2013 Annual Revision Cycle

Report on Proposals

A compilation of NFPA® Technical Committee Reports on Proposals for public review and comment

Public Comment Deadline: August 31, 2012

NOTE: The proposed NFPA documents addressed in this Report on Proposals (ROP) and in a follow-up Report on Comments (ROC) will only be presented for action when proper Amending Motions have been submitted to the NFPA by the deadline of April 5, 2013. The June 2013 NFPA Conference & Expo will be held June 10–13, 2013, at McCormick Place Convention Center, Chicago, IL. During the meeting, the Association Technical Meeting (Tech Session) will be held June 12–13, 2013. Documents that receive no motions will not be presented at the meeting and instead will be forwarded directly to the Standards Council for action on issuance. For more information on the rules and for up-to-date information on schedules and deadlines for processing NFPA documents, check the NFPA website (www.nfpa.org) or contact NFPA Standards Administration.
I. Applicable Regulations. The primary rules governing the processing of NFPA documents (codes, standards, recommended practices, and guides) are the NFPA Regulations Governing Committee Projects (Regs). Other applicable rules include NFPA Bylaws, NFPA Technical Meeting Convention Rules, NFPA Guide for the Conduct of Participants in the NFPA Standards Development Process, and the NFPA Regulations Governing Petitions to the Board of Directors from Decisions of the Standards Council. Most of these rules and regulations are contained in the NFPA Directory. For copies of the Directory, contact Codes and Standards Administration at NFPA Headquarters; all these documents are also available on the NFPA website at “www.nfpa.org.”

The following is general information on the NFPA process. All participants, however, should refer to the actual rules and regulations for a full understanding of this process and for the criteria that govern participation.

II. Technical Committee Report. The Technical Committee Report is defined as “the Report of the Technical Committee and Technical Correlating Committee (if any) on a document consisting of the ROP and ROC.” A Technical Committee Report consists of the Report on Proposals (ROP), as modified by the Report on Comments (ROC), published by the Association.

III. Step 1: Report on Proposals (ROP). The ROP is defined as “a report to the Association on the actions taken by Technical Committees and/or Technical Correlating Committees, accompanied by a ballot statement and one or more proposals on text for a new document or to amend an existing document.” Any objection to an action in the ROP must be raised through the filing of an appropriate Comment for consideration in the ROC or the objection will be considered resolved.

IV. Step 2: Report on Comments (ROC). The ROC is defined as “a report to the Association on the actions taken by Technical Committees and/or Technical Correlating Committees accompanied by a ballot statement and one or more comments resulting from public review of the Report on Proposals (ROP).” The ROP and the ROC together constitute the Technical Committee Report. Any outstanding objection following the ROC must be raised through an appropriate Amending Motion at the Association Technical Meeting or the objection will be considered resolved.

V. Step 3a: Action at Association Technical Meeting. Following the publication of the ROC, there is a period during which those wishing to make proper Amending Motions on the Technical Committee Reports must signal their intention by submitting a Notice of Intent to Make a Motion. Documents that receive notice of proper Amending Motions (Certified Amending Motions) will be presented for action at the annual June Association Technical Meeting. At the meeting, the NFPA membership can consider and act on these Certified Amending Motions as well as Follow-up Amending Motions, that is, motions that become necessary as a result of a previous successful Amending Motion. (See 4.6.2 through 4.6.9 of Regs for a summary of the available Amending Motions and who may make them.) Any outstanding objection following action at an Association Technical Meeting (and any further Technical Committee consideration following successful Amending Motions, see Regs at 4.7) must be raised through an appeal to the Standards Council or it will be considered to be resolved.

VI. Step 3b: Documents Forwarded Directly to the Council. Where no Notice of Intent to Make a Motion (NITMAM) is received and certified in accordance with the Technical Meeting Convention Rules, the document is forwarded directly to the Standards Council for action on issuance. Objections are deemed to be resolved for these documents.

VII. Step 4a: Council Appeals. Anyone can appeal to the Standards Council concerning procedural or substantive matters related to the development, content, or issuance of any document of the Association or on matters within the purview of the authority of the Council, as established by the Bylaws and as determined by the Board of Directors. Such appeals must be in written form and filed with the Secretary of the Standards Council (see 1.6 of Regs). Time constraints for filing an appeal must be in accordance with 1.6.2 of the Regs. Objections are deemed to be resolved if not pursued at this level.

VIII. Step 4b: Document Issuance. The Standards Council is the issuer of all documents (see Article 8 of Bylaws). The Council acts on the issuance of a document presented for action at an Association Technical Meeting within 75 days from the date of the recommendation from the Association Technical Meeting, unless this period is extended by the Council (see 4.8 of Regs). For documents forwarded directly to the Standards Council, the Council acts on the issuance of the document at its next scheduled meeting, or at such other meeting as the Council may determine (see 4.5.6 and 4.8 of Regs).

IX. Petitions to the Board of Directors. The Standards Council has been delegated the responsibility for the administration of the codes and standards development process and the issuance of documents. However, where extraordinary circumstances requiring the intervention of the Board of Directors exist, the Board of Directors may take any action necessary to fulfill its obligations to preserve the integrity of the codes and standards development process and to protect the interests of the Association. The rules for petitioning the Board of Directors can be found in the Regulations Governing Petitions to the Board of Directors from Decisions of the Standards Council and in 1.7 of the Regs.

X. For More Information. The program for the Association Technical Meeting (as well as the NFPA website as information becomes available) should be consulted for the date on which each report scheduled for consideration at the meeting will be presented. For copies of the ROP and ROC as well as more information on NFPA rules and for up-to-date information on schedules and deadlines for processing NFPA documents, check the NFPA website (www.nfpa.org) or contact NFPA Codes & Standards Administration at (617) 984-7246.
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<th>NFPA No.</th>
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<td>P</td>
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**TYPES OF ACTION**

- **P** Partial Revision
- **N** New Document
- **R** Reconfirmation
- **W** Withdrawal
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COMMITTEE MEMBER CLASSIFICATIONS

The following classifications apply to Committee members and represent their principal interest in the activity of the Committee.

1. M Manufacturer: A representative of a maker or marketer of a product, assembly, or system, or portion thereof, that is affected by the standard.

2. U User: A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.

3. IM Installer/Maintainer: A representative of an entity that is in the business of installing or maintaining a product, assembly, or system affected by the standard.

4. L Labor: A labor representative or employee concerned with safety in the workplace.

5. RT Applied Research/Testing Laboratory: A representative of an independent testing laboratory or independent applied research organization that promulgates and/or enforces standards.

6. E Enforcing Authority: A representative of an agency or an organization that promulgates and/or enforces standards.

7. I Insurance: A representative of an insurance company, broker, agent, bureau, or inspection agency.

8. C Consumer: A person who is or represents the ultimate purchaser of a product, system, or service affected by the standard, but who is not included in (2).

9. SE Special Expert: A person not representing (1) through (8) and who has special expertise in the scope of the standard or portion thereof.

NOTE 1: “Standard” connotes code, standard, recommended practice, or guide.

NOTE 2: A representative includes an employee.

NOTE 3: While these classifications will be used by the Standards Council to achieve a balance for Technical Committees, the Standards Council may determine that new classifications of member or unique interests need representation in order to foster the best possible Committee deliberations on any project. In this connection, the Standards Council may make such appointments as it deems appropriate in the public interest, such as the classification of “Utilities” in the National Electrical Code Committee.

NOTE 4: Representatives of subsidiaries of any group are generally considered to have the same classification as the parent organization.
A properly installed and maintained system should be free of ground faults. The occurrence of one or more ground faults should be required to cause a ‘trouble’ signal because it indicates a condition that could contribute to future malfunction of the system. Ground fault protection has been widely available on these systems for years and its cost is negligible. Requiring it on all systems will promote better installations, maintenance and reliability.

6. Copyright Assignment

(a) ☒ I am the author of the text or other material (such as illustrations, graphs) proposed in the Comment.

(b) ☐ Some or all of the text or other material proposed in this Comment was not authored by me. Its source is as follows: (please identify which material and provide complete information on its source)

I hereby grant and assign to the NFPA all and full rights in copyright in this Comment and understand that I acquire no rights in any publication of NFPA in which this Comment in this or another similar or analogous form is used. Except to the extent that I do not have authority to make an assignment in materials that I have identified in (b) above, I hereby warrant that I am the author of this Comment and that I have full power and authority to enter into this assignment.

Signature (Required)

---

PLEASE USE SEPARATE FORM FOR EACH COMMENT

Mail to: Secretary, Standards Council · National Fire Protection Association
1 Batterymarch Park · Quincy, MA 02169-7471 OR
Fax to: (617) 770-3500 OR Email to: proposals_comments@nfpa.org
FORM FOR COMMENT ON NFPA REPORT ON PROPOSALS
2013 Annual Revision CYCLE
FINAL DATE FOR RECEIPT OF COMMENTS: 5:00 pm EDT, August 31, 2012

Please indicate in which format you wish to receive your ROP/ROC [ ] electronic [ ] paper [ ] download
(Note: If choosing the download option, you must view the ROP/ROC from our website; no copy will be sent to you.)

Date .................................. Name .................................. Tel. No. ..................................
Company .................................. Email ..................................
Street Address .................................. City ..................................
State .................................. Zip ..................................

***If you wish to receive a hard copy, a street address MUST be provided. Deliveries cannot be made to PO boxes.

Please indicate organization represented (if any) ..................................

1. (a) NFPA Document Title .................................. NFPA No. & Year ..................................
    (b) Section/Paragraph ..................................

2. Comment on Proposal No. (from ROP): ..................................

3. Comment Recommends (check one): [ ] new text [x] revised text [ ] deleted text

4. Comment (include proposed new or revised wording, or identification of wording to be deleted): [Note: Proposed text should be in legislative format; i.e., use underscore to denote wording to be inserted (inserted wording) and strike-through to denote wording to be deleted (deleted wording).]

5. Statement of Problem and Substantiation for Comment: (Note: State the problem that would be resolved by your recommendation; give the specific reason for your Comment, including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication.)

6. Copyright Assignment
   (a) [ ] I am the author of the text or other material (such as illustrations, graphs) proposed in the Comment.
   (b) [ ] Some or all of the text or other material proposed in this Comment was not authored by me. Its source is as follows: (please identify which material and provide complete information on its source)

I hereby grant and assign to the NFPA all and full rights in copyright in this Comment and understand that I acquire no rights in any publication of NFPA in which this Comment in this or another similar or analogous form is used. Except to the extent that I do not have authority to make an assignment in materials that I have identified in (b) above, I hereby warrant that I am the author of this Comment and that I have full power and authority to enter into this assignment.

Signature (Required) ..................................

PLEASE USE SEPARATE FORM FOR EACH COMMENT

Mail to: Secretary, Standards Council · National Fire Protection Association
1 Batterymarch Park · Quincy, MA 02169-7471 OR
Fax to: (617) 770-3500 OR Email to: proposals_comments@nfpa.org

5/15/2012
Sequence of Events Leading to Issuance of an NFPA Committee Document

Step 1  Call for Proposals

▼ Proposed new document or new edition of an existing document is entered into one of two yearly revision cycles, and a Call for Proposals is published.

Step 2  Report on Proposals (ROP)

▼ Committee meets to act on Proposals, to develop its own Proposals, and to prepare its Report.

▼ Committee votes by written ballot on Proposals. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.

▼ Report on Proposals (ROP) is published for public review and comment.

Step 3  Report on Comments (ROC)

▼ Committee meets to act on Public Comments to develop its own Comments, and to prepare its report.

▼ Committee votes by written ballot on Comments. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.

▼ Report on Comments (ROC) is published for public review.

Step 4  Association Technical Meeting

▼ “Notices of intent to make a motion” are filed, are reviewed, and valid motions are certified for presentation at the Association Technical Meeting. (“Consent Documents” that have no certified motions bypass the Association Technical Meeting and proceed to the Standards Council for issuance.)

▼ NFPA membership meets each June at the Association Technical Meeting and acts on Technical Committee Reports (ROP and ROC) for documents with “certified amending motions.”

▼ Committee(s) vote on any amendments to Report approved at NFPA Annual Membership Meeting.

Step 5  Standards Council Issuance

▼ Notification of intent to file an appeal to the Standards Council on Association action must be filed within 20 days of the NFPA Annual Membership Meeting.

▼ Standards Council decides, based on all evidence, whether or not to issue document or to take other action, including hearing any appeals.
The Association Technical Meeting

The process of public input and review does not end with the publication of the ROP and ROC. Following the completion of the Proposal and Comment periods, there is yet a further opportunity for debate and discussion through the Association Technical Meeting that takes place at the NFPA Annual Meeting.

The Association Technical Meeting provides an opportunity for the final Technical Committee Report (i.e., the ROP and ROC) on each proposed new or revised code or standard to be presented to the NFPA membership for the debate and consideration of motions to amend the Report. The specific rules for the types of motions that can be made and who can make them are set forth in NFPA’s rules, which should always be consulted by those wishing to bring an issue before the membership at an Association Technical Meeting. The following presents some of the main features of how a Report is handled.

The Filing of a Notice of Intent to Make a Motion. Before making an allowable motion at an Association Technical Meeting, the intended maker of the motion must file, in advance of the session, and within the published deadline, a Notice of Intent to Make a Motion. A Motions Committee appointed by the Standards Council then reviews all notices and certifies all amending motions that are proper. The Motions Committee can also, in consultation with the makers of the motions, clarify the intent of the motions and, in certain circumstances, combine motions that are dependent on each other together so that they can be made in one single motion. A Motions Committee report is then made available in advance of the meeting listing all certified motions. Only these Certified Amending Motions, together with certain allowable Follow-Up Motions (that is, motions that have become necessary as a result of previous successful amending motions) will be allowed at the Association Technical Meeting.

Consent Documents. Often there are codes and standards up for consideration by the membership that will be noncontroversial and no proper Notices of Intent to Make a Motion will be filed. These “Consent Documents” will bypass the Association Technical Meeting and head straight to the Standards Council for issuance. The remaining documents are then forwarded to the Association Technical Meeting for consideration of the NFPA membership.

What Amending Motions Are Allowed. The Technical Committee Reports contain many Proposals and Comments that the Technical Committee has rejected or revised in whole or in part. Actions of the Technical Committee published in the ROP may also eventually be rejected or revised by the Technical Committee during the development of its ROC. The motions allowed by NFPA rules provide the opportunity to propose amendments to the text of a proposed code or standard based on these published Proposals, Comments, and Committee actions. Thus, the list of allowable motions include motions to accept Proposals and Comments in whole or in part as submitted or as modified by a Technical Committee action. Motions are also available to reject an accepted Comment in whole or part. In addition, Motions can be made to return an entire Technical Committee Report or a portion of the Report to the Technical Committee for further study.

The NFPA Annual Meeting, also known as the NFPA Conference & Expo, takes place in June of each year. A second Fall membership meeting was discontinued in 2004, so the NFPA Technical Committee Report Session now runs once each year at the Annual Meeting in June.

Who Can Make Amending Motions. NFPA rules also define those authorized to make amending motions. In many cases, the maker of the motion is limited by NFPA rules to the original submitter of the Proposal or Comment or his or her duly authorized representative. In other cases, such as a Motion to Reject an accepted Comment, or to Return a Technical Committee Report or a portion of a Technical Committee Report for Further Study, anyone can make these motions. For a complete explanation, the NFPA Regs should be consulted.
**Action on Motions at the Association Technical Meeting.** In order to actually make a Certified Amending Motion at the Association Technical Meeting, the maker of the motion must sign in at least an hour before the session begins. In this way a final list of motions can be set in advance of the session. At the session, each proposed document up for consideration is presented by a motion to adopt the Technical Committee Report on the document. Following each such motion, the presiding officer in charge of the session opens the floor to motions on the document from the final list of Certified Amending Motions followed by any permissible Follow-Up Motions. Debate and voting on each motion proceeds in accordance with NFPA rules. NFPA membership is not required in order to make or speak to a motion, but voting is limited to NFPA members who have joined at least 180 days prior to the Association Technical Meeting and have registered for the meeting. At the close of debate on each motion, voting takes place, and the motion requires a majority vote to carry. In order to amend a Technical Committee Report, successful amending motions must be confirmed by the responsible Technical Committee, which conducts a written ballot on all successful amending motions following the meeting and prior to the document being forwarded to the Standards Council for issuance.

**Standards Council Issuance**

One of the primary responsibilities of the NFPA Standards Council, as the overseer of the NFPA codes and standards development process, is to act as the official issuer of all NFPA codes and standards. When it convenes to issue NFPA documents, it also hears any appeals related to the document. Appeals are an important part of assuring that all NFPA rules have been followed and that due process and fairness have been upheld throughout the codes and standards development process. The Council considers appeals both in writing and through the conduct of hearings at which all interested parties can participate. It decides appeals based on the entire record of the process as well as all submissions on the appeal. After deciding all appeals related to a document before it, the Council, if appropriate, proceeds to issue the document as an official NFPA code or standard. Subject only to limited review by the NFPA Board of Directors, the decision of the Standards Council is final, and the new NFPA code or standard becomes effective twenty days after Standards Council issuance.
Report on Proposals A2013 — Copyright, NFPA

Report of the Committee on
Lightning Protection

John M. Tobias, Chair
US Department of the Army, MD [U]

Christopher Batchelor, US Department of the Navy, MD [E]
Gerard M. Berger, CNRS - Supelec, France [SE]
Matthew Caie, ERICO, Inc., OH [M]
Joanie A. Campbell, US Department of the Air Force, FL [E]
Josephine Covino, US Department of Defense, VA [E]
Ignacio T. Cruz, Cruz Associates, Inc., VA [SE]
Robert F. Daley, Los Alamos National Laboratory, NM [U]
Joseph P. DeGregoria, Underwriters Laboratories Inc., NY [RT]
Douglas J. Franklin, Thompson Lightning Protection Inc., MN [M]
Mitchell Guthrie, Consulting Engineer, NC [SE]
Thomas R. Harger, Harger Lightning Protection Inc., IL [M]
William E. Heary, Heary Brothers Lightning Protection, NY [IM]
Paul Jacques, Nuclear Service Organization, DE [I]
Carl S. Johnson II, AVCON, Inc., FL [U]
Bruce A. Kaiser, Lightning Master Corporation, FL [M]
Eduardo Mariani, CIMA Ingenieria S.R.L, Argentina [SE]
David E. McAfee, Fire and Lightning Consultants, TN [SE]
Robley B. Melton, Jr., CSI Telecommunications, GA [U]
Rep. Alliance for Telecommunications Industry Solutions
Victor Minak, ExxonMobil Research & Engineering Company, VA [U]
Rep. American Petroleum Institute
Mark P. Morgan, East Coast Lightning Equipment, Inc., CT [M]
Christine T. Porter, Intertek Testing Services, WA [RT]
Terrance K. Portfleet, Michigan Lightning Protection Inc., MI [IM]
Robert W. Rapp, National Lightning Protection Corporation, CO [M]
Lon D. Santis, Institute of Makers of Explosives, DC [U]
Russell Stubbs, Qwest Communications, CO [U]
Harold VanSickle, III, Lightning Protection Institute, MO [IM]

Alternates

Charles H. Ackerman, East Coast Lightning Equipment Inc., CT [M]
(Alt. to Mark P. Morgan)
Richard W. Bouchar, Underwriters Laboratories Inc., CO [RT]
(Alt. to Joseph P. DeGregoria)
Peter A. Carpenter, Lightning Eliminators & Consultants Inc., CO [M]
(Alt. to Luke Pettross)

Dennis P. Dillon, Bonded Lighting Protection, Inc., FL [IM]
(Alt. to Harold VanSickle, III)
Mark S. Harger, Harger Lightning & Grounding, IL [M]
(Alt. to Thomas R. Harger)
Kenneth P. Heary, Heary Brothers Lightning Protection, NY [IM]
(Alt. to William E. Heary)
Stephen Humeriuk, Warren Lightning Rod Company, NJ [IM]
(Alt. to Terrance K. Portfleet)
Morris Kline, HMT Inc. TX [U]
(Alt. to Victor Munak)
(supplemental ballot only)
David John Leidel, Halliburton Energy Services, TX [U]
(Alt. to Lon D. Santis)
Allan P. Steffes, Thompson Lightning Protection Inc., MN [M]
(Alt. to Douglas J. Franklin)
Paul R. Svendsen, National Lightning Protection Corporation, CO [M]
(Alt. to Robert W. Rapp)

Staff Liaison: Richard J. Roux

Committee Scope: This Committee shall have primary responsibility for documents on the protection from lightning of buildings and structures, recreation and sports areas, and any other situations involving danger from lightning to people or property, except those concepts utilizing early streamer emission air terminals. The protection of electric generating, transmission, and distribution systems is not within the scope of this Committee.

This list represents the membership at the time the Committee was balloted on the text of this report. Since that time, changes in the membership may have occurred. A key to classifications is found at the front of the document.

This Report was prepared by the Technical Committee on Lightning Protection and proposes for adoption amendments to NFPA 780, Standard for the Installation of Lightning Protection Systems, 2011 edition. NFPA 780-2011 is published in Volume 11 of the 2012 National Fire Codes and in separate pamphlet form.

This Report has been submitted to letter ballot of the Technical Committee on Lightning Protection, which consists of 28 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.
Committee Statement: The Technical Committee accepts the submitter’s text and changes Chapter X to 12.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 27 Negative: 1

Explanation of Negative: PETTROSS, L.: I think that if Proposal 780-4a (CP11) does not sufficiently meet the intent of #4 it is better to introduce a line similar to that in #4 to the list. Based on the structure of the writing, 1.1.1 should contain the entire scope stated positively. 1.1.2 and on are all exceptions which are stated negatively. Upon reading 1.1.1 the reader should know everything that the standard addresses.

780-6 Log #37 Final Action: Accept in Principle (2.3.1)

Submitted: John F. Bender, Underwriters Laboratories Inc.

Recommendation: Revise text to read as follows:

2.3.1 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.


Committee Meeting Action: Accept in Principle

Recommendation: Revise text to read as follows:

2.3.1 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.


Committee Statement: The Technical Committee retains the document date (by year) but not the revision date.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

870-5 Log #51 Final Action: Accept in Principle (3.3.21 ISO Container (New))

Submitted: Josephine Covino, DoD Explosives Safety Board

Recommendation: Add the following definition; renumber the remainder of the section accordingly.

3.3.21 ISO container. A steel container that provides a protective shield against lightning threats.


Introduction Above is a proposed addition to the subject document that defines US Department of Defense (DoD) guidelines for storage of ammunition and explosives (AE) in steel ISO containers. In particular it delineates two storage categories: one list of AE categories that can be safely stored in a steel ISO container without the need for any LPS installed; the second list is those AE categories that must be stored in an ISO container that has NFPA-compliant LPS installed.

Discussion:

A detailed study of the electromagnetic effects of lightning strikes on steel ISO containers has been performed. The study includes a mathematical analysis of direct and indirect lightning effects, and corroborative electromagnetic transfer impedance testing. Aside from the potential of burn-through due to a direct strike attachment, the report and subsequent private communications between the authors, Dr. John Tobias and Mr. Mitchell Guthrie conclude that the ISO will provide adequate electromagnetic shielding to its contents. Risk levels to the stored AE are equal to or less than that of other authorized storage structures, with the exception of burn-through.

The two AE categories delineated below are:

1. AE that are not adversely affected by burn-through effects (no LPS required) and,

2. AE that could be adversely affected by burn-through (LPS required).

Based on the study and the categorization presented, the DoD Explosives Safety Board recommends that these guidelines be added to NFPA 780, specifically for -- and only applicable to -- DoD AE storage in steel ISO Containers.

The theoretical calculations and electromagnetic measurements of a typical steel ISO container indicate that it will provide adequate protection for most
AE against all lightning threats without the application of any external lightning protection means. The level of protection provided by an ISO container against all lightning threats is consistent with all other DoD-approved lightning protected structures that contain AE with the exception of a small possibility of burn-through.

Proposed Addition to NFPA 780:
This assumes that the container is in good condition, all welds and joints are sound, and that any damage has been repaired per MIL HDN-138B.

DoD steel ISO containers can be used to safely store the following AE items, with a minimum Safe Separation Distance of 0.6 inch, without the need for any external LPS:
1. Small arms in ammo boxes.
2. All-up weapon systems in shipping containers.
3. Warheads in rocket motors in shipping containers.
4. Metal cased or overpacked bombs and AE.
5. Detonators and explosive actuators in metallic overpacks.

The following AE items must be stored in steel ISO containers that are protected with an external LPS:
1. Bulk explosive ordnance or projectiles in non-conductive boxes or drums.
2. Rocket motors which have non-metallic cases.
3. Non-metal cased or overpacked cartridges and ammunition.
4. Items shipped with open detonators or explosive actuators.

For personnel safety, a single earth electrode (e.g., a grounding rod) can be installed at or near the door of the container and bonded to it. If any electrical power, communications and/or signal wiring, metallic pipes and/or ducting are installed on an ISO container, LPS as specified in DoD 6055.09-STD and NFPA-780 must be installed, with surge protection as necessary.

Committee Meeting Action: Accept in Principle
Add the following definition to read as follows:

3.3.21 ISO Container. Intermodal container designed to transport freight by ship, truck or rail built in accordance with ISO 1496.
Renumber subsequent sections.
Add new 2.3.1.1 to read as follows:
2.3.1 ISO Standards. International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland
Renumber subsequent sections.
Committee Statement: The Technical Committee revises the submitter’s definition for an ISO container and adds the ISO document reference to Chapter 2 to comply with the Manual of Style.
The Technical Committee does not necessarily agree with the submitter’s substantiation.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28
Explanation of Negative: 1
BATCHelor, C.: The working group had proposed doing some additional research that did not occur. The guidance provided needs more work before release.

780-8 Log #80 Final Action: Accept in Principle (3.3.29 Strike Termination Device)
Submitter: Mitchell Guthrie, Engineering Consultant
Recommendation: Revise 3.3.29 as follows:
3.3.29 Strike Termination Device. A component of a lightning protection system that is interconnected to lightning protection system using main conductors for the purpose of intercepting lightning flashes and providing a connection connects them to a path to ground. Strike termination devices include air terminals, metal masts, permanent metal parts of structures as described in Section 4.6.1.4, and overhead ground wires installed in catenary lightning protection systems.
Substantiation: The reference to Section 4.9 for a description of permanent metal parts of structures that may be used as strike termination devices is incorrect. Section 4.9 covers conductors. The only clause found that provides such description is 4.6.1.4. It is also suggested that the first sentence be modified to reflect the intent of the device. As written it is technically correct but does not reflect the intent of the use of the term in the document. For example, a down conductor, roof conductor, fastener, connector, bonding cable, etc. would be “strike termination device” if they happen be struck to a bypass of the devices installed for the purpose of intercepting the flash.
Committee Meeting Action: Accept in Principle
Revise 3.3.29 to read as follows:
A conductor component of the lightning protection system capable of receiving a lightning strike and providing a connection to a path to ground. Strike termination devices include air terminals, metal masts, permanent metal parts of structures as described in Section 4.6.1.4, and overhead ground wires installed in catenary lightning protection systems.
Committee Statement: The Technical Committee accepts the submitter’s text and edits for clarity.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-9 Log #43 Final Action: Reject (3.3.29 Strike Termination Device and A.3.3.29 (New))
Submitter: Marcelo M. Hirschler, GBH International
Recommendation: Revise text to read as follows:
3.3.29 Strike Termination Device. A component of a lightning protection system that intercepts lightning flashes and connects them to a path to ground. Strike termination devices include air terminals, metal masts, permanent metal parts of structures as described in Section 4.9, and overhead ground wires installed in catenary lightning protection systems.
A.3.3.29 Strike termination devices include air terminals, metal masts, permanent metal parts of structures as described in Section 4.9, and overhead ground wires installed in catenary lightning protection systems.
Substantiation: The NFPA Manual of Style requires definitions to be in single sentences and not to contain requirements. The additional sentence of this definition contains information that should be placed in an annex or elsewhere in the standard.
Committee Meeting Action: Reject
Committee Statement: The Technical Committee does not accept the submitter’s substantiation that a definition need be in a single sentence. The Technical Committee refers the submitter to the Manual of Style, Section 2.3.2.2.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-10 Log #44 Final Action: Accept in Part (3.3.37 Voltage Protection Rating (VPR) and A.3.3.37)
Submitter: Marcelo M. Hirschler, GBH International
Recommendation: Revise text to read as follows:
3.3.37 Voltage Protection Rating (VPR). A rating (or ratings) selected by the manufacturer based on the measured limiting voltage determined when the SPD is subjected to a combination waveform with an open circuit voltage of 6 kV and a short-circuit current of 3 kA. The value is rounded up to the next highest 100 V level.
A.3.3.37 Voltage Protection Rating (VPR). The VPR is a rating (or ratings) selected by the manufacturer based on the measured limiting voltage determined during the transient voltage surge suppression test specified in ANSI/UL1449, UL Standard for Safety for Surge Protective Devices. This rating is the maximum voltage developed when the SPD is exposed to a 3 kA, 8/20 μs current limited waveform through the device. It is a specific measured limiting voltage rating assigned to an SPD by testing done in accordance with UL 1449, Edition 3. Nominal VPR values include 330 V, 400 V, 500 V, 600 V, 700 V, and so forth. The value is rounded up to the next highest 100 V level.
Substantiation: The NFPA Manual of Style requires definitions to be in single sentences and not to contain requirements. The additional sentence of this definition contains information that should be placed in an annex or elsewhere in the standard.
Committee Meeting Action: Accept in Part
Committee Statement: The Technical Committee accepts deletion of the last sentence in Section 3.3.37.
The Technical Committee does not accept relocation of the last sentence in Section 3.3.37 to Section A.3.3.37.
The Technical Committee does not agree with the submitter’s substantiation that a definition must be in a single sentence. The Technical Committee refers the submitter to the NFPA Manual of Style, Section 2.3.2.2.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28
Explanation of Negative: HEARY, W.: This topic belongs in the National Electrical Code.

780-11 Log #79 Final Action: Accept in Principle (Chapter 4, Title)
Submitter: Mitchell Guthrie, Engineering Consultant
Recommendation: (1) Revise the title of Chapter 4 as follows:
Chapter 4 Protection for Ordinary Structures
(2) This change will also require the following modifications be made to the remainder of the chapter to remove references to “ordinary structures:”
4.1.1 Ordinary Structures. An ordinary structure shall be any structure that is used for ordinary purposes, whether commercial, industrial, farm, institutional, or recreational. This chapter provides general requirements for the protection of structures against lightning.
4.1.1.1 Ordinary structures shall be protected according to 4.1.1.1.1 or 4.1.1.1.2.
4.1.1.1.1 Ordinary structures not exceeding 23 m (75 ft) in height shall be protected with Class I materials as shown in Table 4.1.1.1.1.
4.1.1.1.2 Ordinary structures exceeding 23 m (75 ft) in height shall be protected with Class II materials as shown in Table 4.1.1.1.2.
A.3.3.22 Lightning Protection System. The term refers to systems as described and detailed in this standard. A traditional lightning protection system used for ordinary structures is described in Chapter 4. Mast and catenary-type systems
Ballot Results: 780-13 Log #CP8 Final Action: Accept
(4.1.1.1.1 and Table 4.1.1.1.2)

Submitter: Technical Committee on Lightning Protection,
Recommendation: Revise Table 4.1.1.1.1 to add the following values under the Copper column for SI to read as follows:
9.5 mm, 15.9 mm, 0.8 mm, 1.04 mm², 278 g/m², 29 mm², 1.04 mm², 13.3 mm², 1.30 mm, 12.7 mm, 130 mm, 29 mm²
Revise Table 4.1.1.1.1 to add the following values under the Aluminum column for SI to read as follows:
12.7 mm, 15.9 mm, 1.63 mm, 2.08 mm², 141 g/m, 50 mm², 2.08 mm², 20.8 mm², 1.63 mm, 12.7 mm, 1.63 mm, 50 mm²
Revise Table 4.1.1.1.2 to add the following values under the Steel column for SI to read as follows:
12.7 mm, 1.05 mm², 558 g/m, 58 mm², 1.04 mm², 13.2 mm, 1.30 mm, 12.7 mm, 1.63 mm, 58 mm²
Revise Table 4.1.1.1.2 to add the following values under the Aluminum column for SI to read as follows:
15.9 mm, 2.62 mm², 283 g/m, 97 mm², 2.08 mm², 20.8 mm², 1.63 mm, 12.7 mm, 2.61 mm, 97 mm²
Substantiation: The TC edits Table 4.1.1.1.1 and Table 4.1.1.1.2 for consistency within the document.
Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-14 Log #67 Final Action: Accept in Principle
(4.1.2)

Submitter: Thomas R. Harger, Harger Lightning Protection Inc.
Recommendation: Move sections 4.1.2.1, 4.1.2.2, 4.1.2.3, and 4.1.2.4 to new sections 4.7.2.1, 4.7.2.2, 4.7.2.3, 4.7.2.4 respectively. Move figure 4.1.2.3 to 4.7.2.3 and rename.
Substantiation: Section 4.1.2 deals with roof slopes and types and is currently removed from the requirements for location of strike termination devices on pitched roofs. Relocation of this text will serve to clarify the standard and its application.
Committee Meeting Action: Accept in Principle
Delete 4.1.2
Move sections 4.1.2.1, 4.1.2.2, 4.1.2.3, and 4.1.2.4 to new sections 4.7.2.1, 4.7.2.2, 4.7.2.3, 4.7.2.4 respectively. Move figure 4.1.2.3 to 4.7.2.3 and rename.
Renumber remaining sections.
Committee Statement: The Technical Committee accepts the submitter’s text and includes 4.1.2. Figure 4.1.2.3 is renumbered but not renamed as requested by the submitter.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:
HEARY, W.: This topic belongs in the National Electrical Code.

780-15 Log #91 Final Action: Accept in Part
(Figure 4.1.2.3)

Recommendation: Add metric values to entire diagram. Change caption: 1 ft. = 0.305 m
Substantiation: Change is need to maintain consistency throughout the document as per the Manual of Style Section 4.1.2.
Committee Meeting Action: Accept in Part
Committee Statement: The Technical Committee does not accept the submitter’s recommendation to add metric values in Figure 4.1.2.3. The Technical Committee refers the submitter to the Manual of Style, Section 3.7.1.5.2.1.
The Technical Committee accepts changing the caption: 1 ft = 0.3 m.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:
HEARY, W.: This topic belongs in the National Electrical Code.
780-16 Log #68 Final Action: Accept

4.1.2.4 Protection for a shed roof shall be as illustrated for the gable method; typical roof types shall be as illustrated in Figure 4.1.2.4.

Revise figure 4.1.2.4 as follows:

Figure 4.1.2.4 Protection Measures for Various Roof Types

- : Air terminal
- : Conductor
† : Ground electrode

Substantiation: Roof types and requirements shown in figure 4.1.2.4 are not currently referenced in text. Also shed roof type should be included in figure. Current text references “gable method” which is not defined in the document.

Committee Meeting Action: Accept

Number Eligible to Vote: 28

Ballot Results: Affirmative: 27 Negative: 1

Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

780-17 Log #69 Final Action: Accept

4.1.2.5 (New) Roof Hips shall not be considered as ridges for the protection of these types of roofs.

Substantiation: Added text clarifies that strike termination devices are not required on roof hips when strike termination devices are properly located on the ridges.

Committee Meeting Action: Accept

Number Eligible to Vote: 28

Ballot Results: Affirmative: 26 Negative: 2

Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

780-18 Log #127 Final Action: Accept

4.6.1.4 A fixed metal object that has moveable metal components shall be allowed to be used as a strike termination device under the following conditions.

(1) The highest surface is greater than 4.8 mm (3/16 in.) thick in accordance with Section 4.6.1.4

(2) The fixed portion is attached to the lightning protection system in accordance with Section 4.9

(3) The point of articulation between the fixed portion and the moveable portion is constructed entirely of metal.

(4) All other portions of the device are electrically continuous.

Substantiation: There are many metallic objects on structures that are subject to direct strike, but cannot be protected since they are designed to move. Bonding of the moveable portion would impede or eliminate the devices intended function (such as a jib crane or a wind sock). If the point of articulation is all metal, there is a reasonable possibility that the surface contact between the components may be sufficient to carry the charge. If it isn’t, the probability is that arcing would take place at the joint and fusing of the component parts would be the extent of the damage. Similar exceptions are made for antennae.

Committee Meeting Action: Reject

Committee Statement: The submitter’s text does not fit the criteria for a strike termination device.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 27 Negative: 1

Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.
Recommendation: Modify existing text for clarity 4.6.2.2.2 Air terminals exceeding 600 mm (24 in.) in height length beyond the highest point of their mounting base shall be supported at a point not less than one-half their height as shown in figure 4.6.2.2.2.

Substantiation: Clarifies the intent of the Section.

Committee Meeting Action: Accept in Principle

Change the dimensions on Figure 4.6.2.2.2 to match

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Air Terminal Support Image

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Committee Statement: The Technical Committee notes the submitter’s intent to change the dimensions on Figure 4.6.2.2.2.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 27 Negative: 1

Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

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Submitter: Thomas R. Harger, Harger Lightning Protection Inc.

Recommendation: Move requirements in section “4.8 Strike Termination Devices on Roofs” to before section “4.7 Zones of Protection” and renumber sections accordingly. This will result in section “4.7 Strike Termination Devices on Roofs” followed by section “4.8 Zones of Protection”

Substantiation: Relocation of these sections will place requirements for locating strike termination devices immediately following requirements for strike terminations. Zone of Protection requirements then follow. The intent is to clarify requirements and application of the standard. Requirements of where strike terminals are required follow by requirements that allow for omissions of devices. Currently these requirements are intermingled causing confusion and misapplication of the standard.

Committee Meeting Action: Accept in Principle

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Submitter: Mitchell Guthrie, Engineering Consultant

Recommendation: Revise the characterization of factor “n” as follows: $n = 1.5$ where there is a single overhead wire, one or more than one wire interconnected above the structure to be protected, such that only two down conductors are located spaced greater than 7.6 m (25 ft) and less than 30 m (100 ft) apart

$n = 2.25$ where there are more than two down conductors spaced more than 7.6 m (25 ft) apart within a 30 m (100 ft) wide area that are interconnected above the structure being protected

Substantiation: To correct a 20 year old typographical error in the spacing of down conductors in the determination of $n = 1.5$, eliminate confusion as to the value of $n$ for overhead wires between 100 and 200 feet horizontal distance, and provide a greater correlation between these requirements and the bonding calculations of 4.21.

Committee Meeting Action: Accept

Number Eligible to Vote: 28

Ballot Results: Affirmative: 27 Negative: 1

Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.
(5) Roofs with ridges, Wells, chimneys, or vents

Revise 4.7.3 to read as follows:

4.8.3 Multiple-Level Roofs

Revise 4.8.3.1 to read as follows:

For structures with multiple-level roofs no more than 15 m (50 ft) in height, the zone of protection shall include areas as identified in 4.8.3.3 and 4.8.3.4.

Revise 4.7.3.2 to read as follows:

4.8.3.2 The zone of protection shall be permitted to be delineated by a cone with the apex located at the highest point of the strike termination device, with its surface formed by a 45-degree or 63-degree angle from the vertical, based on the height of the strike termination device above the ground as defined in 4.8.3.3 and 4.8.3.4.

Revise 4.7.3.3 to read as follows:

4.8.3.3 Structures that do not exceed 7.6 m (25 ft) above earth shall be considered to protect lower portions of a structure located within a one-to-two zone of protection as shown in Figure 4.8.3.3(a) and Figure 4.8.3.3(b).

Revise 4.7.3.4 to read as follows:

4.8.3.4 Structures that do not exceed 15 m (50 ft) above earth shall be considered to protect lower portions of a structure located within a one-to-one zone of protection as shown in Figure 4.8.3.4(a) and Figure 4.8.3.4(b).

Revise 4.7.4 to read as follows:

4.8.4 Rolling Sphere Method.

Revise 4.8.4.1 to read as follows:

4.8.4.1 The zone of protection shall include the space not intruded by a rolling sphere having a radius of the striking distance determined for the type of structure being protected, as shown in Figure 4.8.4.1.

Revise 4.7.4.1.1 to read as follows:

4.8.4.1.1 Where the sphere is tangent to earth and resting against a strike termination device, all space in the vertical plane between the two points of contact and under the sphere shall be considered to be in the zone of protection.

Revise 4.7.4.1.2 to read as follows:

4.8.4.1.2 A zone of protection shall also be formed where such a sphere is resting on two or more strike termination devices and shall include the space in the vertical plane under the sphere and between those devices, as shown in Figure 4.8.4.1.

Revise 4.7.4.1.3 to read as follows:

4.8.4.1.3 All possible placements of the sphere shall be considered when determining the zone of protection using the rolling sphere method.

Revise 4.7.4.1.4 to read as follows:

4.8.4.1.4 The striking distance of an ordinary structure shall not exceed 46 m (150 ft).

Revise 4.7.4.2 to read as follows:

4.8.4.2 For structure heights exceeding the striking distance above earth or above a lower strike termination device, the zone of protection shall be the space in the vertical plane between the points of contact, and also under the sphere where the sphere is resting against a vertical surface of the structure and the space in the vertical plane between the points of contact.

Revise 4.7.4.3 to read as follows:

4.8.4.3 Under the rolling sphere method, the horizontal protected distance found geometrically by Figure A.4.8.4.1 also shall be permitted to be calculated using the following formula (units shall be consistent, m or ft):

Add formula here:

Revise 4.7.4.3.1 to read as follows:

4.8.4.3.1 For the formula to be valid, the sphere shall be either tangent to the lower roof or in contact with the earth, and in contact with the vertical side of the higher portion of the structure.

Revise 4.7.4.3.2 to read as follows:

4.8.4.3.2 In addition, the difference in heights between the upper and lower roofs or earth shall be the striking distance or less.

Revise 4.8 to read as follows:

4.7 Strike Termination Devices on Roofs

Revise 4.8.1 to read as follows:

4.7.1* Location of Devices. As shown in Figure 4.7.1, the distance between strike termination devices and ridge ends on pitched roofs, or edges and outside corners of flat or gently sloping roofs, shall not exceed 0.6 m (2 ft).

Revise 4.8.1.11 to read as follows:

4.7.1.11 Strike termination devices shall be placed on ridges of pitched roofs, and around the perimeter of flat or gently sloping roofs, at intervals not exceeding 6 m (20 ft).

Revise 4.8.1.2 to read as follows:

4.7.1.2 Strike termination devices 0.6 m (2 ft) or more above the object or area to be protected shall be permitted to be placed at intervals not exceeding 7.6 m (25 ft).

Revise 4.8.2 to read as follows:

4.7.2 Pitched Roof Area. For a pitched roof with eave heights over 15 m (50 ft) but less than 46 m (150 ft) above grade, it shall be permitted to omit strike termination devices at the eaves if the slope of that roof is equal to or steeper than the tangent of the arc at the eave elevation of a rolling sphere having a 46 m (150 ft) radius. (See Figure 4.7.2.)

Revise 4.8.2.1 to read as follows:

4.7.2.1 Except for the portions of the building that extends beyond that tangent shall be protected.

Revise 4.8.2.2 to read as follows:

4.7.2.2 Eaves over 46 m (150 ft) above grade shall be protected in accordance with 4.7.1.

Revise 4.8.2.3 to read as follows:

4.7.2.3 The tangent of the rolling sphere arc shall be considered a vertical line over 46 m (150 ft) above grade, except as permitted by 4.8.3.4.

Revise 4.8.3 to read as follows:

4.7.3 Flat or Gently Sloping Roof Area. Flat or gently sloping roofs that exceed 15 m (50 ft) in width or length shall have additional strike termination devices located at intervals not to exceed 15 m (50 ft) on the flat or gently sloping areas, as shown in Figure 4.7.3(a) and Figure 4.7.3(b), or such area can also be protected using taller strike termination devices that create zones of protection using the rolling sphere method so the sphere does not contact the flat or gently sloping roof area.

Revise 4.8.4 to read as follows:

4.7.4* Dormers.

Revise 4.8.4.1 to read as follows:

4.7.4.1 Dormers as high as or higher than the main roof ridge shall be protected with strike termination devices, conductors, and grounds.

Revise 4.8.4.2 to read as follows:

4.7.4.2 Dormers and projections below the main ridge shall require protection only on those areas extending outside a zone of protection.

Revise 4.8.5 to read as follows:

4.7.5 Roofs with Intermediate Ridges. Strike termination devices shall be located along the outermost ridges of buildings that have a series of intermediate ridges at the same intervals as required by 4.7.1.

Revise 4.8.5.1 to read as follows:

4.7.5.1 Strike termination devices shall be located on the intermediate ridges in accordance with the requirements for the spacing of strike termination devices on flat or gently sloping roofs.

Revise 4.8.5.2 to read as follows:

4.7.5.2 If any intermediate ridge is higher than the outermost ridges, it shall be treated as a main ridge and protected according to 4.7.1.

Revise 4.8.6 to read as follows:

4.7.6 Flat or Gently Sloping Roofs with Irregular Perimeters. Structures that have exterior wall designs that result in irregular roof perimeters shall be treated on an individual basis.

Revise 4.8.6.1 to read as follows:

4.7.6.1 The imaginary roof edge formed by the outermost projections shall be used to locate the strike termination devices in accordance with 4.7.1.

Revise 4.8.6.2 to read as follows:

4.7.6.2 In all cases, however, strike termination devices shall be located in accordance with Section 4.8, as shown in Figure 4.7.6.2.

Revise 4.8.6.3 to read as follows:

4.7.6.3 Strike termination devices installed on vertical roof members shall be permitted to use a single main-size cable to connect to a main roof conductor.

Revise 4.8.6.4 to read as follows:

4.7.6.4 The main roof conductor shall be run adjacent to the vertical roof members so that the single cable from the strike termination device is as short as possible and in no case longer than 4.9 m (16 ft).

Revise 4.8.6.5 to read as follows:

4.7.6.5 The connection of the single cable to the down conductor shall be made with a tee splice or other fitting listed for the purpose, as shown in Figure 4.7.6.5.

Revise 4.8.7 to read as follows:

4.7.7 Open Areas in Flat Roofs. The perimeter of open areas, such as light or mechanical wells, shall be protected if the open area perimeter exceeds 92 m (300 ft), provided both rectangular dimensions exceed 15 m (50 ft).

Revise 4.8.8 to read as follows:

4.7.8 Domed or Rounded Roofs. Strike termination devices shall be located so that no portion of the structure is located outside a zone of protection, as set forth in Section 4.8.

Revise 4.8.9 to read as follows:

4.7.9 Chimneys and Vents. Strike termination devices shall be required on all chimneys and vents that are not located within a zone of protection, including metal chimneys having a metal thickness of less than 4.8 mm (3/16 in.).

Revise 4.8.9.1 to read as follows:

4.7.9.1 Chimneys or vents with a metal thickness of 4.8 mm (3/16 in.) or more shall require only a connection to the lightning protection system.

Revise 4.8.9.2 to read as follows:

4.7.9.2 The connection for 4.7.9.1 shall be made using a mainsize lightning conductor and a connector that has a surface contact area of not less than 1940mm² (3 in.²) and shall provide two or more paths to ground, as is required for strike termination devices.

Revise 4.8.9.3 to read as follows:

4.7.9.3* Required strike termination devices shall be installed on chimneys and vents, as shown in Figure 4.7.9.3, so that the distance from a strike termination device to an outer edge of a corner or the distance perpendicular to an outside edge is not greater than 0.6 m (2 ft).

Revise 4.8.9.4 to read as follows:

4.7.9.4 Where only one strike termination device is required on a chimney or vent, at least one main-size conductor shall connect the strike termination device to the main conductor at the location where the chimney or vent meets the roof surface and provides two or more paths to ground from that location in accordance with Section 4.9 and 4.9.2.
Committee Statement:

4.7.10 Metal Roof Top Units. Strike termination devices shall be required in accordance with 4.7.10.1 through 4.7.10.3.2 on all roof top mechanical units with continuous metal housings less than 46 m (150 ft) in height. Metal air intake/exhaust housings and cooling towers, that are not located in a zone of protection. 

Revise 4.8.10.1 to read as follows:

4.7.10.1 Air terminals shall be installed in accordance with 4.7.1 through 4.7.3.

Revise 4.8.10.2 to read as follows:

4.7.10.2 The air terminals shall be mounted on bases having a minimum contact area of 1940 mm² (3 in.²), each secured to bare metal of the housing or mounted by drilling and tapping to the unit’s frame in accordance with 4.16.3.2 and 4.16.1.3.3.

Revise 4.8.10.3 to read as follows:

4.7.10.3 At least two main-size conductors shall be installed to connect the unit to the lightning protection system.

Revise 4.8.10.3.1 to read as follows:

4.7.10.3.1 The connection shall be made to bare metal at the base or lower edges of the unit using main-size lightning conductors and bonding devices that have a surface contact area of not less than 1940 mm² (3 in.²) and shall provide two or more paths to ground, as is required for strike termination devices.

Revise 4.8.10.3.2 to read as follows:

4.7.10.3.2 The two main bonding plates shall be located a far apart as practicable at the base or lower edges of the unit’s electrically continuous metal housing and connected to the lightning protection system.

Revise A.4.7.3.4 to read as follows:

A.4.8.3.4 Research indicates that the probability of low-amplitude strikes to the vertical side of a structure of less than 60 m (200 ft) in height are low enough that they need not be considered (see IEC 62305-3, Protection Against Lightning, Section 5.2.3.1). It is suggested that a wall or surface with a slope characterized by an angle from vertical of no more than 15 degrees be considered essentially vertical as it relates to the electric field gradient that would result in the generation of streamers. See Figure A.4.8.3.4. IEC 62305-3, Protection Against Lightning, Section 5.2.3.2 acknowledges that the rules for the placement of strike termination devices can be relaxed to the equivalent of IEC Lightning Protection Class IV for upper parts of tall structures where protection is provided on the top of the structure. Figure A.4.8.3.4 identifies the maximum values of protection angle versus class of lightning protection system based on IEC 62305-3. The 15- degree angle from vertical falls well within the limits specified for a Class IV lightning protection system at a height of 60 m (200 ft).

Revise A.4.7.4.1 to read as follows:

A.4.8.4.1 Figure A.4.8.4.1 depicts the 46 m (150 ft) rolling sphere method for structures of selected heights up to 46 m (150 ft). Based on the height of the strike termination device for a protected structure being 7.6 m (25 ft), 15 m (50 ft), 23.75 m (75 ft), 30m (100 ft), or 46 m (150 ft) above ground, reference to the appropriate curve shows the anticipated zone of protection for objects and roofs at lower elevations. 

Revise A.4.8.4 to read as follows:

A.4.7.4.7 Figure A.4.7.4 illustrates dormer protection.

Committee Statement: The Technical Committee accepted the submitter’s text with revisions to appropriately retain the annex material and figures/tables.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 27 Negative: 1

Explanation of Negative:

HEARY, W.: I do not believe surge protection belongs in this document.

Comment on Affirmative:

RAPP, R: 4.8 Zones of Protection. The geometry of the structure shall determine the zone of protection. Should be “shall determine the “zones” of protection, there are more than one from any structure.

Revise 4.7.4.1 to read as follows:

4.8.4.1.1 Where the sphere is tangent to earth and resting against a strike termination device, all space in the verticalplane between the two points of contact and under the sphere shall be considered to be in the zone of protection. “resting against”, means it could be resting on the side of the strike termination device, I believe it should read, “resting on the top of”.

Revise 4.7.4.1.2 to read as follows: 4.8.4.1.2 A zone of protection shall also be formed where such a sphere is resting on two or more strike termination devices and shall include the space(shall include the space not intruded) in the vertical plane under the sphere and between those devices, as shown in Figure 4.8.4.1.
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>4.7 Zones of Protection.</strong> The geometry of the structure shall determine the zone of protection.</td>
<td><strong>4.7 Zones of Protection.</strong> Zones of protection shall be a volume afforded by a system of strike termination devices described by one or more of the methods by 4.7.2 through 4.7.6.</td>
<td></td>
</tr>
<tr>
<td>4.7.1 One or more of the methods described in 4.7.2 through 4.7.4 and Section 4.8 shall be used to determine the overall zone of protection.</td>
<td>4.7.1 One or more of the methods described in 4.7.3 through 4.7.6 and Section 4.8 may be used together on a single structure to determine the overall zone of protection.</td>
<td></td>
</tr>
<tr>
<td>4.7.2 Strike Termination placements shall comply with section 4.x.x (Existing 4.8)</td>
<td></td>
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</tr>
<tr>
<td><strong>4.7.2 Roof Types.</strong> The zone of protection for the following roof types shall include the roof and appurtenances where protected in accordance with Section 4.8:</td>
<td><strong>4.7.3 Simple Roof Zone of Protection</strong> The zone of protection for the following roof types shall include the volume below the roof where strike terminations are placed IAW 4.8.</td>
<td></td>
</tr>
<tr>
<td>(1) Pitched roofs</td>
<td>(1) Pitched roofs</td>
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</tr>
<tr>
<td>(2) Flat or gently sloping roofs</td>
<td>(2) Flat or gently sloping roofs</td>
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<tr>
<td>(3) Dormers</td>
<td>(3) Dormers</td>
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<tr>
<td>(4) Domed roofs</td>
<td>(4) Domed roofs</td>
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<tr>
<td>(5) Roofs with ridges, wells, chimneys, or vents</td>
<td>(5) Roofs with ridges, wells, chimneys, or vents</td>
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<tr>
<td><strong>4.1.2.4 Protection for a shed roof shall be as illustrated for the gable method in Figure 4.1.2.4.</strong> Delete 4.1.2.4.</td>
<td></td>
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</tr>
<tr>
<td><strong>4.7.3.1 Simple roofs include:</strong> a) Gable b) Hip c) Broken Gable d) Flat e) Mansard f) Gambrel</td>
<td>Accounts for the specific guidance in 4.1.2.4, with preservation of the figure. Expands applicability, as expressed in September 2011 780 meeting.</td>
<td></td>
</tr>
<tr>
<td>These roofs are considered as having a zone of protection with strike termination (air terminal?) arrangements as illustrated in figure (4.1.2.4 – new number needed) under the conditions of 4.7.3.2</td>
<td></td>
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<tr>
<td><strong>4.7.3.2 Simple roofs shall:</strong> a) Have an eave height less than 50 ft. b) Place strike terminations IAW 4.8 c) Place strike terminations IAW 4.8 on the interior of any flat roof areas when dimensions exceed 50 ft on each side. d) Comply with 4.8 to protect any projections greater than 10 inches (or the height of the strike termination above the roof line?) above the roof line. If these conditions cannot be met, another method shall be used to determine the zone of protection.</td>
<td>Limitations solve eave problem, preserves limitations of height and projections.</td>
<td></td>
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<tr>
<td><img src="image.png" alt="Diagram" /></td>
<td></td>
<td></td>
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</tbody>
</table>

**FIGURE 4.1.2.4 Protection Methods for Various Roof Types.** Drawings are copied and adapted from NFPA 780.
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>4.7.3 Multiple-Level Roofs.</td>
<td>4.7.4 Multiple-Level Simple Roofs.</td>
<td></td>
</tr>
<tr>
<td>4.7.3.1 For structures with multiple-level roofs no more than 15 m (50 ft) in height, the zone of protection shall include areas as identified in 4.7.3.3 and 4.7.3.4.</td>
<td>4.7.4.1 Lower roof levels of simple roofs shall be considered within the zone of protection of the simple roof under the conditions of 4.7.3.2 - 4.7.3.5.</td>
<td></td>
</tr>
<tr>
<td>4.7.3.2 The zone of protection shall be permitted to be delineated by a cone with the apex located at the highest point of the strike termination device, with its surface formed by a 45-degree or 63-degree angle from the vertical, based on the height of the strike termination device above the ground as defined in 4.7.3.3 and 4.7.3.4.</td>
<td>4.7.4.2 The zone of protection shall be permitted to be delineated by a cone with the apex located at the highest point of the strike termination device, with its surface formed by a 45-degree or 63-degree angle from the vertical, based on the height of the strike termination device above the ground as defined in 4.7.3.3 and 4.7.3.4.</td>
<td>Preserves the intent of existing 4.7.3, EXCEPT draws protective angle from the strike termination NOT the eave.</td>
</tr>
<tr>
<td>4.7.3.3 Structures that do not exceed 7.6 m (25 ft) above earth shall be considered to protect lower portions of a structure located within a one-to-two zone of protection as shown in Figure 4.7.3.3(a) and Figure 4.7.3.3(b).</td>
<td>4.7.4.3 Structures that do not exceed 7.6 m (25 ft) above earth shall be considered to protect lower portions of a structure located within a one-to-two zone of protection as shown in Figure 4.7.3.3(a) and Figure 4.7.3.3(b). (Existing enumeration used.)</td>
<td></td>
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<tr>
<td>4.7.3.4* Structures that do not exceed 15 m (50 ft) above earth shall be considered to protect lower portions of a structure located within a one-to-one zone of protection as shown in Figure 4.7.3.4(a) and Figure 4.7.3.4(b).</td>
<td>4.7.4.4* Structures that do not exceed 15 m (50 ft) above earth shall be considered to protect lower portions of a structure located within a one-to-one zone of protection as shown in Figure 4.7.3.4(a) and Figure 4.7.3.4(b). (Existing enumeration used.)</td>
<td></td>
</tr>
<tr>
<td>4.7.4 Zones of protection for lower roof levels of simple roofs shall be permitted to be described by 4.7.5, protective angle method or by 4.7.6, rolling sphere method, or by any combination of methods.</td>
<td></td>
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<tr>
<td>4.7.5 Protective Angle Method</td>
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<tr>
<td>4.7.5.1 For structures no more than 15 m (50 ft) in height, the zone of protection shall be permitted to be described by a surface formed by a 45-degree angle from the vertical with the apex located at the highest point of the strike termination device. (Refer to existing figure 4.7.3.4a)</td>
<td>A dd s section to become more general. Fact that zone of protection contains lower roof is not relevant. Should just be able to articulate that a protective angle is permissible. (As an approximation of RSM.) Also recognizes the surface is not necessarily a cone.</td>
<td></td>
</tr>
<tr>
<td>4.7.5.2 For structures no more than 7.6 m (25 ft) in height, the zone of protection shall be permitted to be described by a surface formed by a 63-degree angle from the vertical with the apex located at the highest point of the strike termination device. (Refer to existing figure 4.7.3.3a)</td>
<td>Same.</td>
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<tr>
<td>4.7.5.3 For structures with multiple-level</td>
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<tr>
<td><strong>4.7.4 Rolling Sphere Method.</strong></td>
<td><strong>4.7.6 Rolling Sphere Method.</strong></td>
<td></td>
</tr>
<tr>
<td>4.7.4.1* The zone of protection shall include the space not intruded by a rolling sphere having a radius of the striking distance determined for the type of structure being protected, as shown in Figure 4.7.4.1.</td>
<td>4.7.6.1* The zone of protection shall include the space not intruded by a rolling sphere having a radius of the striking distance determined for the type of structure being protected, as shown in Figure 4.7.4.1.</td>
<td></td>
</tr>
<tr>
<td>4.7.4.1.1 Where the sphere is tangent to earth and resting against a strike termination device, all space in the vertical plane between the two points of contact and under the sphere shall be considered to be in the zone of protection.</td>
<td>4.7.6.1.1 Where the sphere is tangent to earth and resting against a strike termination device, all space in the vertical plane between the two points of contact and under the sphere shall be considered to be in the zone of protection.</td>
<td></td>
</tr>
<tr>
<td>4.7.4.1.2 A zone of protection shall also be formed where such a sphere is resting on two or more strike termination devices and shall include the space in the vertical plane under the sphere and between those devices, as shown in Figure 4.7.4.1.</td>
<td>4.7.6.1.2 A zone of protection shall also be formed where such a sphere is resting on two or more strike termination devices and shall include the space in the vertical plane under the sphere and between those devices, as shown in Figure 4.7.4.1.</td>
<td></td>
</tr>
<tr>
<td>4.7.4.1.3 All possible placements of the sphere shall be considered when determining the overall zone of protection using the rolling sphere method.</td>
<td>4.7.6.1.3 All possible placements of the sphere shall be considered when determining the overall zone of protection using the rolling sphere method.</td>
<td></td>
</tr>
<tr>
<td>4.7.4.1.4 The striking distance of an ordinary structure shall not exceed 46 m (150 ft).</td>
<td>4.7.6.1.4 The striking distance of an ordinary structure shall not exceed 46 m (150 ft).</td>
<td></td>
</tr>
<tr>
<td>4.7.4.2* For structure heights exceeding the striking distance above earth or above a lower strike termination device, the zone of protection shall be the space in the vertical plane between the points of contact, and also under the sphere where the sphere is resting against a vertical surface of the structure and the lower strike termination device(s) or earth.</td>
<td>4.7.6.2* For structure heights exceeding the striking distance above earth or above a lower strike termination device, the zone of protection shall be the space in the vertical plane between the points of contact, and also under the sphere where the sphere is resting against a vertical surface of the structure and the lower strike termination device(s) or earth.</td>
<td></td>
</tr>
<tr>
<td>4.7.4.3 Under the rolling sphere method, the horizontal protected distance found geometrically by Figure A.4.7.4.1 also shall be permitted to be calculated using the following formula (units shall be consistent, m or ft):</td>
<td>4.7.6.3 Under the rolling sphere method, the horizontal protected distance found geometrically by Figure A.4.7.4.1 also shall be permitted to be calculated using the following formula (units shall be consistent, m or ft):</td>
<td></td>
</tr>
<tr>
<td>[ d = h_1 + R + h_2 ] where: [ d = \text{horizontal protected distance (m or ft)} ] [ h_1 = \text{height of the higher roof (m or ft)} ] [ R = \text{rolling sphere striking distance radius (m or ft)} ] [ h_2 = \text{height of the lower roof (top of the object)(m or ft)} ]</td>
<td>[ d = h_1 + R + h_2 ] where: [ d = \text{horizontal protected distance (m or ft)} ] [ h_1 = \text{height of the higher roof (m or ft)} ] [ R = \text{rolling sphere striking distance radius (m or ft)} ] [ h_2 = \text{height of the lower roof (top of the object)(m or ft)} ]</td>
<td></td>
</tr>
<tr>
<td>4.7.4.3.1 For the formula to be valid, the sphere shall be either tangent to the lower roof or in contact with the earth, and in contact with the vertical side of the higher portion of the structure.</td>
<td>4.7.6.3.1 For the formula to be valid, the sphere shall be either tangent to the lower roof or in contact with the earth, and in contact with the vertical side of the higher portion of the structure.</td>
<td></td>
</tr>
<tr>
<td>4.7.4.3.2 In addition, the difference in</td>
<td>4.7.6.3.2 In addition, the difference in</td>
<td></td>
</tr>
</tbody>
</table>
### 4.8 Strike Termination Devices on Roofs

**4.8.1 Location of Devices.** As shown in Figure 4.8.1, the distance between strike termination devices and ridge ends on pitched roofs, or edges and outside corners of flat or gently sloping roofs, shall not exceed 0.6 m (2 ft).

**4.8.1.1** Strike termination devices shall be placed on ridges of pitched roofs, and around the perimeter of flat or gently sloping roofs, at intervals not exceeding 6 m (20 ft).

**4.8.1.2** Strike termination devices 0.6 m (2 ft) or more above the object or area to be protected shall be permitted to be placed at intervals not exceeding 7.6 m (25 ft).

**4.8.2 Pitched Roof Area.** For a pitched roof with eave heights over 15 m (50 ft) but less than 46 m (150 ft) above grade, it shall be permitted to omit strike termination devices at the eaves if the slope of that roof is equal to or steeper than the tangent of the arc at the eave elevation of a rolling sphere having a 46 m (150 ft) radius. (See Figure 4.8.2.)

**4.8.2.1** Except for the gutter, any portion of the building that extends beyond that tangent shall be protected.

**4.8.2.2** Eaves over 46 m (150 ft) above grade shall be protected in accordance with 4.8.1.

**4.8.3 Flat or Gently Sloping Roof**
## Area
Flat or gently sloping roofs that exceed 15 m (50 ft) in width or length shall have additional strike termination devices located at intervals not to exceed 15 m (50 ft) on the flat or gently sloping areas, as shown in Figure 4.8.3(a) and Figure 4.8.3(b), or such area can also be protected using taller strike termination devices that create zones of protection using the rolling sphere method so the sphere does not contact the flat or gently sloping roof area.

### 4.8.4 Dormers

#### 4.8.4.1 Dormers as high as or higher than the main roof ridge shall be protected with strike termination devices, conductors, and grounds.

#### 4.8.4.2 Dormers and projections below the main ridge shall require protection only on those areas extending outside a zone of protection.

Consistent with new 4.7.3.2 & 4.7.4.

### 4.8.5 Roofs with Intermediate Ridges
Strike termination devices shall be located along the outermost ridges of buildings that have a series of intermediate ridges at the same intervals as required by 4.8.1.

#### 4.8.5.1 Strike termination devices shall be located on the intermediate ridges in accordance with the requirements for the spacing of strike termination devices on flat or gently sloping roofs.

#### 4.8.5.2 If any intermediate ridge is higher than the outermost ridges, it shall be treated as a main ridge and protected according to 4.8.1.

### 4.8.6 Flat or Gently Sloping Roofs with Irregular Perimeters
Structures that have exterior wall designs that result in irregular roof perimeters shall be treated on an individual basis.

#### 4.8.6.1 The imaginary roof edge formed by the outermost projections shall be used to locate the strike termination devices in accordance with 4.8.1.

#### 4.8.6.2 In all cases, however, strike termination devices shall be located in accordance with Section 4.8, as shown in Figure 4.8.6.2.

#### 4.8.6.3 Strike termination devices installed on vertical roof members shall be permitted to use a single main-size cable to connect to a main roof conductor.

#### 4.8.6.4 The main roof conductor shall be run adjacent to the vertical roof members so that the single cable from the strike termination device is as short as possible and in no case longer than 4.9 m (16 ft).

#### 4.8.6.5 The connection of the single cable to the down conductor shall be made with a tee splice or other fitting...
4.8.7 Open Areas in Flat Roofs. The perimeter of open areas, such as light or mechanical wells, shall be protected if the open area perimeter exceeds 92 m (300 ft), provided both rectangular dimensions exceed 15 m (50 ft).

4.8.8 Domed or Rounded Roofs. Strike termination devices shall be located so that no portion of the structure is located outside a zone of protection, as set forth in Section 4.7.

4.8.9 Chimneys and Vents. Strike termination devices shall be required on all chimneys and vents that are not located within a zone of protection, including metal chimneys having a metal thickness of less than 4.8 mm (\(\frac{3}{16}\) in.).

4.8.9.1 Chimneys or vents with a metal thickness of 4.8 mm (\(\frac{3}{16}\) in.) or more shall require only a connection to the lightning protection system.

4.8.9.2 The connection for 4.8.9.1 shall be made using a mainsize lightning conductor and a connector that has a surface contact area of not less than 1940 mm\(^2\) (3 in.\(^2\)) and shall provide two or more paths to ground, as is required for strike termination devices.

4.8.4.2 Dormers and projections below the main ridge shall require protection only on those areas extending outside a zone of protection.

4.8.5 Roofs with Intermediate Ridges. Strike termination devices shall be located along the outermost ridges of buildings that have a series of intermediate ridges at the same intervals as required by 4.8.1.

4.8.5.1 Strike termination devices shall be located on the intermediate ridges in accordance with the requirements for the spacing of strike termination devices on flat or gently sloping roofs.

4.8.5.2 If any intermediate ridge is higher than the outermost ridges, it shall be treated as a main ridge and protected according to 4.8.1.

4.8.6 Flat or Gently Sloping Roofs with Irregular Perimeters. Structures that have exterior wall designs that result in irregular roof perimeters shall be treated on an individual basis.

4.8.6.1 The imaginary roof edge formed by the outermost projections shall be used to locate the strike termination devices in accordance with 4.8.1.

4.8.6.2 In all cases, however, strike termination devices shall be located in
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8.6.3</td>
<td>Strike termination devices installed on vertical roof members shall be permitted to use a single main-size cable to connect to a main roof conductor.</td>
</tr>
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<td>4.8.6.4</td>
<td>The main roof conductor shall be run adjacent to the vertical roof members so that the single cable from the strike termination device is as short as possible and in no case longer than 4.9 m (16 ft).</td>
</tr>
<tr>
<td>4.8.6.5</td>
<td>The connection of the single cable to the down conductor shall be made with a tee splice or other fitting listed for the purpose, as shown in Figure 4.8.6.5.</td>
</tr>
<tr>
<td>4.8.7</td>
<td>Open Areas in Flat Roofs. The perimeter of open areas, such as light or mechanical wells, shall be protected if the open area perimeter exceeds 92 m (300 ft), provided both rectangular dimensions exceed 15 m (50 ft).</td>
</tr>
<tr>
<td>4.8.8</td>
<td>Domed or Rounded Roofs. Strike termination devices shall be located so that no portion of the structure is located outside a zone of protection, as set forth in Section 4.7.</td>
</tr>
<tr>
<td>4.8.9</td>
<td>Chimneys and Vents. Strike termination devices shall be required on all chimneys and vents that are not located within a zone of protection, including metal chimneys having a metal thickness of less than 4.8 mm (3/16 in.).</td>
</tr>
<tr>
<td>4.8.9.1</td>
<td>Chimneys or vents with a metal thickness of 4.8 mm (3/16 in.) or more shall require only a connection to the lightning protection system.</td>
</tr>
<tr>
<td>4.8.9.2</td>
<td>The connection for 4.8.9.1 shall be made using a mainsize lightning conductor and a connector that has a surface contact area of not less than 1940 mm² (3 in.²) and shall provide two or more paths to ground, as is required for strike termination devices.</td>
</tr>
<tr>
<td>4.8.9.3*</td>
<td>Required strike termination devices shall be installed on chimneys and vents, as shown in Figure 4.8.9.3, so that the distance from a strike termination device to an outside corner or the distance perpendicular to an outside edge is not greater than 0.6 m (2 ft).</td>
</tr>
<tr>
<td>4.8.9.4</td>
<td>Where only one strike termination device is required on a chimney or vent, at least one main-size conductor shall connect the strike termination device to a main conductor at the location where the chimney or vent meets the roof surface and provides two or more paths to ground from that location in accordance with Section 4.9 and.</td>
</tr>
</tbody>
</table>
4.9.2.

<table>
<thead>
<tr>
<th>4.8.101</th>
<th>Air terminals shall be installed in accordance with 4.8.1 through 4.8.3.</th>
</tr>
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<tbody>
<tr>
<td>4.8.102</td>
<td>The air terminals shall be mounted on bases having a minimum contact area of 1940 mm² (3 in.²), each secured to bare metal of the housing or mounted by drilling and tapping to the unit’s frame in accordance with 4.16.3.2 and 4.16.3.3.</td>
</tr>
<tr>
<td>4.8.103</td>
<td>At least two main-size conductors shall be installed to connect the unit to the lightning protection system.</td>
</tr>
<tr>
<td>4.8.103.1</td>
<td>The connection shall be made to bare metal at the base or lower edges of the unit using main-size lightning conductors and bonding devices that have a surface contact area of not less than 1940 mm² (3 in.²) and shall provide two or more paths to ground, as is required for strike termination devices.</td>
</tr>
<tr>
<td>4.8.103.2</td>
<td>The two main bonding plates shall be located as far apart as practicable at the base or lower edges of the unit’s electrically continuous metal housing and connected to the lightning protection system.</td>
</tr>
</tbody>
</table>
Ballot Results:
Committee Meeting Action: Accept in Principle
Revise test to read as follows:
(4.7.1) One or more of the following methods described in 4.7.2 through 4.7.4 and Section 4.8 shall be used to determine the overall zone of protection:
(1) The rules of air terminal placements as described in Section 4.8
(2) The angle method as described in Sections 4.7.2 and 4.7.3
(3) The rolling sphere method as described in Section 4.7.4
Substantiation:
Committee: The Technical Committee accepts the submitter’s text with revisions made for clarity. The Technical Committee retains the text as submitted.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 26 Negative: 2
Explanation of Negative:
HEARY, W.: This topic belongs in the National Electrical Code.
RAPP, R.: 4.8 allows the use of 10’ air terminals with specified distances that allows the rolling ball to “intrude” touch the structure or equipment. The document conflicts itself.
780-25 Log #66 Final Action: Accept
(4.7.4.1.4)
Submitter: Technical Committee on Lightning Protection
Recommendation: Change 4.7.4.1 to read as follows:
4.7.4.1.4 The striking distance of an ordinary structure shall not exceed 46 m (150 ft).
Substantiation: The TC removes the word “ordinary” to correlate with action on Proposal 780-11.
Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28
780-26 Log #71 Final Action: Accept in Principle
(4.8.2 through 4.8.2.3)
Submitter: Thomas R. Harger, Harger Lightning Protection Inc.
Recommendation: Revise text to read as follows:
4.8.2.1 Strike termination devices shall not be required around the perimeters of pitched roofs with eave heights less than or equal to over 15 m (50 ft) above
grade.
4.8.2.2 For pitched roofs with a span of 30 m (100 ft) or less and eave heights over fifteen m (50 ft) but less than 46 m (150 ft) above grade, it shall be permitted to omit strike termination devices at the eaves if the slope of the roof is equal to or steeper than the tangent of the arc at the eave elevation of a rolling sphere having a 46 m (150 ft) radius. (See Figure 4.8.2.2.)
4.8.2.3 For pitched roofs not meeting the above shall be treated in the same manner as flat or gently sloping roofs
Substantiation: Added text clarifies exceptions and requirements for locating strike terminals on pitched roofs
Committee Meeting Action: Accept in Principle
Revise text to read as follows:
4.8.2.2 Pitched Roof
For a pitched roof with a span of 30 m (100 ft) or less and eave heights over fifteen m (50 ft) but less than 46 m (150 ft) above grade, it shall be permitted to omit strike termination devices at the eaves if the slope of the roof is equal to or steeper than the tangent of the arc at the eave elevation of a rolling sphere having a 46 m (150 ft) radius. (See Figure 4.8.2.2.
4.8.2.3 For a pitched roof with a span of 30 m (100 ft) or less than or equal to
15 m (50 ft) but less than 46 m (150 ft) above grade, it shall be permitted to omit strike termination devices at the eaves if the slope of that roof is equal to or steeper than the tangent of the arc at the eave elevation of a rolling sphere having a 46 m (150 ft) radius. (See Figure 4.8.2.2.)
4.8.2.2.1 Except for the gutter, any portion of the building that extends beyond that tangent shall be protected.
4.8.2.2.2 Eaves over 46 m (150 ft) above grade shall be protected in accordance with 4.8.1.
4.8.2.2.3 The tangent of the rolling sphere arc shall be considered a vertical line over 46 m (150 ft) above grade, except as permitted by 4.7.3.4.
4.8.2.3 Pitched roofs not meeting the criteria of 4.8.2.1 and 4.8.2.2 shall be treated in the same manner as flat or gently sloping roofs.
Change Figure 4.8.2.2 to Figure 4.8.2.2.
Committee Statement: The Technical Committee accepts the submitter’s text with revisions made for clarity. The Technical Committee retains the text that was inadvertently omitted by the submitter.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:
HEARY, W.: This topic belongs in the National Electrical Code.
780-27 Log #72 Final Action: Accept in Principle
(4.8.9 through 4.8.9.5)
Submitter: Thomas R. Harger, Harger Lightning Protection Inc.
Recommendation: Revise text as follows:
4.8.9 Chimneys, Vents and Other Objects on Roofs. Strike termination devices shall be required on all chimneys and vents objects on roofs that are not located within a zone of protection, including metal chimneys objects having a metal thickness of less than 4.8 mm (3/16 in.) except as permitted in this section.
4.8.9.1 Chimneys or vents Metal objects on roofs with a metal thickness of 4.8 mm (3/16 in.) or more shall require only a connection to the lightning protection system.
4.8.9.2 The connection for 4.8.9.1 shall be made using a main-size lightning conductor and a connector that has a surface contact area of not less than 1940 mm2 (3 in.2) and shall provide two or more paths to ground, as is required for strike termination devices.
4.8.9.3 Required strike termination devices shall be installed on chimneys and vents objects on roofs, as shown in Figure 4.8.9.3, so that the distance from a strike termination device to an outside corner or the distance perpendicular to an outside edge is not greater than 0.6 m (2 ft).
4.8.9.4 Where only one strike termination device is required on a chimney or vent an object, at least one main-size conductor shall connect the strike termination device to a main conductor at the location where the object meets the roof surface and provides two or more paths to ground from that location in accordance with Section 4.9 and 4.9.2.
4.8.9.5 Small objects on roofs that are less than 254 mm (10 in.) above the surface of the roof shall not require strike termination devices unless they are located within 0.9 m (3 ft) of the ridge or roof edge.
Substantiation: Current text does not address objects that are found on roofs other than chimneys, vents or metal roof top units. Revised text addresses other objects on roofs that may require strike termination devices. Added text addresses small objects on roofs that may not generate appreciable streamers and thus may not require strike termination devices.
Committee Meeting Action: Accept in Principle
Revise text to read as follows:
4.8.9 Chimneys, Vents and Other Objects on Roofs. Strike termination devices shall be required on all chimneys and vents objects on roofs that are not located within a zone of protection, including metal chimneys objects having a metal thickness of less than 4.8 mm (3/16 in.) except as permitted in this section.
Change Figure 4.8.9.1 to Figure 4.8.9.2.
Committee Statement: The Technical Committee accepts the submitter’s text with revisions made for clarity. The Technical Committee retains the text that was inadvertently omitted by the submitter.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 26 Negative: 2
Explanation of Negative:
HEARY, W.: This topic belongs in the National Electrical Code.
780-28 Log #73  Final Action: Accept in Principle
(4.8.9.2)

Submitter: Thomas R. Harger, Harger Lightning Protection Inc.

Recommendation: Revise text to read as follows:

4.8.9.2 The connection for 4.8.9.1 shall be made using a main-size lighting conductor and a listed main-size connector that has a surface contact area on flat surfaces of not less than 1940 mm² (3 in.²) or a minimum of 38 mm (1-1/2 in) of copper along the axis of a round surface and shall provide two or more paths to ground, as is required for strike termination devices.

Substantiation:
The added words allow the use of listed main-size connectors for connecting to metal objects that are round in section that are used as strike termination devices. This has been industry practice for bonding of antenna masts, conduit risers, vent pipes, light poles, etc, for many years.

Committee Meeting Action: Accept in Principle
See Committee Action on Proposal 780-27,
Committee Statement: The change satisfies the submitter’s intent.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

780-29 Log #74  Final Action: Accept in Principle
(4.8.11 (New))

Submitter: Thomas R. Harger, Harger Lightning Protection Inc.

Recommendation: Revise text to read as follows:

4.8.11 Movable or Rotating Objects on Roofs
4.8.11.1 Movable or rotating objects on roofs shall be protected using properly supported long air terminals or lightning masts.
4.8.11.2 Movable or rotating metal objects on roofs that do not pose an additional hazard to the protected structure shall be permitted to be connected to the lightning protection system in accordance with 4.8.9.1.

Substantiation:
This new text adds movable or rotating objects found on roofs that cannot be protected by usual means without affecting their functionality.

Committee Meeting Action: Accept in Principle
Revise text to read as follows:

4.8.11 Movable or Rotating Objects on Roofs
4.8.11.1 Movable or rotating objects on roofs shall be protected using properly supported long air terminals or lightning masts.
4.8.11.2 Movable or rotating metal objects on roofs that do not pose an additional hazard to the protected structure shall be permitted to be connected to the lightning protection system in accordance with 4.8.9.1.

Committee Statement: The Technical Committee accepts the submitter’s text and changes “protected” to “protected.”

Number Eligible to Vote: 28
Ballot Results: Affirmative: 26 Negative: 2
Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.
RAPP, R.: 4.8.11.2 ...“that do not pose an additional hazard” Vague and Unenforceable language.

Comment on Affirmative:

DALEY, R.: 4.8.11.1 suggests that only air terminals or mast are acceptable. Being in the zone of protection of a higher object should also be noted.

780-30 Log #126  Final Action: Accept
(4.9.3.3)

Submitter: Simon Larter, Warren Lightning Rod Company

Recommendation: Revise text to read as follows:

Likewise, metal roofing or siding having a thickness of less than 4.8 mm (3/16 in.) shall not be substituted for main conductors.

Substantiation:
The word “likewise” is unnecessary and doesn’t refer to anything in the preceding paragraphs.

Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

780-31 Log #83  Final Action: Reject
(4.9.11.2)


Recommendation: Change the value as follows:

4.9.11.2 “distance of 1.8 m (6 ft.)”

Substantiation:
Change is needed to maintain consistency throughout the document as per the Manual of Style Section 4.1.2

Committee Meeting Action: Reject

780-32 Log #128  Final Action: Reject
(4.10.1)

Submitter: Simon Larter, Warren Lightning Rod Company

Recommendation: Revise text to read as follows:

Attached by nails, screws, bolts, or adhesives as necessary. The fasteners shall not be subject to breakage and shall be of the same material as the conductor or a material equally resistant to corrosion as that of the conductor.

Substantiation:
The deleted text adds no requirement to this paragraph, and is therefore unnecessary. Also, it’s grammatically inelegant. Yes, I actually said that.

Committee Meeting Action: Reject
Committee Statement: The submitter did not provide any technical substantiation to justify deletion of the text. The Technical Committee disagrees with the submitter’s substantiation. The Technical Committee chooses to retain the current language.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

Comment on Affirmative:

PORTFLEET, T.: The existing text does not conform to the Manual of Style. There is more than one requirement in this text. A committee proposal was put forward at the ROP meeting that was not addressed. It was to modify the existing text as follows:

4.10.1 Attached by nails, screws, bolts or adhesive as necessary, the fasteners shall not be subject to breakage.

4.10.2 Fasteners shall be of the same materials as the conductor or a material equally resistant to corrosion as that of the conductor.

Renumber existing 4.10.2 to 4.10.3

780-33 Log #130  Final Action: Accept
(4.12.2)

Submitter: Simon Larter, Warren Lightning Rod Company

Recommendation: Revise text to read as follows:

Fittings used for required connections to metal bodies in or on a structure shall be secured to the metal body by bolting, brazing, welding, screwing, or using high-compression connectors listed for the purpose.

Substantiation:
Machine screws are extensively used in industry for attachment to metal rooftop units, and are technically not a bolt.

Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

Comment on Affirmative:

RAPP, R.: Instead of “screwing” “the use of metals screws suitable for the application”

780-34 Log #75  Final Action: Accept
(4.13.1.1)

Submitter: Thomas R. Harger, Harger Lightning Protection Inc.

Recommendation: Revise text to read as follows:

4.13.1.1 Each down conductor shall terminate at a grounding electrode dedicated to the lightning protection system or to a grounding electrode system in the case of a building, structure or facility that has multiple grounding electrodes that are bonded together with a ground ring electrode to form the grounding electrode system.

Substantiation:
The added words will permit the use of building or facility grounding electrode system for grounding electrodes for the lightning protection system where a building or facility has multiple grounding electrodes that are bonded together.

Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.
Recommendation: Revise text as follows:

The design, size, and depth and number of grounding electrodes shall comply with 4.13.2 through 4.13.8.

Substantiation: Sections 4.13.2 through 4.13.8 say nothing whatsoever about the number of ground rods required.

Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative: HEARY, W.: This topic belongs in the National Electrical Code.

Committee Meeting Action: Accept Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative: HEARY, W.: This topic belongs in the National Electrical Code.

The ground ring electrode shall be a main-size lightning conductor, or a listed ground conductor of equivalent or greater cross-sectional area.

Substantiation: No one lists 500 KCM conductor as a lighting protection conductor, but it’s used all the time as a ground loop conductor. Perhaps we should be able to use that as a ground if it’s, y’know, there already.

Committee Meeting Action: Accept in Principle
Revise text to read as follows:

The ground ring electrode shall be a main-size lightning conductor, or a listed ground conductor of equivalent or greater cross-sectional area.

Committee Statement: The Technical Committee accepts deletion of the second phrase in Section 4.13.1.4.

The Technical Committee does not accept addition of Section 4.13.1.4.1 as listed for the purpose adequately provides the requirement.

The Technical Committee does not necessarily agree with the submitter’s substantiation.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative: HEARY, W.: This topic belongs in the National Electrical Code.

The ground ring electrode shall be a main-size lightning conductor, or a listed ground conductor of equivalent or greater cross-sectional area.

Substantiation: No one lists 500 KCM conductor as a lighting protection conductor, but it’s used all the time as a ground loop conductor. Perhaps we should be able to use that as a ground if it’s, y’know, there already.

Committee Meeting Action: Accept in Principle
Revise text to read as follows:

The ground ring electrode shall be a main-size lightning conductor, or a listed ground conductor of equivalent or greater cross-sectional area.

Committee Statement: The Technical Committee accepts the submitter’s text but not the requirement for “listed” as bare wire is not listed.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative: HEARY, W.: This topic belongs in the National Electrical Code.

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. The ground ring electrode, radial(s), or plate electrode shall be buried at a maximum depth of topsoil available.

Substantiation: Just inserting the definite article to keep things nice and grammatically correct.
For structures exceeding 18 m (60 ft.) in height, the interconnection of meters (12 vertical feet) of the base of the structure to provide a common shall be interconnected to the lightning protection system within 3.6 vertical that can assist in providing a path for lightning currents in or on a structure

4.14.2.1 Where electric, community antenna television (CATV), data, communications, or other systems are bonded to a metallic water pipe system, 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.

Substantiation: Reorganization of 4.14 to include parts of 4.20 (Ground-Level Potential Equalization) and more closely coordinate bonding interconnections with wording in the NEC (NFPA 70 - 2011). The intent is to have a common ground point used for all building systems whenever possible.

4.14.5 Where bonding of the lightning protection system, grounded systems, and metallic water pipes is required, provided the water pipe is electrically continuous between all systems.

4.14.6 (1) - "base of the structure" - undefined term and vague
4.14.6 (1) - "base of the structure" - undefined term and vague

Final Action: Reject (4.14.2.1)

Ballot Results: Affirmative: 27 Negative: 1

Explanation of Negative:
HEARY, W.: This topic belongs in the National Electrical Code.
MELTON, JR., R.: I vote negative as currently proposed and recommend to modify 4.14.4 to incorporate the following text:

The interior metal water pipe shall not be used as an electrical bonding conductor for the lightning protection system to access a common point of bonding to the grounding electrode system in the interior of the structure served located more than 1.52m (5 ft) from the point of entrance.

Exception: The following shall apply to industrial, commercial, and institutional buildings or structures that have a metal underground water pipe in direct contact with the earth for 3.0 m (10 ft) or more (including any metal well casing bonded to the pipe) and electrically continuous (or made electrically continuous by bonding around insulating joints or piping) to the points of connection of the grounding electrode system and the bonding conductors. For these locations where conditions of maintenance and suitable ground electrodes ensure the installation, interior metal water piping located more than 1.52 m (5 ft) from the point of entrance to the building shall be permitted as a part of the grounding electrode system or as a conductor of interconnect electrodes that are part of the grounding electrode system provided that the entire length, other than short lengths passing perpendicular through walls, floors, or ceilings, of the interior metal pipe that is being used for the conductor is exposed.

FPN: It is recommended that the access to the grounding electrode system be located on the outside of the structure served, or at a point within 3 m (5 ft) of the entrance to the structure and adjacent to the power service entrance.

The Technical Committee notes that the references in this proposal correlate and relocates Section A.4.14.1.5 to A.4.14.6(8).

4.14.1.1 - "where electrical continuity is ensured" - to what?
4.14.6 (1) - "base of the structure" - undefined term and vague

Committee Meeting Action: Accept in Principle
Revise text to read as follows:

4.14.1 General. All grounding grounded media and buried metallic conductors that can assist in providing a path for lightning currents in or on a structure shall be interconnected to the lightning protection system within 3.6 vertical meters (12 vertical feet) of the base of the structure to provide a common ground point.

4.14.2 For structures exceeding 18 m (60 ft.) in height, the interconnection of meters (12 vertical feet) of the base of the structure to provide a common shall be interconnected to the lightning protection system within 3.6 vertical that can assist in providing a path for lightning currents in or on a structure

The Technical Committee notes that the references in this proposal correlate and relocates Section A.4.14.1.5 to A.4.14.6(8).

4.15 Potential Equalization.

Recommendation:

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hazards because they are grounded or assist in providing a path to ground for metal bodies, not covered by other sections of 4.16 Bonding of Metal Bodies.

Other grounded media shall be sized no smaller than the size required for the main conductor, as listed in Table 4.1.1.1 and Table 4.1.1.2.

The lightning protection system downlead conductors, grounding electrodes, or other grounded media shall be interconnected with a loop conductor at intermediate levels not exceeding 18 m (60 ft) from the top of any structure exceeding 18 m (60 ft) in vertical length, all grounded media in or on the structure shall be interconnected within 3.6 m (12 ft) of the main roof level.

Intermediate-level potential equalization shall be accomplished by the interconnection of the lightning protection system down conductors and other grounded media at the intermediate levels between the roof and the base of a structure in accordance with the formula shown in 4.16.2.5 if they change vertical direction more than 3.6 m (12 ft).

Where such bonding has been accomplished either inherently through construction or by physical contact between electrically conductive materials, no additional bonding connection shall be required.

4.16.2 Structures More Than 12 m (40 ft) in Height.

4.16.2.1 Grounded metal bodies shall be bonded to the lightning protection system where located within a calculated bonding distance, D, as determined by the following formula:

\[ D = \frac{h}{nK_m} \]

where:

- \( D \) = calculated bonding distance
- \( h \) = vertical distance between the bond being considered and the nearest lightning protection system bond
- \( n \) = a value related to the number of down conductors that are spaced at least 7.6 m (25 ft) apart, located within a zone of 30 m (100 ft) from the bond in question, and where bonding is required within 18 m (60 ft) from the top of any structure
- \( K_m \) = 1 if the flashover is through air, or 0.50 if through dense material such as concrete, brick, wood, and so forth

4.16.2.2 The value \( n \) shall be calculated as follows: \( n = 1 \) where there is only one down conductor in this zone; \( n = 1.5 \) where there are only two down conductors in this zone; \( n = 2.25 \) where there are three or more down conductors in this zone.

4.16.2.3 Where bonding is required below a level 18 m (60 ft) from the top of a structure, \( n \) shall be the total number of down conductors in the lightning protection system.

4.16.2.4 Structures 12 m (40 ft) and Less in Height.
4.16.2.5.1 Grounded metal bodies shall be bonded to the lightning protection system where located within a calculated bonding distance, D, as determined by the following formula:

\[ D = \frac{h}{6n} \times K_m \]

where:
- \( D \) = calculated bonding distance
- \( h \) = either the height of the building or the vertical distance from the nearest bonding connection from the grounded metal body to the lightning protection system and the point on the down conductor where the bonding connection is being considered
- \( n \) = a value related to the number of down conductors that are spaced at least 7.6 m (25 ft) apart and located within a zone of 30 m (100 ft) from the bond in question
- \( K_m \) = 1 if the flashover is through air, or 0.50 if through dense material such as concrete, brick, wood, and so forth

4.16.2.5.2 The value \( n \) shall be calculated as follows: \( n = 1 \) where there is only one down conductor in this zone; \( n = 1.5 \) where there are only two down conductors in this zone; \( n = 2.25 \) where there are three or more down conductors in this zone.

4.16.3.3 Punctured (Nongrounded) Metallic Bodies. An isolated metallic body, such as a metal window frame in a nonconducting medium, that is located close to a lightning conductor and to a grounded metal body will influence bonding requirements only if the total of the isolated distances between the lightning conductor and the isolated metallic body and between the isolated metallic body and the grounded metal body is equal to or less than the calculated bonding distance. The effect shall be determined by 4.16.3.1.

4.16.3.1 The effect shall be determined by using Figure 4.16.3.1 according to either 4.16.3.1.1 or 4.16.3.1.2.

Change FIGURE 4.21.3.1 to FIGURE 4.16.3.1.

4.16.3.1.1 If \( a + b \) is less than the calculated bonding distance, then \( A \) shall be bonded to \( B \) directly.

4.16.3.1.2 If \( a + b \) is greater than the calculated bonding distance, bonds shall not be required.

4.16.3.2 A bonding connection shall be required where the total of the shortest distance between the lightning conductor and the isolated metal body and the shortest distance between the isolated metal body and the grounded metal body is equal to or less than the bonding distance as calculated in accordance with 4.16.2.

4.16.3.3 Bonding connections shall be made between the lightning protection system and the grounded metal body.

4.16.3.3.1 The bonding connection shall be permitted to be made directly to the grounded metal body.

4.16.3.3.2 The bonding connection shall be permitted to be made from the lightning protection system to the isolated metal body and from the isolated metal body to the grounded metal body.

4.16.4 Materials. Conductors used for the bonding of grounded metal bodies or isolated metal bodies requiring connection to the lightning protection system shall be in accordance with bonding conductor requirements in Table 4.11.1.1.

4.17 Metal Antenna Masts and Supports. Metal antenna masts or supports located on a protected structure shall be connected to the lightning protection system using main-size conductors and listed fittings unless they are within a zone of protection.

4.18 Concealed Systems.

4.18.1 General.

4.18.1.1 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.

4.18.1.2 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.

4.18.2 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.

4.18.3 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.

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

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

4.18.4 Grounding Electrodes. Grounding electrodes for concealed systems shall be constructed of steel, copper, or other materials of durable quality that will effectively and safely carry a large electrical current. Where metal plates having a surface contact area of not less than 5200 mm² (8 in.²) or by welding or brazing.

4.19 Structural Metallic Systems.

4.19.1 General. The metal framework of a structure shall be permitted to be utilized as the main conductor of a lightning protection system if it is equal to or greater than 4.8 mm (5⁄32 in.) in thickness and is electrically continuous, or it is made electrically continuous by methods specified in 4.19.3.

4.19.2 Strike Termination Devices.

4.19.2.1 Strike termination devices shall be connected to the structural metal framework by direct connection, by use of individual conductors routed through the roof or parapet walls to the steel framework, or by use of an exterior conductor that interconnects all strike termination devices and that is connected to the metal framework.

4.19.2.2 Where such an exterior conductor is used, it shall be connected to the metal framework of the structure at intervals not exceeding an average distance of 30 m (100 ft), as widely spaced as practicable.

4.19.3 Connections to Framework. Conductors shall be connected to areas of the structural metallic framework that have been cleaned to base metal, by use of bonding plates having a surface contact area of not less than 5200 mm² (8 in.²) or by welding or brazing.

4.19.3.1 Drilling and tapping the metal column to accept a threaded connector also shall be permitted.

4.19.3.2 The threaded device shall be installed with at least five threads fully engaged and secured with a jam nut or equivalent.

4.19.3.3 The threaded portion of the connector shall be less than 12.7 mm (½ in.) in diameter.

4.19.3.4 Bonding plates shall have bolt-pressure cable connectors and shall be bolted, welded, or brazed to the structural steel framework so as to maintain electrical continuity.

4.19.3.5 Where corrosion-protective paint or coatings are removed, the completed electrical connection shall have corrosion protection equivalent to
4.20.3.1 Electrical Power Circuits. Where metal bodies located within a steel-framed structure are inherently bonded to the structure through the construction, separate bonding connections shall not be required.

4.20.2 Surge Protection. The requirements for surge protection systems installed for the electrical, communications (including, but not limited to, CATV, alarm, and data), or antenna systems or for other electrical system hardware shall apply only to permanently installed SPDs.

4.20.2.4 Surge Protection Requirements. SPDs shall be installed at all points where an electrical or electronic system conductor leaves a structure to supply another structure if the conductor or cables are run over 30 m (100 ft).

4.20.2.5 Surge Protection Requirements. SPDs shall be installed at entrances of conductive communications systems (including, but not limited to, CATV, alarm, and data) and antenna systems by the manufacturer in accordance with the requirements of this standard.

4.20.3 Surge Protection. Surge protection shall be permitted for installation at subpanels or branch panels and at the point of utilization (outlet or signal termination; also see Annex C for a discussion of bonding and an understanding of problems often encountered.)

4.20.5.1 Change Table 4.18.4 to Table 4.20.4. The SPD shall protect against surges produced by a 1.2/50 μs and 8/20 μs combination waveform generator.

4.20.3.1.1 The SPD shall protect against surges produced by a 1.2/50 μs and 8/20 μs combination waveform generator.

4.20.3.1.2 SPDs at the service entrance shall have a nominal discharge current rating of not less than 10 kA 8/20 μs or greater when installed at the entrance.

4.20.3.2 Signal, Data, and Communication Protection. SPDs shall be listed for the protection of signal, data, and communications systems and shall have an Imax rating of at least 10 kA 8/20 μs or greater when installed at the entrance.

4.20.3.3 Measured Limiting Voltage of an SPD. The published voltage protection rating (VPR) for each mode of protection shall be selected to be no greater than those given in Table 4.20.4 for the different power distribution systems to which they can be connected.

4.20.3.4 Facility or Surge Protection. SPDs are available in a wide range of types and are designed to protect the system from overvoltage transients resulting from the system or from external sources.

4.20.3.5 Electrical Power Circuits. The SPD shall be selected to protect the system from overvoltage transients resulting from the system or from external sources.

4.20.3.6 Communications Surge Protection. The SPD shall be selected to protect the system from overvoltage transients resulting from the system or from external sources.

4.20.3.7 Communications Surge Protection. The SPD shall be selected to protect the system from overvoltage transients resulting from the system or from external sources.

4.20.3.8 Earth Grounding Electrode. Resistance of the earth electrode system used in the grounding of SPDs shall comply with NFPA 70, National Electrical Code.

4.20.9 Physical Characteristics. The SPDs shall be protected with consideration for the operational environment and according to the manufacturer’s instructions.

A.4.15.1 For structures 18 m (60 ft) or less in height, a loop conductor should be provided for the interconnection of all grounding electrodes and other grounded media. Regardless of the building height, ground loop conductors should not be installed underground in contact with earth. Ground-level potential equalization allows use of a ground ring electrode as a ground loop conductor. A ground ring electrode conforming to A.4.13.4 can be utilized for the ground loop conductor.

A.4.15.2 In the case of flat or gently sloping roofs, the roof conductors required by A.4.9.2 can be used for achieving roof-level potential equalization. In the case of pitched roofs, the connection should be a loop placed at the eave level.

A.4.16.3 In addition to the bonding of metal bodies, surge suppression should be provided to protect power, communication, and data lines from dangerous overvoltages and sparks caused by lightning strikes, see Annex C for a discussion of bonding and an understanding of problems often encountered.

A.18.4.1 It is preferable that grounding electrodes be located no closer than 0.6 m (2 ft) from foundation walls to minimize the probability of damage to the foundation, although this is not always practicable for all applications. For structures 18 m (60 ft) or less in height, IEC 62305-3, Protection Against Lightning, requires that ring earth electrodes be buried at a depth of at least 0.5 m (18 in.) and a distance of approximately 1 m (3 ft) around external walls.

A.19.3.5 Protecting the base metal with a conductive, corrosion-inhibiting coating, coating the entire bond with a corrosion-inhibiting coating, or other corrosion prevention methods is recommended. A.4.20.1 Surge protection alone is not intended to prevent or limit physical damage from a direct lightning strike to a facility or structure. Rather, it is intended to defend against indirect lightning effects imposed on the electrical services to a structure as part of a coordinated lightning protection system installation. Surge currents and their corresponding overvoltage transients can be coupled onto electrical utility feeders in a number of ways. These mechanisms include magnetic or capacitive coupling of a nearby strike or the more dramatic but much less frequent conductive coupling of a direct cloud-to-ground discharge. These overvoltage transients pose a significant threat to modern electrical and electronic equipment.

A.4.20.2 The SPD responds to surges by lowering its internal impedance so as to divert surge current to limit the voltage to its protective level — the voltage limiting value. All SPDs shall be listed or identified as having the ability to protect against damaging surges. Occasionally, services exempted from the requirements in A.4.20.2.4 for surge protection alone are intended to prevent or limit physical damage from a direct lightning strike to a facility or structure. Rather, it is intended to defend against indirect lightning effects imposed on the electrical services to a structure as part of a coordinated lightning protection system installation. Surge currents and their corresponding overvoltage transients can be coupled onto electrical utility feeders in a number of ways. These mechanisms include magnetic or capacitive coupling of a nearby strike or the more dramatic but much less frequent conductive coupling of a direct cloud-to-ground discharge. These overvoltage transients pose a significant threat to modern electrical and electronic equipment.

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A.4.20.3 SPDs should be considered on branch distribution panels 30 m (100 ft) or more from the primary service entrance panel where the electrical equipment is susceptible to overvoltage transients. Exempt services less than 30 m (100 ft) from a SPD can be sufficient to allow overvoltages of magnitudes that can result in failure of susceptible electrical equipment. In order to reduce the probability of failure of mission-critical equipment or equipment that is critical to life safety, surge protection should be considered where the distance between the SPD at the service entrance exceeds 30 m (100 ft).

A.4.20.5 Most services to facilities will require discrete surge suppression devices installed to protect against damaging surges. Occasionally, services will be located in an area or manner where the threat from lightning-induced surges and overvoltage transients might be negligible. For example, the requirements in 4.20.2.3 (also see 4.20.6.1) exempt services less than 30 m (100 ft) in length that are run in grounded metal conduit between buildings requiring surge protection. Other examples where SPDs might not be required to be installed at each service entrance are those applications where fiber optic transmission lines (with no conducting members) are utilized. The standard recognizes that there can be acceptable exceptions and consequently allows for such exceptions to the requirements for surge suppression on electrical utility, data, and other signal lines, provided a competent engineering authority
has determined that the threat is negligible or that the system is protected in a manner equivalent to surge suppression.

Allowance in this standard for the exemption of surge suppression at specific locations is not intended as a means to provide a broad exemption simply because surge suppression might be considered inconvenient to install. Rather, this allowance recognizes that all possible circumstances and configurations, particularly those in specialized industries, cannot be covered by this standard. Determinations made by an engineering authority for exempting installation of SPDs should focus on the likelihood of lightning activity in the region, the level of damage that might be incurred, and the potential loss of human life or essential services due to inadequate overvoltage protection.

Four methods of analysis are commonly used for this determination, although other equivalent analysis can be used. The four methods are the following:

1. A risk assessment could be performed in accordance with IEC 62305-2, Protection Against Lightning, and surge protection requirements could be waived if justified by the assessment.
2. The lightning flash density/risk analysis is an analysis to determine the frequency of lightning activity in the geographic area of the facility. As a rule of thumb, the likelihood exceeds one flash per year, surge suppression or other physical protection should be considered. Lightning energy can indirectly couple to services at ranges greater than 1 km (0.6 mi) to create potentially damaging overvoltages.
3. Plant/facility statistical or maintenance records can also be used as a risk analysis. If these records can demonstrate the lack of damage on a service due to surges, it can be used to justify low risk of surge damage to a particular system or facility.
4. The lightning electromagnetic environment analysis starts with a threat electromagnetic field from a nearby lightning strike and computes the magnitude and rise-time characteristics of transients coupled into services feeding a structure or facility. Based on the computed threat, SPDs can be sized appropriately or omitted, as warranted. This analysis is typically performed for critical communications facilities and in military applications. Electromagnetic environments for such an analysis can be found in MIL-STD-464, Interface Standard for Electromagnetic Environmental Effects Requirements for Systems, and IEC 62305-4, Protection Against Lightning.

In all cases, the criticality of continued operation, potential life hazard to persons and essential services, and the consequence of facility damage or shutdown should be factors in the analysis. If a hazardous condition results from a surge causing temporary shutdown without permanent damage (e.g., the disabling of a computer or communication system), then the requirements for surge protection as articulated by Section 4.20 should not be exempted.

A.4.20.3.1 SPDs are typically sized significantly larger than the expected challenge level. At service entries, it is generally agreed that a nominal discharge current (I_d) of 25 kA will provide adequate protection. However, larger ratings that protect against less probable but more powerful lightning events will usually provide a better capability to handle multiple strikes and will usually provide a longer service life.

Rating the SPD’s In higher than the minimums in this document is recommended in areas with frequent lightning. Where installed, SPDs at branch panels or subpanels should have an In rating of 10 kA 8/20 µs or greater per phase.

Where installed, supplementary protection (also called point of utilization) SPDs should have an In rating of 5 kA 8/20 µs or greater per phase.

A.4.20.4 The measured limiting voltages of the SPD should be selected to limit damage to the service or equipment protected.


A.4.20.5 Surges can be induced upon any line entering a structure. Where installed, branch panels over 30 m (100 ft) from the service entrance should have SPDs rated for L–L, L–G, and L–N modes of protection. Additionally, L–L protection is also permitted (although this is usually achieved by the L–N modes across two phases). L–L protection is achieved by the L–N modes across two phases.

The following modes of protection are possible to minimize voltage differences between the individual conductors:

1. Line-to-line (L–L) protection places the SPD between the current-carrying conductors in a power system.
2. Line-to-neutral (L–N) protection places the SPD between the current-carrying conductors and the grounded conductor (neutral) in a power system.
3. Line-to-ground (L–G) protection places the SPD between the current-carrying conductors and the grounding conductor (ground) in a power system.
4. Neutral-to-ground (N–G) protection places an SPD between the grounded conductor (neutral) and the grounding conductor (ground) in a power system.

Differential mode is a term used for a mode of protecting telecommunications, data lines, and so forth. This mode places the SPD between the signal conductor and ground. It is analogous to L–G mode in power systems.

Differential mode is used for a mode of protecting telecommunications, data lines, and so forth. In this mode, an SPD is placed between the individual signal lines, analogous to the L–L mode of protection in power systems.

A.4.20.6.1 SPDs should be placed on both ends of external signal, data, and communication lines longer than 30 m (100 ft) connecting pieces of equipment or facilities, to protect against surges coupled into the wiring or caused by ground potential differences.

A.4.20.6.4 Differential mode protection should also be provided where practicable.

A.4.20.7.2 Longer, or looped, SPD line and ground conductors increase the impedance of the SPD ground circuit. Increasing the lead length serves to increase pass-through voltage at the point where the SPD is wired into service equipment or a branch panelboard. Consequently, it is essential to minimize lead length impedance in this circuit.

A.4.20.8 The effectiveness of the SPD is based on the impedance of the path to ground. A lower ground resistance minimizes voltage differences of conductors attached to SPDs near the service entrance and reduces the chance of arcing or insulation breach. Consequently, it is essential to minimize impedance in this circuit.

Substantiation: The TC reorders, reorganizes and simplifies Sections 4.15 through 4.21.

Committee Meeting Action: Accept

Ballot Results: Accept: 28 Negative: 0

Explanation of Negative: RAPP, R.: 4.19.3.3 “The threaded portion of the connector shall be not less than 12.7 mm (1/2 in.) - material requirements now call for a minimum of 1/4” - where is the research and justification for the change to 1/2”?

4.20 - Surge Protection should not be a requirement of this installation standard, but a recommendation and a referral to the NEC, NFPA 70.

A.4.15.1 - “For structures 18 m (60 ft) or less in height - not or less but 60’ or greater.

Comment on Affirmative: PORTFLEET, T.: All value in text and formulas have to be changed to express ‘English’ values first.
Committee Meeting Action: Accept  
Number Eligible to Vote: 28  
Ballot Results: Affirmative: 27 Negative: 1  
Explanation of Negative:  
RAPP, R.: See response to 780-45

780-46 Log #136  Final Action: Accept  
(4.18.3)

Submitter: Simon Larter, Warren Lightning Rod Company  
Recommendation: Revise text to read as follows:  
Surge Threat Levels Protective Device Ratings  
Substantiation: Section 4.18.3 has nothing to do with surge threat levels, but  
does have something to do with the required ratings of SPDs.  
Committee Meeting Action: Accept  
Number Eligible to Vote: 28  
Ballot Results: Affirmative: 26 Negative: 2  
Explanation of Negative:  
HEARY, W.: This topic belongs in the National Electrical Code.  
RAPP, R.: Surge Protection should not be a requirement for this installation  
standard and should be addressed in the NEC, NFPA 70.

780-47 Log #105  Final Action: Accept in Principle  
(4.18.3.2 and 4.18.3.2.1 (new))

Recommendation: Revise 4.18.3.2 to read as follows:  
4.18.3.2 Signal, Data, and Communication Protection. SPDs shall be listed  
for the protection of signal, data, and communications systems.  
Add new 4.18.3.2.1 to read as follows:  
4.18.3.2.1 Signal, data, and communications SPDs shall have a maximum  
discharge current (I max) rating of at least 10kA 8/20 us or greater when  
installed at the entrance.  
Substantiation: The text requires multiple requirements and which need to  
be broken out into subsections according to the Manual of Style Section 1.8.3  
Committee Meeting Action: Accept in Principle  
Revise text to read as follows:  
4.18.3.2 Signal, Data, and Communication Protection.  
4.18.3.2.1 SPDs shall be listed for the protection of signal, data, and  
communications systems.  
4.18.3.2.2 Signal, data, and communications SPDs shall have a maximum  
discharge current (I max) rating of at least 10kA 8/20 us or greater when  
installed at the entrance.  
Committee Statement: The Technical Committee accepts the submitter’s text  
and revises to comply with the Manual of Style.  
Number Eligible to Vote: 28  
Ballot Results: Affirmative: 26 Negative: 2  
Explanation of Negative:  
HEARY, W.: This topic belongs in the National Electrical Code.  
RAPP, R.: See response to 780-45  
Comment on Affirmative:  
MELTON, J.R.: 8X20 use waveforms apply to power service protection,  
whereas 10X1000 @ 100 Amps. (UL 497, UL 497A and UL 497C) apply to  
teleco and CATV protection. (Telecordia GR 1089, Chapter 4)

780-47a Log #CP10  Final Action: Accept  
(Table 4.18.4)

Submitter: Technical Committee on Lightning Protection,  
Recommendation: Revise Table 4.18.4 to add the following values under the  
Line-to-Neutral column to read as follows:  
600, 1000, 600, 600, 1200, 1200, 1200, 1800, 1200, 1800, 1800, 1800  
Rewrite Table 4.18.4 to add the following values under the Line-to-Neutral  
column to read as follows:  
600, 1000, 600, 600, 1200, 1200, 1800, 1200, 1800, 1800, 1800, 1800  
Rewrite Table 4.18.4 to add the following values under the Line-to-Neutral  
column to read as follows:  
- - 1200, 1200, 1800, 1800, 1800  
Substantiation: The technical committee updates the table.

Committee Meeting Action: Accept  
Number Eligible to Vote: 28  
Ballot Results: Affirmative: 26 Negative: 2  
Explanation of Negative:  
HEARY, W.: This topic belongs in the National Electrical Code.  
RAPP, R.: See response to 780-45

780-48 Log #65  Final Action: Reject  
(4.18.4 and A.4.18.4)

Submitter: Mitchell Guthrie, Engineering Consultant  
Recommendation: Revise 4.18.4 as follows:  
4.18.4 Measured Limiting Voltage of an SPD. The published voltage  
protection rating (VPR) for each mode of protection shall be selected to limit  
damage to the service or equipment protected. The recommended voltage protection  
rating per mode of protection for different power distribution systems to which  
they may be connected is shown in Table 4.18.4.  
Substantiation: The Surge Protection Task Group considered a suggestion to  
delete Table 4.18.4 but felt there may be some value to moving it to Annex A.  
Committee Meeting Action: Reject  
Committee Statement: The submitter did not provide any technical  
substantiation to justify the proposed text. The Technical Committee chooses to  
retain the table in the body of the document.  
Number Eligible to Vote: 28  
Ballot Results: Affirmative: 26 Negative: 2  
Explanation of Negative:  
HEARY, W.: This topic belongs in the National Electrical Code.  
RAPP, R.: See response to 780-45  
Comment on Affirmative:  
GUTHRIE, M.: I agree with the action taken on the proposal but do not  
concur with the Committee Statement. The reason for the rejection of the  
proposal is that 780-109 references the table, which minimizes the need to  
move the table.

780-49 Log #38  Final Action: Accept  
(4.18.5.3)

Submitter: John F. Bender, Underwriters Laboratories Inc.  
Recommendation: Revise text to read as follows:  
4.18.5.3 The protection of service entrances shall use Type 1 or Type 2 SPD, in  
compliance with applicable standards such as UL 1449, UL Standard for Safety  
Substantiation: Delete reference to edition of the UL standard in the text of  
this section. Instead, refer to the referenced edition as updated and listed in  
2.3.1 so the referenced standard edition is consistent throughout the document.  
Committee Meeting Action: Accept  
Number Eligible to Vote: 28  
Ballot Results: Affirmative: 26 Negative: 2  
Explanation of Negative:  
HEARY, W.: This topic belongs in the National Electrical Code.  
RAPP, R.: See response to 780-45

780-50 Log #110  Final Action: Reject  
(4.18.6)

Recommendation: Differentiate requirements base on the media carrying the  
signal  
Substantiation: 4.18.6.1 Requires SPDs on All Communications systems.  
Fiber optic cable is none conductive and does not require an SPD.  
Similarly the I max rating required may exceed the conductive capacity of  
some signal wires i.e. one twisted pair of phone wire.  
Committee Meeting Action: Reject  
Committee Statement: The submitter has not provided the specific proposed  
text in the recommendation for this proposal in accordance with 4.3.3(c) of the  
NFPA Regulations Governing Committee Projects including the wording to be  
added or revised and how the text in the document should be revised.  
Number Eligible to Vote: 28  
Ballot Results: Affirmative: 26 Negative: 2  
Explanation of Negative:  
HEARY, W.: This topic belongs in the National Electrical Code.  
RAPP, R.: See response to 780-45

780-26
Recommendation: Add new text to read as follows:

4.18.6.5.1 SPDs shall be provided on all proprietary equipment by the communication utility provider or the tenant communication utility.

Committee Meeting Action: Accept in Principle

Committee Statement: The Technical Committee accepts the submitter’s text and revised to comply with the Manual of Style.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

780-59 Log #109 Final Action: Accept in Principle (4.18.6.6.1 and 4.18.6.6.1.1)

Recommendation: Add new section: 4.18.6.6. SPDs shall be provided on all proprietary equipment by the communication utility provider or the tenant communication utility.

Committee Meeting Action: Accept in Principle

Add new text to read as follows:

4.18.6.5.1 SPDs shall be provided on all proprietary equipment by the communication utility provider or the tenant communication utility.

Committee Statement: The Technical Committee accepts the submitter’s text and revised to comply with the Manual of Style.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

780-57 Log #49 Final Action: Accept in Principle (4.19, 4.20, and 4.21)

Recommendation: Revise text to read as follows:

4.19 - Metal Bodies

4.19.1 - Metal bodies located outside or inside a structure that contribute to lightning hazards because they are grounded or assist in providing a path to ground for lightning currents shall be bonded to the lightning protection system in accordance with Sections 4.19.1.20, and 4.21-4.19.1.4. General - The factors in 4.19.1.1 through 4.19.1.4 shall determine the necessity of bonding a metal body to a lightning protection system.

4.19.1.4 Bonding - Bonding should be required if there is likely to be a parallel or inductive effect that might affect the electrical connection to the lightning protection system.

Committee Meeting Action: Accept in Principle

Committee Statement: The change satisfies the submitter’s intent.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 26 Negative: 2
Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

780-54 Log #106 Final Action: Accept in Principle (4.18.6.4.2.1 (New))

Recommendation: Add new text to read as follows:

4.18.6.2.1. Attachment to other grounded media such as building steel, grounded metallic conduit or water pipe, and the ground wire of the electric system shall be acceptable as electrode systems at the SPD location.

Committee Meeting Action: Accept in Principle

See Committee Action on Proposal 780-52.

Committee Statement: The Technical Committee notes the submitter intended to refer to 4.18.6.4.2.1. The change satisfies the submitter’s intent.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

780-55 Log #108 Final Action: Reject (4.18.6.5)

Recommendation: Add new text to read as follows:

4.18.6.5.1 SPDs shall not be required if the service provider has made other provisions for lightning surge threats.

Committee Meeting Action: Reject

Committee Statement: SPDs are not required on nonconductive lines. SPDs are not available to protect fiber optic cable.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

780-56 Log #109 Final Action: Accept in Principle (4.18.6.6 and 4.18.6.6.1)

Recommendation: Add new section: 4.18.6.6. SPDs shall be provided on all proprietary equipment by the communication utility provider or the tenant communication utility.

Committee Meeting Action: Accept in Principle

Add new text to read as follows:

4.18.6.5.1 SPDs shall be provided on all proprietary equipment by the communication utility provider or the tenant communication utility.

Committee Statement: The Technical Committee accepts the submitter’s text and revised to comply with the Manual of Style.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:

HEARY, W.: This topic belongs in the National Electrical Code.

780-57 Log #49 Final Action: Accept in Principle (4.19, 4.20, and 4.21)
5.8.4 Roof Top Helipads. Roof top helipads on protected structures shall be in accordance with Chapter 4 except as permitted by 5.8.1 through 5.8.7.

5.8.4.1 Metal bodies located in a steel framed structure that are inherently bonded through construction shall not require further bonding.

5.8.4.2 Conductors used for the interconnection of lightning protection system grounding electrodes, other grounded media shall be sized no smaller than the size required for the main conductor, as listed in Table 4.1.1.1.1 and Table 4.1.1.1.2.

5.8.4.3 Clamps and conductors shall be secured against vibration and rotor wash.

5.8.5 All exposed components shall be nonreflective or treated with a nonreflective finish.

5.8.6 Helipads used for parking shall have a designated point to connect the helicopter to the lightning protection system while parked.

5.8.7 All components of the lightning protection and grounding systems shall be located so as not to interfere with helicopter operations.

A.5.8.1 The metal thickness could be less than the dimensions required in Chapter 4. For nonmetal helipads, a flat metal plate should be permitted to serve as a strike termination device in the landing area if the landing area exceeds 15 m (50 ft) in both dimensions. The minimum exposed area of the plate should be 1950 mm² (3 in²). The minimum thickness of the plate should be 4.8 mm (3/16 in). The plate should be installed flush with the helipad surface and exposed to the air. The plate should be connected to the roof lightning protection system with a two-way horizontal or downward path.

A.5.8.6 The connection does not provide lightning protection for the parked aircraft. Consideration should be given to relocate the helicopter to a safer location.

Substantiation: Provide guidance for any AHJ and installers for protecting helipads on roofs of buildings and other structures.

This proposal was developed by the NFPA 780 Helipad Task Group (TG Members: Bruce Kaiser, Doug Franklin, Rich Bouchard and Tom Harger.)

The proposed change to 5.8.1 reflects the proper intent of the section that the metal frame of the safety net serve as a strike termination device rather than the safety net itself.

The first proposed change to 5.8.2 correlates with the proposed change to 5.8.1 while the second proposed change clarifies that the metal frame need not be electrically continuous, but rather, the mounting system to which the safety net is secured to be electrically continuous.

The term “aircraft warning” is proposed to be deleted from 5.8.3 as the intent of the section is not to solely limit the application to these but rather, to any type light that may be installed about the perimeter of the pad. Further, only lights that extend above the edge of the helipad require protection by air terminals.

In 5.8.4, “bonded” is proposed to be change to “connected” for clarity and for consistency with other text throughout NFPA 780. Reference is made to 4.16.3 to clarify how the connection is required to be made.

Annex text is proposed to be added to 5.8.6 to clarify that although the parked aircraft is connected to the LPS, that it is not necessarily protected by the LPS.

Proposed text is added to A.5.8.1 to clarify that the flat metal plate is applicable to nonmetal helipads whereas such a plate need not be added where the helipad surface is already metal. Reference to 4.15.3.2 is proposed to be added to point the user to the bonding requirements section of NFPA 780.

Committee Meeting Action: Accept

Explain Negative: HEARY, W.: This topic belongs in the National Electrical Code.

780-59 Log #98 Final Action: Accept

(6.2.2)

Committee Meeting Action: Accept


Recommendation: Change values as follows: 6.2.2 “lead having a minimum thickness of 1.63 mm (1/16 0.064 in)’’

Substantiation: Change is need to maintain consistency throughout the document as per the Manual of Style Section 4.1.2.

Committee Meeting Action: Accept

Ballot Results: Affirmative: 28
**780-60 Log #137**  
**Final Action: Accept in Principle**  
(Figure 7.3.2.2(a))

**Submitter:** Simon Larter, Warren Lightning Rod Company  
**Recommendation:** Revise text to read as follows:  
Extend tip of mast in figure to above the circumference of the circle around it.  
**Substantiation:** As the figure is now, the mast is not sufficiently differentiated from a simple radius arrow on the circle.  
**Committee Meeting Action:** Accept in Principle  
Revise figure as follows:

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**Committee Statement:** The Technical Committee accepts the submitter’s recommendation and edits Figure 7.3.2.2.(a). The change satisfies the submitter’s intent.  
**Number Eligible to Vote:** 28  
**Ballot Results:** Affirmative: 28

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**780-61 Log #26**  
**Final Action: Reject**  
(7.3.3.1 through 7.3.3.7)  

**Submitter:** Nestor Camerino, Naval Ordinance Safety and Security Activity (NOSSA)  
**Recommendation:** Publish equations contained on Pages 18 – 51 of the RSM Technical Paper that I have provided so that users have all of the equations required to accomplish NFPA 780, paragraph 7.3.3.6., and a mathematical model that allows heights above grade (e.g., numbers) to be placed against any points on the dashed zone of protection lines shown in Figure 7.3.3.2.  
**Substantiation:** Because equation

\[ d = \sqrt{h_1(2R - h_1)} - \sqrt{h_2(2R - h_2)} \]

is the only equation provided by NFPA 780 for review of air termination systems against the Rolling Sphere Model, it is widely thought that no other equations are required or that other equations are invalid. Further, and because equation

\[ d = \sqrt{h_1(2R - h_1)} - \sqrt{h_2(2R - h_2)} \]

is the only equation provided by NFPA 780, it is often incorrectly applied in attempts to define zone of protection coverage for air termination systems other than the single mast systems for which it was intended. The Abstract and Discussion Chapters of the accompanying RSM Technical Paper expound on the problem.  
**Note:** Supporting material is available for review at NFPA Headquarters.  
**Committee Meeting Action:** Reject  
**Committee Statement:** The submitter has not provided the specific proposed text in the recommendation for this proposal in accordance with 4.3.3(c) of the NFPA Regulations Governing Committee Projects including the wording to be added or revised and how the text in the document should be revised.  
The submitter’s text does not improve usability of the document or provide increased safety.  
**Number Eligible to Vote:** 28  
**Ballot Results:** Affirmative: 28

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**Figure 7.3.2.2(a)**  
(a) Single Mast  
Zone of protection defined by dashed lines

**Figure 7.3.2.2(b)**  
(b) Overhead Ground Wires  
Zone of protection defined by ground wire(s) and dashed lines
Committee Meeting Action: Accept in Principle

Recommendation: Delete existing requirements of 8.5.5 and add new 8.7 as follows:

8.7 Metallic Fences.
8.7.1 Grounding.
8.7.1.1 Fences shall be grounded where located within 3 m (10 ft) of a structure housing explosives with the grounding electrode interconnected with the grounding system of the structure.
8.7.1.2 Fences surrounding an explosives facility shall be grounded within 100 feet of where overhead power lines cross the fence.
8.7.1.3 Perimeter fences
8.7.1.4 Gate posts through which explosives material or personnel will pass shall be grounded in accordance with 8.7.3
8.7.2 Bonding
8.7.2.1 Fences shall be bonded across gates and other discontinuities in accordance with the requirements of 8.7.3
8.7.2.2 Metallic posts supporting fencing with a nonconductive coating shall utilize a rigid metallic bar, conductive tubing or wire bonded to the support post for interconnection of the fence posts.
8.7.3 Gates and Gate Posts
8.7.3.1 All gate posts shall be provided with a grounding electrode.
8.7.3.2 Class I main-size conductors, buried not less than 38 mm (18 in.) shall interconnect posts on opposite sides of a gate underground.
8.7.3.3 Gates shall be bonded to their grounded support posts.
8.7.3.4 Nonconductive gate posts supporting horizontal single metallic strands shall have down conductors extending the full height of the nonconductive pole and bonded to each single strand to form a continuous path to ground.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

8.7 Metallic Fences
8.7.1 Grounding
8.7.1.1 Fences shall be grounded where located within 6 ft (1.8 m) of a structure housing explosives by interconnection with the grounding system of the structure.
8.7.1.2 Fences meeting the criteria of 8.7.1.1 shall also be grounded within 30 m (100 ft) on both sides of where overhead power lines cross the fence.
8.7.1.3 Gate posts through which explosives material or personnel will pass shall be grounded in accordance with 8.7.3.
8.7.1.4 Metal single-strand fences with nonconductive posts requiring grounding in accordance with 8.7.1 shall use a main-size conductor extending the full height of the post.
8.7.1.5 The main-size conductor discussed in 8.7.3.4 shall be bonded to each single-strand to form a continuous path to ground.

8.7.2 Bonding
8.7.2.1 Fences shall be bonded across gates and other discontinuities in accordance with the requirements of 8.7.3.
8.7.2.2 Fencing mesh covered with nonconductive material shall be bonded to posts requiring grounding by 8.7.1.
8.7.3.1 All gate posts shall be provided with a grounding electrode meeting the requirements of 4.13 using a main-size conductor.
8.7.3.2 Class I main-size conductors, buried not less than 460 mm (18 in.) in depth, shall interconnect posts on opposite sides of a gate.
8.7.3.3 Gates shall be bonded to their grounded support posts using a flexible, secondary-size jumper.

Committee Statement: The Technical Committee accepts the submitter’s text with revisions for clarity and consistency of terms.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Comment on Affirmative:

8.7.3.3 Gates shall be bonded to their grounded support posts using a flexible, secondary-size jumper.

8.7.3.1 All gate posts shall be provided with a grounding electrode meeting the requirements of 4.13 using a main-size conductor.
8.7.3.2 Class I main-size conductors, buried not less than 460 mm (18 in.) in depth, shall interconnect posts on opposite sides of a gate.
8.7.3.3 Gates shall be bonded to their grounded support posts using a flexible, secondary-size jumper.

Committee Meeting Action: Accept

Ballot Results: Affirmative: 28

Proposal for an Addition to NFPA 780, 2011 Edition, Chapter 8

8.6.5.5 ISO Containers

Add the following section 8.6.5.5 ISO Containers.

8.6.5.5.1 ISO container shall be allowed to be used for the storage of small arms in ammo boxes, All-up weapons systems in shipping containers, warheads and rocket motors in shipping containers, metal cased or overpacked bombs, overpacked ammunition and explosives, as well as detonators and explosive actuators that are metallic overpacks, with no additional lightning protection system when the following conditions are met:

1. The container is in good condition, all welds and joints are sound.
2. Any damage has been repaired per MIL HDBK-138B.
3. (there is a Safe Separation Distance of 3m (6.0ft.)

8.6.5.5.2 ISO containers must have external NFPA 780 compliant Lightning Protection Systems when storing bulk explosives/propellants in non-conductive boxes or drums, rocket motors which have non-metallic cases, non-metal cased or overpacked cartridges and ammunition, or items shipped with open detonators or explosive actuators.

8.5-5.5 If any electrical power, communications and/or signal wiring, metallic pipes and/or ducting are installed on an ISO container, LPS as specified in DoD 6005.09-STD and NFPA-780 must be installed, with surge protection as necessary.

Final Action: Accept in Principle (8.6.5.5)
DoD steel ISO containers can be used to safely store the following AE items, with a minimum Safe Separation Distance of 0.6 inch, without the need for any external LPS:

1. Small arms in ammo boxes.
2. All-up weapon systems in shipping containers.
3. