

## Chapter E 165

## HANGARS, BALLOONS AND AIRSHIPS

E 165.01 Prevention of damage to hangars      E 165.02 Prevention of damage to airships

**E 165.01 Prevention of damage to hangars.** Where buildings housing aircraft are to be protected against lightning the following rules shall apply.

*Note:* Buildings for the housing of aircraft require special attention in regard to protection against lightning because of the hazardous nature of their contents, and in the case of buildings for housing rigid airships, because of their great height and area. Permanent structures are usually all-steel, steel over wood frames, or asbestos on either wood or steel. For the protection of all-steel structures it is considered sufficient to ground the framework (as indicated in subsection (8) below), but for the protection of buildings of other forms of construction more extensive measures are necessary.

(1) **MATERIALS.** Materials used for the purposes of this chapter shall comply with the requirements of subsection E 161.01 (1) "Materials".

(2) **CONDUCTORS.** Conductors shall comply with the requirements of subsection E 161.01 (2).

*Note:* It is recommended that where existing conditions are especially severe with respect to weather or other causes, as may be the case with very large buildings for the housing of aircraft, more massive conductors be used than required by subsection E 161.01 (2).

(3) **CONSTRUCTION AND INSTALLATION.** The construction and installation of conductors where used shall comply with subsections E 161.01 (3) and (4), sections E 161.02 and E 161.03.

(4) **STRUCTURES WITH STEEL FRAMES.** Where protection is provided for buildings with steel frames, all parts of which are securely bonded together, the air terminals may be connected to the steel frame at the nearest point and other conductors between air terminals and ground omitted. Where such connection is made the connecting conductor shall comply with the requirements of subsection E 161.01 (2), as to weight, and shall be secured in electrical contact with the frame by means of bolts and nuts. The steel frame shall be grounded as provided in subsection E 165.01 (8).

(5) **CONSTRUCTION OF AIR TERMINALS.** Air terminals shall be strongly constructed and shall be securely attached and braced against overturning.

*Note 1.* The following construction is suggested for air terminals on the roofs of steel-frame buildings. The elevation rod may consist of a length of "extra strong" galvanized-steel pipe not less than 0.75 inch internal diameter, or an equivalent aluminum, copper or copper-alloy tube, threaded at both ends, one to receive a threaded solid point 6 inches in length, and the other an attachment for securing the elevation rod to the roof. By "equivalent" is meant of equivalent strength and conductivity.

*Note 2.* This attachment should consist of a pair of wooden blocks bolted to the outer and inner surfaces of the wood sheathing and cut to fit the roof and afford horizontal parallel surfaces for mounting floor flanges. The roof and blocks should be drilled through at the hub of the flanges and the tube screwed through both flanges in a vertical position. The roofing should be laid on around the outer wooden block and copper or aluminum flashing applied.

(6) HEIGHT OF AIR TERMINAL. (a) Where air terminals are placed on projections the height shall be such as to bring the tip not less than 10 inches above the object to be protected. Where air terminals are placed near projections there shall be at least 4 inches of additional height above the object to be protected for each foot of separation.

(b) Where air terminals are spaced 25 feet or less apart on roof ridges or flat surfaces the height shall not be less than 4 feet 10 inches. For each additional foot of separation above 25 feet there shall be an increase in height of not less than 2 inches.

(c) Where air terminals are placed in rectangular arrangement as in subsection E 165.01 (7) the height shall be determined by the longest side of the rectangle.

(7) LOCATION OF AIR TERMINALS. Air terminals shall be provided for all structural parts that are likely to receive, and be damaged by, a stroke of lightning.

(a) In the case of projections the air terminal shall be placed on the object to be protected where practicable, otherwise it shall be attached to the roof as near by as practicable.

(b) Along ridges, parapets, and edges of both flat and pitched roofs, air terminals shall be erected at intervals not exceeding 25 feet.

(c) Flat and sloping surfaces, except as indicated below, shall be divided into rectangles having sides not exceeding 50 feet in length by drawing lines parallel to the edges of the roof, and air terminals erected at the intersection of these lines.

