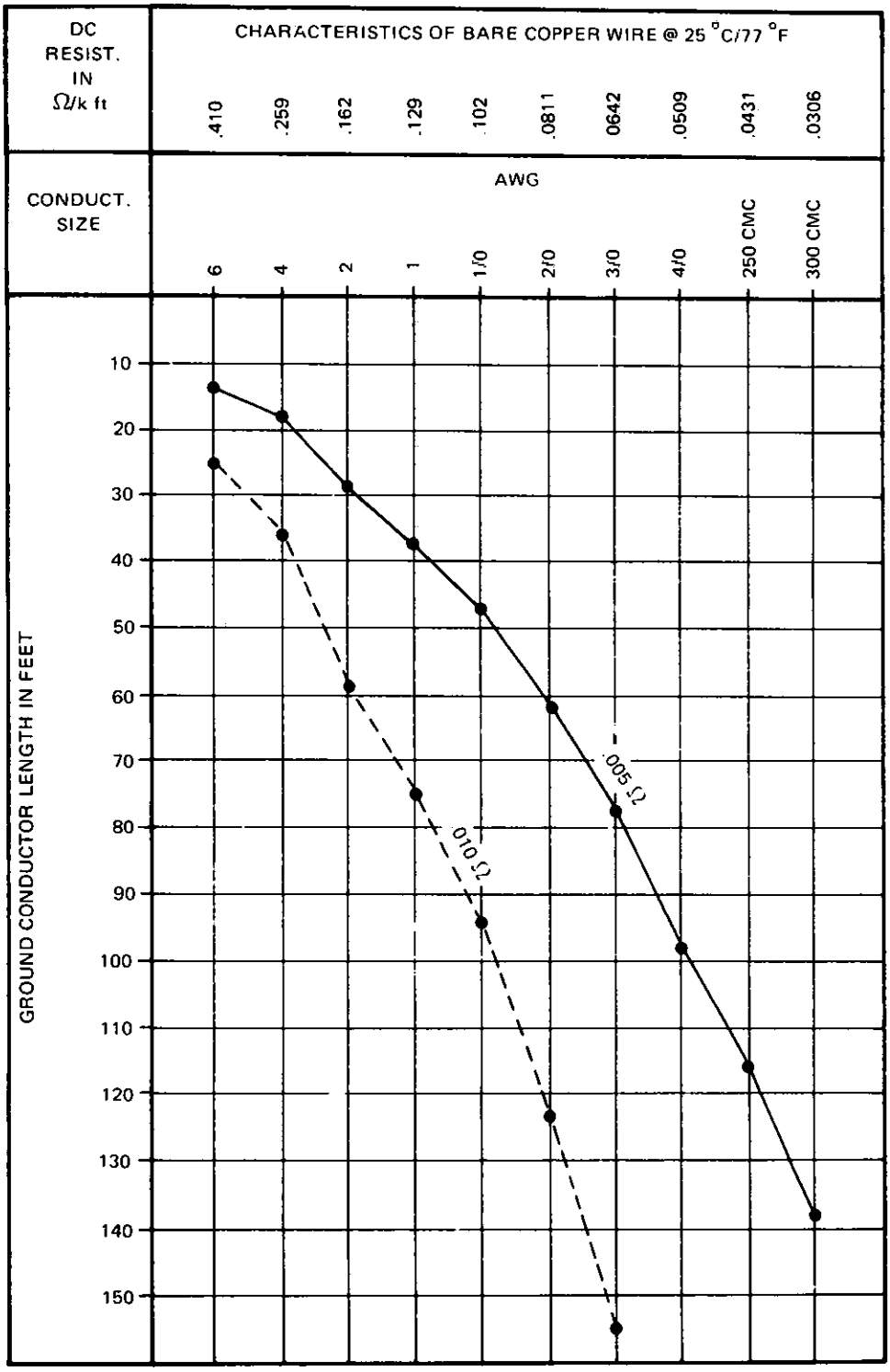
8.02 Warning Tags.

Warning tags, warning against removal of a connection or bond without approval from the telephone company, should be attached to the CO grounding conductor where it is attached to the primary grounding electrode (water pipe) and at the master ground bar.

9. INSTALLATION TESTING

9.01 Ground resistance measurements should be made and recorded for each element of the CO building ground system. Also, as each item of equipment is installed, isolation and insulation tests should be made. Procedures for making these tests are provided in sections listed in paragraph 2.

Table 1. Ground Conductor Sizing Chart



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