GROUNDING AND BONDING FOR CANADIAN AMATEUR RADIO STATIONS

Introduction

I seem to recall that recently, during one of Zoom meetings, there was a discussion of grounding. This reminded me that the information available from the ARRL, which is based on the requirements of the National Electrical Code are not always applicable in Canada, where we must meet the requirements of the Provincial electrical requirements. In Alberta, the Canadian Electrical Code has been adopted with modifications as the Alberta Electrical Regulation. In this presentation, I will identify some of the requirements of the CEC for grounding and bonding. I will also briefly discuss some of the requirements for lightning protection.

To set the stage for the talk, consider Figure 28.5 from the 2014 edition of the ARRL Handbook for Radio Communications:

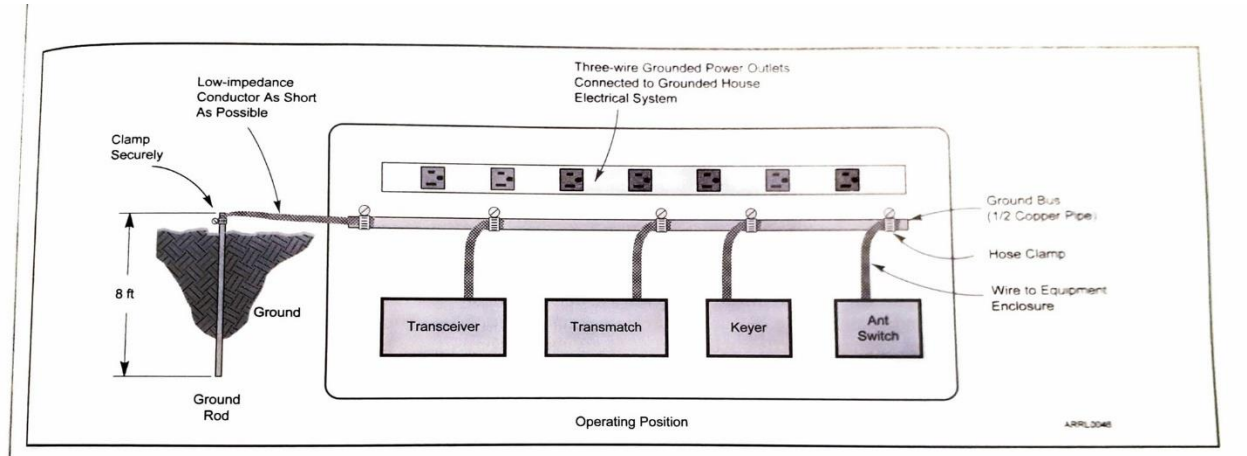

Fig 28.5 — An effective station safety ground bonds the chassis of all equipment together with low-impedance conductors and ties into a good earth ground.

There are three of issues with this illustration:

- Firstly, under the CEC, a ground rod must be 3 m long,
- Secondly, the ground rod must be driven into the ground for the full length of the rod.
- Thirdly, the bonding conductor must be returned to the building electrical system ground by means of a conductor, not the earth.

I do not know if the ARRL publication on grounding and bonding has other directions that do not comply with the CEC, so it is best to check against the Code. Copies are available at the central branch and at the Fish Creek branch (this copy can be taken home for study).

Building Electrical System Ground

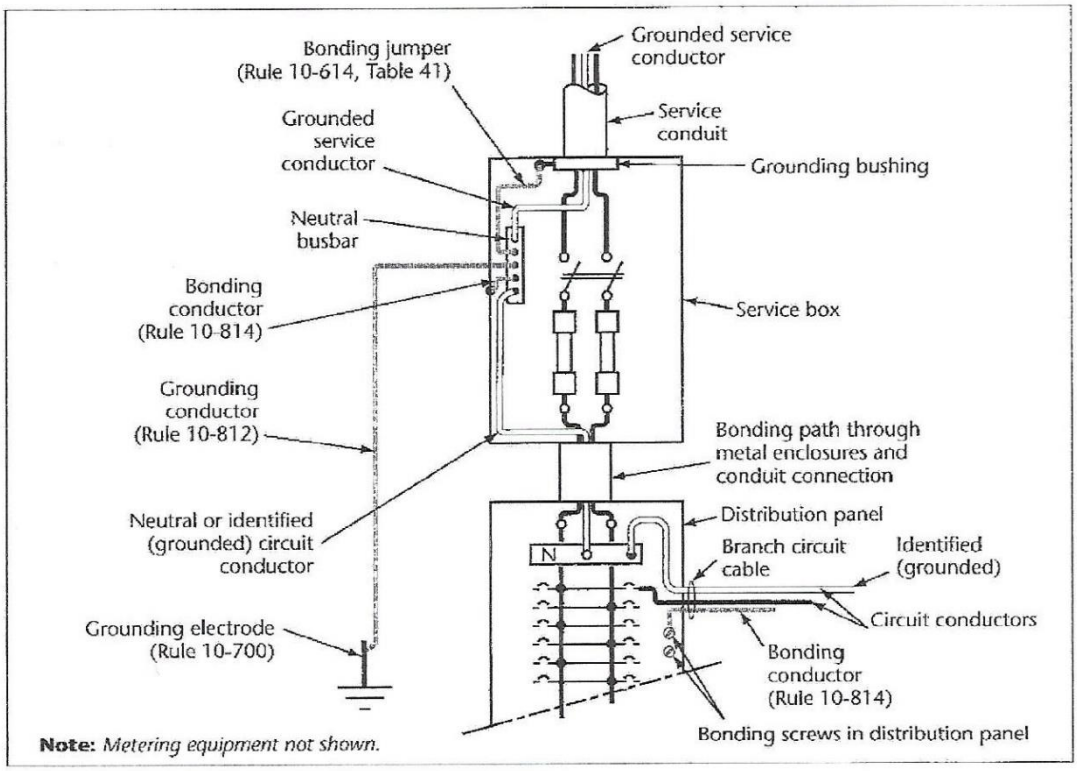

Figure 10-1
Bonding and grounding conductors

This figure, and others that follow are taken from the 2015 edition of the Canadian Electrical Code Handbook. It shows a schematic of a service entrance to the building and the distribution panel for the building. Our equipment bonding conductor system, by hook or by crook, is required to get back to the grounding electrode. Fortunately, this may not be as difficult as it first appears.

NON-ELECTICAL EQUIPMENT BONDING

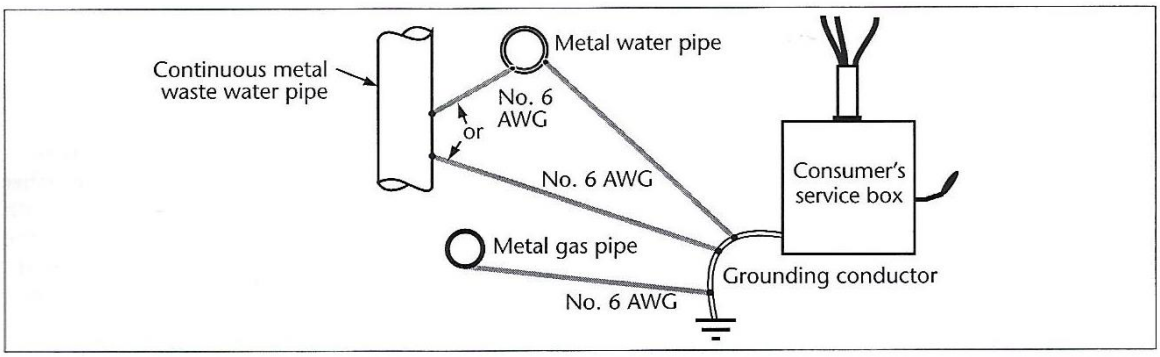

Figure 10-16
Bonding of non-electrical equipment

The CEC requires that various non-electric equipment be provided with equipotential bonding. Of interest to us who live in certain types of structure (single and two-family residential buildings, row housing for example), it may not be necessary to run a line to a point in the main panel where the system ground is connected. For instance, in my house, which was built around 1959, the water line into the house is metallic and, at the time of construction, it was customary practice to make the water piping the system ground.

In order for this to be acceptable, then and now, the water inlet piping had to meet a specific requirement:

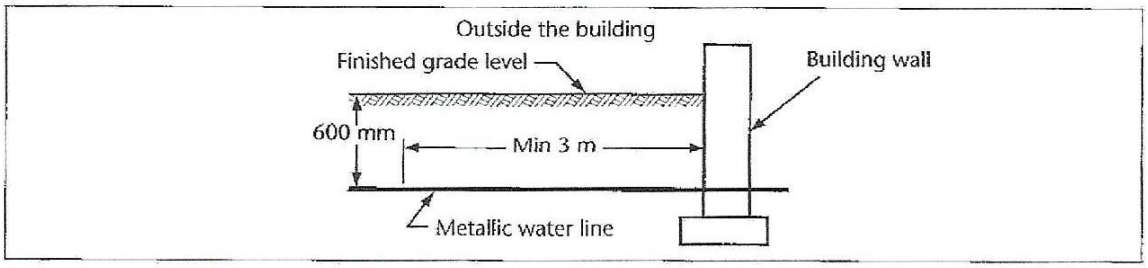

Figure 10-25
In-situ grounding electrode — Water piping

I do not know when the use of plastic piping came into common use for municipal water distribution systems, nor do I know when plastic piping became the standard practice for interior water distribution systems in low rise, residential construction. I suppose the Canadian Standards Association would be able to tell us when the organization first published standards for such piping.

All is not lost, however. As far as I am aware, if a building is provided with natural gas, the piping for such a system is still required to be metallic construction. Since the CEC requires such piping to be bonded to the electrical system ground, if such piping is located close to your shack, it may be possible to use that piping as a route to the electrical system ground.

MANUFACTURED GROUNDING ELECTRODES

The CEC permits the use of manufactured grounding electrodes and in-situ grounding electrodes. Except for the water piping just discussed, the other examples are of interest only if you are constructing the building and can arrange to install them during construction.

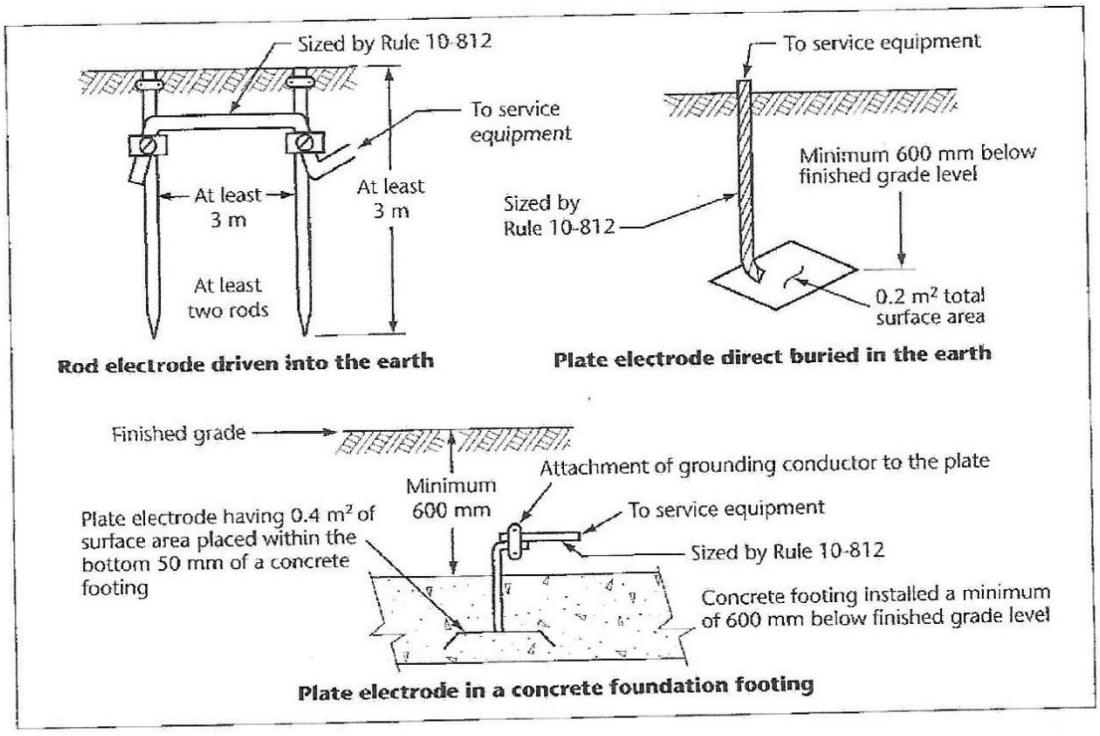

Figure 10-23
Manufactured grounding electrodes

The key points in Figure 10-23 are the length of the rods, the separation between rods if more than one is used for the building electrical system ground, and the implied requirement that the conductor connecting multiple rods must be buried. The CEC permits the wiring which interconnects grounding electrodes from burial if it is free from exposure to mechanical damage. However, there is a requirement in the CEC that if the grounding conductor is smaller than 8 AWG, it must be enclosed in a raceway or flexible armour. The requirements for the grounding system for lightning protection are slightly different. Figure 10-30 requires the interconnection of ground rods used for different systems and requires only a 2 metre separation between ground rods,

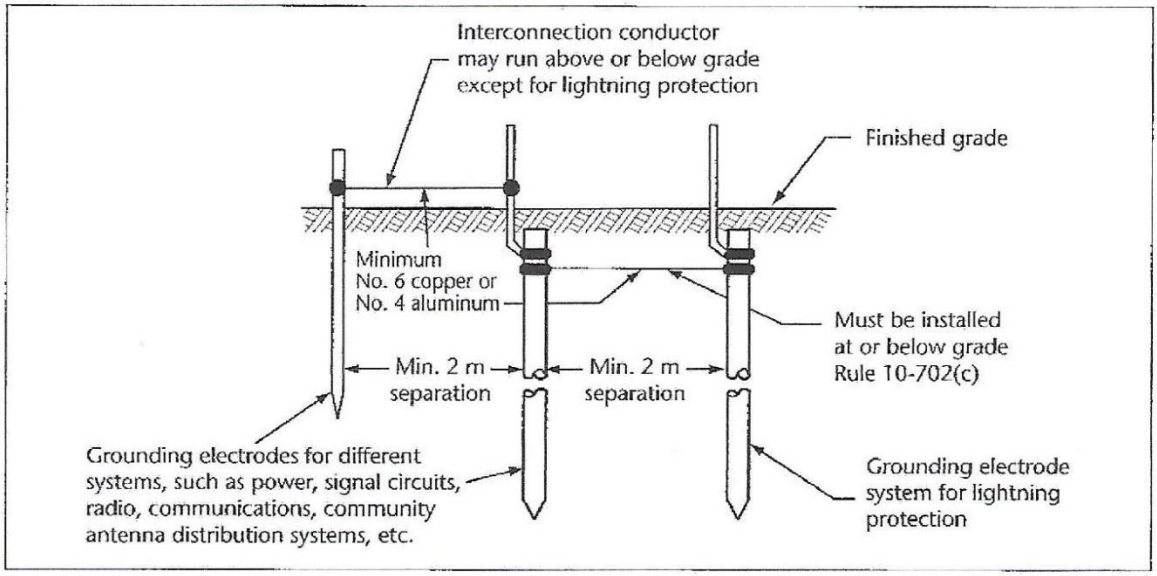

Figure 10-30
Bonding requirements for multiple grounding electrode systems

REQUIREMENTS SPECIFIC TO AMATEUR RADIO STATIONS

Amateur radio stations must conform to the general requirements contained in the CEC with respect to grounding and bonding. Specifically, noncurrent carrying metallic parts of electrical equipment in the station must be bonded together and that bonding system must be connected to the building electrical system ground. Unless the bonding system is already incorporated in the equipment (i.e. the plug for a power supply), the bonding conductor must be a minimum 6AWG, unless it can be shown that a smaller conductor can be safely used. There are guidelines in the CEC for determining the acceptability of smaller conductors.

In cases where the amateur station requires both an operating ground and a protective ground, the same wiring can be used for both provided it is possible to disconnect the operating ground without interfering with the protective ground.

Figure 54-7 illustrates the requirements for grounding of antennas. The requirements indicated are those required by the CEC and the code for the installation of lightning protection systems may contain additional requirements.

The masts, metal support structures and antenna frames must be grounded. Surge arrestors must be installed where the cable between the antenna and equipment enters the building.

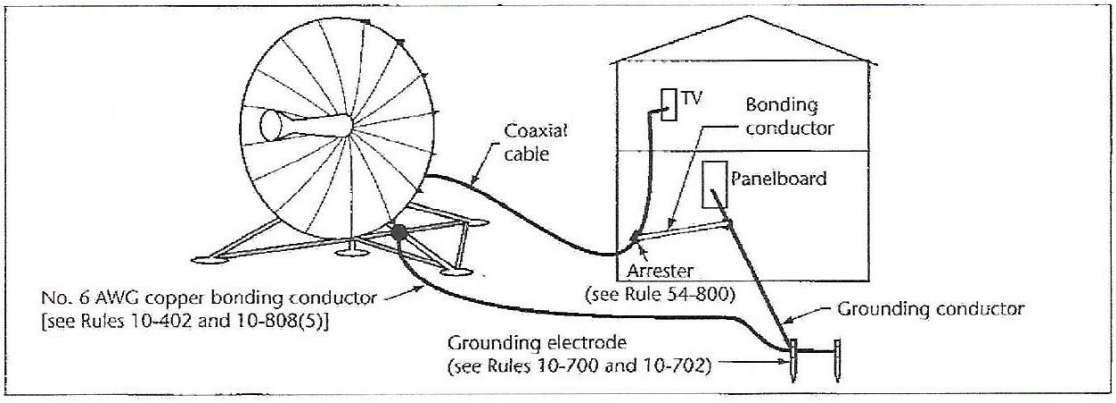

Figure 54-7
Grounding of antennas

LIGHTNING PROTECTION

CSA B72-2020 provides guidance for the installation of lightning protection systems. The current addition of this standard is dated 2020. I have not been able to verify that the current standard has been adopted by the Province (by reference in the Alberta Building Code). The 2020 edition of the standard replaces the 1987 and 1960 versions which were referenced in the Alberta Building Code.

I suggest that you get a copy of B72 (expensive) or consult with an expert in lightning protection systems (also expensive) regarding the design of your lightning protection system.

Masts and antenna structures are grouped in with Class IV installations. B72 contains specific requirements for Class I and II installations and, except as noted in Clause 11 of the Code, Class IV structures must comply with the requirements for a Class I (structures 23 m or less in height) or Class II (structures over 23 m in height). The system must also comply with the relevant parts of Clause 10 of the CEC.

The ground conductors for a lightning protection system are significantly heavier than required for the electrical system grounding and bonding system.

A mast is required to have a dedicated ground rod which is required to be connected to any other ground rods that provide lightning protection. The conductor connecting the rods must be buried 150 mm below ground. All ground rods for lightning protection must be connected to the grounding device for the building electrical system.