

4.13.4.2 The ground ring electrode shall be a main-size lightning conductor.

4.13.5* Radials.

4.13.5.1 A radial electrode system shall consist of one or more main-size conductors, each in a separate trench extending outward from the location of each down conductor.

4.13.5.2 Each radial electrode shall be not less than 3.6 m (12 ft) in length and not less than 460 mm (18 in.) below grade and shall diverge at an angle not greater than 90 degrees.

4.13.6* Plate Electrode or Ground Plate Electrode.

4.13.6.1 A ground plate or plate electrode shall have a minimum thickness of 0.8 mm (0.032 in.) and a minimum surface area of 0.18 m² (2 ft²).

4.13.6.2 The ground plate electrode shall be buried not less than 460 mm (18 in.) below grade.

4.13.7 Combinations. Combinations of the grounding electrodes in Section 4.13 shall be permitted.

4.13.8 Grounding Electrode Selection Criteria. The site limitations and soil conditions shall determine the selection of the type or combinations of types of grounding electrodes used.

4.13.8.1* Shallow Topsoil. The methods in 4.13.3 through 4.13.7 shall be used in shallow topsoil conditions where practicable.

4.13.8.1.1 Where the methods described in 4.13.3 through 4.13.6 are found to be impractical due to topsoil depth less than 460 mm (18 in.), it shall be permitted to provide a ground terminal buried at the maximum depth of topsoil available.

4.13.8.1.2 The ground terminal for shallow topsoil shall be either a ground ring electrode in accordance with 4.13.4 a minimum distance of 0.6 m (2 ft) from the foundation or exterior footing, radial(s) in accordance with 4.13.5, or a plate electrode in accordance with 4.13.6 a minimum distance of 0.6 m (2 ft) from the foundation or exterior footing. The ground ring electrode, radial(s), or plate electrode shall be buried at maximum depth of topsoil available.

4.13.8.1.3 Where a method of 4.13.8.1.2 is impossible, radial(s) shall be permitted to be laid directly on bedrock a minimum distance of 3.6 m (12 ft) from the foundation or exterior footing. A ground ring electrode encircling the structure shall be permitted to be laid directly on bedrock a minimum distance of 0.6 m (2 ft) from the foundation or exterior footing.

4.13.8.1.4 In those cases where the grounding conductor is laid directly on bedrock, the conductor shall be secured to the bedrock every 0.9 m (3 ft) by nailing, conductive cement, or a conductive adhesive to ensure electrical contact and protect against movement.

4.13.8.2 Sandy Soil Conditions. Because sandy or gravelly soil conditions are characterized by high soil resistivity, multiple grounding electrodes shall be used to augment the lightning grounding electrode system.

4.14 Common Grounding.

4.14.1* General. All grounding media and buried metallic conductors that can assist in providing a path for lightning currents in or on a structure shall be interconnected to provide a common ground potential.

4.14.1.1 This interconnection shall include lightning protection, electric service, communications, and antenna system grounds, as well as underground metallic piping systems.

4.14.1.2 Underground metallic piping systems shall include water service, well casings located within 7.6 m (25 ft) of the structure, gas piping, underground conduits, underground liquefied petroleum gas piping systems, and so on.

4.14.1.3 Interconnection to a gas line shall be made on the customer's side of the meter.

4.14.1.4 Main-size lightning conductors shall be used for interconnecting these grounding systems to the lightning protection system.

4.14.2 Common Ground Bondings.

4.14.2.1 Where electric, community antenna television (CATV), data, communications, or other systems are bonded to a metallic water pipe, only one connection from the lightning protection system to the water pipe system shall be required, provided the water pipe is electrically continuous between all systems.

4.14.2.2 If the water pipe is not electrically continuous due to the use of plastic pipe sections or other reasons, the nonconductive sections shall be bridged with main-size conductors, or the connection shall be made at a point where electrical continuity is ensured.

4.15 Concealed Systems.

4.15.1 General.

4.15.1.1 Requirements covering exposed systems also shall apply to concealed systems, except conductors shall be permitted to be cased under roofing materials, under roof framing, behind exterior wall facing, between wall studding, in conduit chases, or embedded directly in concrete or masonry construction.

4.15.1.2 Where a conductor is run in metal conduit, it shall be bonded to the conduit at the point where it enters the conduit, at the point where it emerges from the conduit, and at all locations where the conduit is not electrically continuous.

4.15.2 Masonry Chimneys. Chimney strike termination devices and conductors shall be permitted to be concealed within masonry chimneys or to be attached to the exterior of masonry chimneys and routed through the structure to concealed main conductors.

4.15.3 Concealment in Steel-Reinforced Concrete. Conductors or other components of the lightning protection system concealed in steel-reinforced concrete units shall be connected to the reinforcing steel.

4.15.3.1 Concealed down conductors shall be connected to the vertical reinforcing steel in accordance with 4.9.13.

4.15.3.2 Roof conductors or other concealed horizontal conductor runs shall be connected to the reinforcing steel at intervals not exceeding 30 m (100 ft).

4.15.4 Grounding Electrodes. Grounding electrodes for concealed systems shall comply with Section 4.13.

4.15.4.1* Grounding electrodes located under basement slabs or in crawl spaces shall be installed as near as practicable to the outside perimeter of the structure.