Chapter E 171

PROTECTIVE MEASURES

E 171.01 Conductors, air terminals, and ground connectors. Conductors for protective systems shall be selected as to material, form, and size in accordance with sections E 160.01 through E 168.03. Details as to air terminals, down conductors, interconnection of metallic masses, and ground connections are also given in sections E 160.01 through E 168.03. Connections to ground and interconnections between metallic bodies should be as short and direct as possible.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 171.02 Sheet steel. Experience in the petroleum industry demonstrates that the use of 3/16 inch steel roof sheets on tanks has been adequate. Sheet metal substantially less than 3/16 inch in thickness may be punctured by severe strokes and should be protected by suitable air terminals.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 171.03 Rods, masts, and overhead ground wires. (1) The cone of protection of a grounded rod or mast of conducting material is conventionally taken as the space enclosed by a cone, which has its apex at the highest point of the rod or mast and a radius at the base which bears a relation to the height. This relation depends upon the height of the cloud above the earth relative to the height of the rod or mast. A radius of base HM equal to the height of the rod or mast in important cases, or up to twice the height in less important cases, has been found to be substantially immune to direct strokes of lightning. No part of the structure to be protected should extend outside of the cone of protection (figure A). If more than one rod or mast is used, the shielded region between them is somewhat greater than the total of the shielded regions of all of the rods or masts considered individually.

(2) Masts separate from the structure to be protected should be a minimum of 6 feet from the protected structure, and the clearance should be increased by one foot for every 10 feet of structure height above 50 feet to prevent side flashes. The masts shall be thoroughly grounded and connected at ground level to the grounding system of the structure to be protected.

(3) Where a suitable underground metallic water pipe serves the structure, the water pipe is ordinarily the common grounding electrode for all services and facilities which require grounding at the structure. If there is no water pipe or if the water pipe is not accessi-

ble, the separate grounding electrodes of the various services and facilities shall be bonded together and to the masts. If such separate grounding electrodes are not accessible, the minimum separation between the mast and the structure shall be increased to 10 feet for mast ground resistance of 10 ohms or less. As an alternative, a buried grounding conductor around the outside of the structure may be used and bonded to the mast ground to avoid larger separations.

(4) The zone of protection of overhead ground wires is conventionally taken as a triangular prism or wedge. One-half of the base of the wedge (HM) equal to the height of lowest point of the overhead ground wire in important cases, or up to twice the height in less important cases, has been found to be satisfactory (figure B). The supporting masts should have a clearance from the protected structure as under section E 171.03 (2). Ground wires should be of a size as indicated under section E 160.01. The material selected should be non-corrosive for the conditions existing at the site, and the rules of section E 160.01 should be observed.

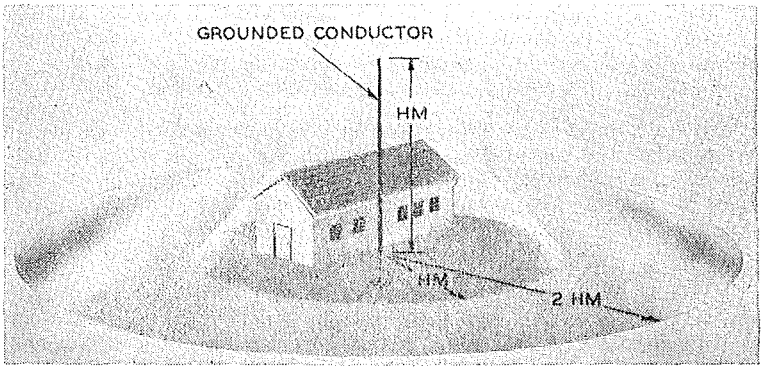

Figure A.

Cone of Protection Provided by a Vertical Grounded Conductor.

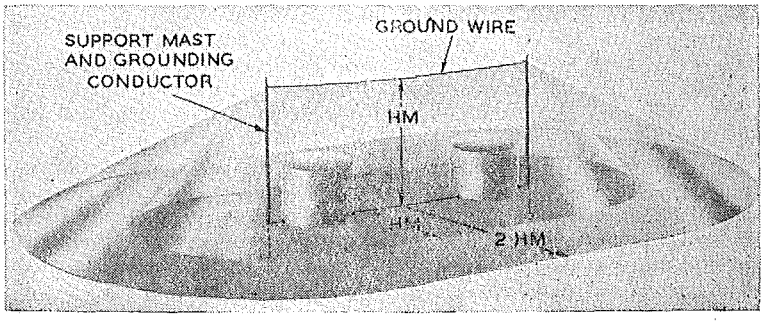

Figure B. HM = Height of Mast.

Zone of Protection Provided by a Horizontal Aerial Ground Wire.

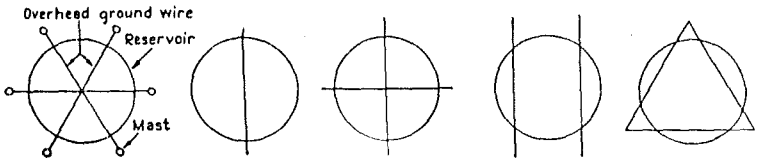

Figure C.

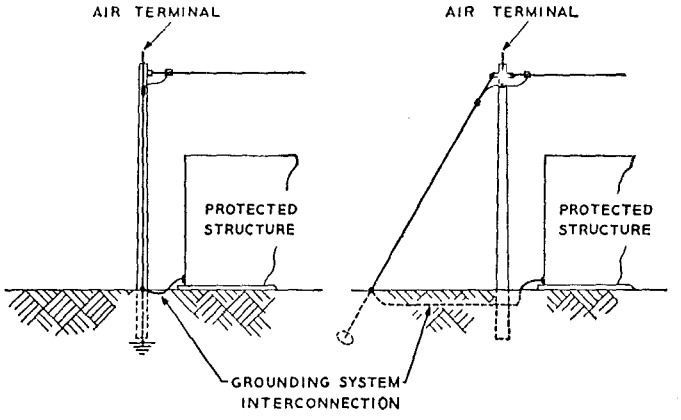

Figure D.

Alternate Grounding Method for Aerial Ground Wire Protection

(5) The minimum clearance between the overhead ground wires and the highest projection on the protected structure shall be 6 feet. For each 10 feet of lead between a point on the ground wire midway between the supporting masts and ground in excess of 60 feet, the clearance should be increased by one foot. These dimensions apply when the ground-wire system is interconnected with the grounding of the protective system in accordance with subsection (2). Where no interconnection is made the recommendations of subsection (2) apply. Variations in the ground-wire system design are shown in the plan view of figure C.

(6) Masts used either separately or with ground wires may be of wood. An approved type of air terminal shall be securely mounted to the top of the pole (see figure D) extending not less than 2 feet above the top of the pole and connected to ground electrodes. In case of an overhead ground-wire system, the pole guy wire may be used as the down conductor (see figure D). For metallic masts, the air terminal and the down conductor are not required, but the masts shall be grounded as described.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 171.04 Ground resistance. (1) The resistance of ground rods driven in the earth and separated by distances of 10 feet or more will be reduced in approximate proportion to the number of rods in parallel.

(2) The resistance of a conductor buried in the ground decreases almost directly in proportion to the increase in length of the buried conductor. Such conductors are usually buried from 1 to 3 feet beneath the ground surface and running parallel with the ground surface.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 171.05 Electrostatic shielding. The electrostatically induced voltage on isolated objects in the field of a storm cloud may cause sparks to ground when a lightning discharge occurs to some adjacent object. Isolated objects within a structure that is adequately shielded will themselves be electrostatically shielded. If the structure is not shielded or is only partially shielded, then the isolated objects should be grounded to prevent electrostatic sparks. For further discussion of the grounding of isolated internal objects see section E 161.07.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.

E 171.06 Flame protection of vapor openings. (1) Flame protectors of any type should be such as have been proved by adequate investigation and tests to be effective for the conditions under which they are installed and used.

(2) For pipe sizes larger than 4 inches, the effectiveness of flame protection employing screens on the Davy principle is questionable. Pressure relief valves that remain closed at pressure differentials of less than 1-inch head of water, and arresters in the forms of tubes, plates, and their equivalent, have been found to be reasonably effective flame protection devices.

(3) Flame protectors should be substantially encased and capable of withstanding the effect of cleaning and of flame and pressures without material distortion or injury.

(4) Where screens are used, they should be made of corrosion-resistant wire with a mesh of about 40 per inch. They should be protected so far as possible from mechanical injury.

History: Cr. Register, January, 1968, No. 145, eff. 2–1–68.