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NFPA® 780

Standard for the Installation of Lightning Protection Systems Handbook 2014

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An International Codes and Standards Organization

NFPA® 780 Standard for the Installation of Lightning Protection Systems Handbook 2014

Second Edition

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NFPA® 780

Standard for the

Installation of Lightning Protection Systems

2014 Edition

This edition of NFPA 780, *Standard for the Installation of Lightning Protection Systems*, was prepared by the Technical Committee on Lightning Protection. It was issued by the Standards Council on May 28, 2013, with an effective date of June 17, 2013, and supersedes all previous editions.

This edition of NFPA 780 was approved as an American National Standard on June 17, 2013.

Origin and Development of NFPA 780

NFPA first adopted *Specifications for Protection of Buildings Against Lightning* in 1904. Revised standards were adopted in 1905, 1906, 1925, 1932, and 1937. In 1945, the NFPA Committee and the parallel American Standards Association (ASA) Committee on Protection Against Lightning were reorganized and combined under the sponsorship of NFPA, the National Bureau of Standards, and the American Institute of Electrical Engineers (now the IEEE). In 1946, NFPA acted to adopt Part III and in 1947 published a revised edition incorporating this part. Further revisions recommended by the Committee were adopted by NFPA in 1949, 1950, 1951, 1952, 1957, 1959, 1963, 1965, 1968, 1975, 1977, 1980, 1983, 1986, 1989, and 1992.

Commencing with the 1992 edition of the *Lightning Protection Code*, the NFPA numerical designation of the document was changed from NFPA 78 to NFPA 780.

With the issuance of the 1995 edition, the name of the document was changed from *Lightning Protection Code* to *Standard for the Installation of Lightning Protection Systems*. This change was directed by the Standards Council in order to make the title more accurately reflect the document's content. In addition, the Council directed certain changes to the scope of the document to clarify that the document did not cover lightning protection installation requirements for early streamer emission systems or lightning dissipater array systems.

The 1997 edition of NFPA 780 incorporated editorial changes to make the document more user friendly.

In issuing this document, the Standards Council noted that lightning is a stochastic, if not capricious, natural process. Its behavior is not yet completely understood. This standard is intended to provide requirements, within the limits of the current state of knowledge, for the installation of those lightning protection systems covered by the standard.

The 2000 edition of NFPA 780 was amended to provide requirements for open structures such as those found on golf courses. A 1998 lightning flash density chart replaced the 1972 lightning frequency isoceraunic chart.

The 2004 edition of NFPA 780 reflected an extensive editorial revision of the standard to comply with the concurrent edition of the *NFPA Manual of Style for Technical Committee Documents*. These revisions included the addition of three administrative chapters at the beginning of the standard: "Administration," "Referenced Publications," and "Definitions." Five technical chapters followed the administrative chapters in the same sequence as in the 2000 edition. Other editorial revisions included the breakout of paragraphs with multiple requirements into an individually numbered paragraph for each requirement, the minimization of the use of exceptions, the use of consistent headings for sections and section subdivisions, and reorganization to limit paragraph numbering to six digits. The International System of Units, commonly known as SI or metric, was used throughout the document. The appendixes were renamed annexes and reordered in a more logical sequence.

The 2004 edition also contained a number of technical revisions throughout the standard. These revisions included the following: a main conductor, solid strip, was added for Class II material requirements for ordinary structures exceeding 75 ft in height; handrails could be used as a substitute for down conductors; additional separation between ground rods was required where multiple ground rods are used; additional guidance was provided for those

instances where it is necessary to install the grounding conductor directly on bedrock; the section entitled Surge Suppression was entirely rewritten; titanium strike termination devices were permitted to be used; and in Annex K the term *Faraday cage* was replaced with *metallic cage*.

The 2008 edition provided requirements for surge protective devices to be installed at all power service entrances, at the entrance of conductive communications systems and antenna systems, and where an electrical or electronic system conductor leaves the structure.

The new definition for *lightning protection system* included the term *conductive structural members*. Clarification was provided relative to the use of ancillary metal parts that cannot be substituted for the main conductor. Strike termination devices included air terminals, metal masts, certain permanent metal parts of structures, and elevated conductors. Revisions clarified that metal masts and overhead ground wires were included in the requirements of Chapter 4.

Significant changes were made to the requirements for the use of bimetallic clamps and aluminum in proximity to earth. The standard has long required that grounding electrodes be located near the outside perimeter of the structure, and in the 2008 edition additional guidance was provided to assist the system designer. Changes were also made to better address the requirements for grounding electrodes in shallow topsoil applications.

The requirements for the use of multiple ground rods were revised. Revisions were also made in numerous areas of the standard for clarity and to enhance its usability. Revisions to the graphs and formulas for the rolling sphere method were made to facilitate their use in metric units.

Requirements were added to address proper installation of lightning protection equipment on large roof top mechanical units. The installation of air terminals and main-size conductors in these applications were quantified and detailed.

Revisions were made to enhance and clarify the requirements for the bonding together of all grounded media and underground metallic piping. The intent was to provide for potential equalization and not to use the metallic piping as a lightning protection system grounding electrode. All grounding media and buried metallic conductors that might assist in providing a path for lightning currents in or on a structure must be interconnected to provide a common ground potential. Guidance was provided on the use of isolating spark gaps.

Significant changes were made to the requirements pertaining to the conductors and other lightning protection system hardware used near the top of a heavy-duty stack.

Other significant changes included a complete rewrite of Chapter 8, Protection for Watercraft, providing a number of technical revisions; more user information added in Annex B, Principles of Lightning Protection; and a revision of Annex F, Protection for Trees.

In addition to significant technical changes, the 2011 edition included new and revised text.

With the addition of two new chapters, the 2011 edition of the standard presented a major change in the scope of the document. The first new chapter addressed the protection of structures housing ammunition and explosive materials. The second new chapter included requirements for providing lightning protection for wind turbines, specifically wind turbine structures that comprise externally rotating blades, a nacelle, and a supporting tower. The 2011 edition was substantially reorganized to accommodate these new chapters in a logical order.

The sections pertaining to strike termination devices, zones of protection, and the rolling sphere method were totally reorganized for better usability. The text clearly provided that strike termination devices include air terminals, metal masts, permanent metal parts of structures, and overhead ground wires. The text qualified where a metal mast would be permitted to serve as the down conductor. The requirements for overhead ground wires and masts and overhead ground wires were relocated.

The 2011 edition clarified the requirements for strike termination devices at the eaves for a pitched roof, and a figure was added to graphically illustrate that condition.

A new section on roof top helipads provided requirements to ensure that an adequate level of protection is provided to those areas within the height and safety criteria set forth by the Federal Aviation Administration (FAA) or other AHJs.

Chapter 7 provided requirements for the protection of structures containing flammable vapors, flammable gases, or liquids that can give off flammable vapors. The section on floating roof tanks was revised in its entirety as a result of recent testing and research conducted for aboveground storage tanks.

The lightning risk assessment methodology provided in Annex L was completely rewritten. The lightning risk assessment was provided to assist the building owner, safety professional, or architect/engineer in determining the risk of damage or injury due to lightning. This annex provided both a simplified, quick-look assessment and a more detailed assessment for those requiring a more detailed analysis. Once the level of risk has been determined, the development of appropriate lightning protection measures can begin.

The 2014 edition provides reorganization of Sections 4.7 and 4.8, to better align the requirements for strike termination devices. Reorganization of these sections in a more logical order clarifies the requirements and application of the standard. Previously, these requirements were intermingled, causing confusion and possible misapplication. Section 4.8 has also been revised to clarify the requirements for protection where small objects are located on roofs.

Section 4.14 has been revised and reorganized to include parts of Section 4.20, and explanatory text was provided to ensure clarity, alignment, and coordination with the bonding interconnections of *NFPA 70, National Electrical Code*.

Sections 4.15 through 4.21 have been totally restructured and revised to place similar bonding requirements together to improve the flow of the document for the user. Similar or repetitive requirements have been combined or restructured to clarify the requirements.

A new subsection, 4.7.13, in the 2014 edition addresses the use on buildings of fixed metal objects that have movable or rotating metal components, for example, jib cranes, wind socks, observatories/telescopes, opening roofs (typically over swimming pools), window washing davits/cars (left permanently on the roof, typically on a track), construction cranes, panning security cameras, broadcast television cameras, traffic cameras, radar dishes, weather vanes, gravity vents, roof-mounted wind turbines, smoke hatches/blowout hatches, opening skylights, and photovoltaic arrays (motorized arrays that tilt to track the sun as it moves across the sky).

NFPA 780 has been revised to reformat the use of U.S. customary (inch-pound) and metric (SI) units. U.S. customary units are followed by SI units in parentheses. Several formulas and tables were updated to provide both U.S. customary (inch-pound) and metric (SI) units. Also, a new section, Section 1.4, addresses retroactivity for NFPA 780.

A new chapter, Chapter 11, has been added to provide lightning protection criteria requirements and guidance for airfield lighting circuits. Development of this chapter began prior to the 2011 edition but was held by the Committee in anticipation of new material and to enable better alignment with federal aviation requirements. Chapter 11 provides a thorough look at design and installation of lightning protection systems to afford protection to those open areas. Several figures provide ample explanation and guidance to the user.

As the demand for renewable and alternative energy sources continues, there is a rapid deployment of solar systems and arrays. Because these are often installed on roof tops, there is a risk of greater exposure. Buildings provided with lightning protection systems now see a greater abundance of roof top-mounted equipment, and the lightning protection system might not be designed to address the new equipment. Buildings not provided with lightning protection systems might need to address the additional mechanical structure and equipment. The new Chapter 12 addresses lightning protection systems for solar systems and arrays.

The requirements pertaining to catenary systems have been reviewed, and significant annex material has been provided to clarify computations for applications with metal or wood poles.

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