(d) On gambrel roofs only the portion above the breaks need be considered and is to be treated as a pitched roof.

(e) On mansard roofs only the flat portion need be considered and is to be treated as a flat roof.

(8) GROUND CONNECTIONS. Ground connections for lightning conductors shall comply with section E 161.08. Where the frame of the building is of steel it shall be permanently and effectively grounded as follows:

(a) If there is a water-pipe system entering the structure the frame shall be bonded to it at the point of entrance with a conductor secured to the pipe by means of a substantial clamp with a lug, and to the frame with a bolt and nut. In addition, artificial grounds shall be provided for the steel pedestals, columns, or roof trusses, at not less than half of the footings, and distributed as uniformly about the perimeter as practicable.

(b) If there is no water-pipe system available, an artificial ground shall be provided at each footing.

(c) Where the soil is deep, artificial grounds may be made by extending the grounding conductor into the soil a distance of at least 10 feet, by driving a pipe or rod to a depth at least 8 feet, or by burying to a depth of at least 6 feet a metal plate having an area of at least 4 square feet.

(d) Where the soil is shallow, grounds may be made by digging trenches radially from the building and burying in them a length of grounding conductor, or its equivalent in the form of a metal strip. In addition, a trench should be dug surrounding the building and a conductor laid in it which connects all of the grounding conductors together.

(e) Conductor for grounding purposes shall conform to subsection E 165.01 (2) above.

(f) Where galvanized-steel pipes are used they shall be standard "extra strong" and have a nominal internal diameter of not less than 0.75 inch.

(g) Where copper strips or plates are used they shall have a thickness of not less than No. 14 AWG (0.064 inch).

(h) Grounding conductors shall be attached to buried electrodes by means of soldered, riveted, welded, or bolted joints, and to the frame with bolts and nuts.

(i) Trenches for grounding purposes must be long enough to accommodate 12 feet of conductor when laid straight but need not be more than 3 feet in depth.

(9) INTERCONNECTION OF METALS. (a) Exterior metallic bodies such as roof flashings and down spouts shall be securely bonded to the lightning-conductor system. In the case of steel-frame buildings they shall be securely bonded to the frame, and all parts of the frame shall be securely bonded together.

(b) Interior metallic bodies, such as piping systems and machinery, shall be independently grounded and if within 10 feet of a lightning conductor shall be securely bonded thereto. In the case of steel-frame buildings, all interior metallic bodies within 10 feet of the walls shall be securely bonded to the frame.

(c) Where water pipes are available they shall be used in preference to other means for grounding interior bodies of metal. Where artificial grounds are necessary they shall be constructed in compliance with section E 161.08.

(d) For all bonding, interconnecting and grounding purposes the conductor used shall be at least the equivalent in strength and conducting cross-sectional area of a No. 6 AWG copper wire except where full-size lightning conductor is otherwise required. (See section E 161.07 and notes.)

(10) SPARK PREVENTION. Each structure, after its protective system is installed, shall be examined by competent authority with a view of determining whether all possible interior sources of sparks from a stroke of lightning on the building have been eliminated. If it appears that gaps between adjacent bodies of metal or between bodies of metal and ground, are likely to give rise to sparks, suitable bonds or ground connections shall be installed in such a manner as permanently and effectively to prevent them.

**History:** Cr. Register, April, 1964, No. 100, eff. 5-1-64.

**E 165.02 Prevention of damage to airships.** To prevent damage from lightning and accumulation of static electricity, balloons and airships shall be treated as follows:

(1) **CAPTIVE BALLOONS.** Captive balloons shall be grounded through the metal cable and winch by means of a pipe or rod driven 6 feet in the ground, or its equivalent in metal buried in a trench.

(2) **FREE BALLOONS AND AIRSHIPS.** Free balloons and airships shall be provided with an effective grounding wire which is to be dropped just previous to landing, and a good ground contact made for carrying off such electrical charges as may have been accumulated by them while in the air.

(3) **INTERCONNECTION OF METALLIC PARTS.** All metal parts of lighter-than-aircraft shall be interconnected so that any charge that may accumulate may be distributed rather than remain concentrated.

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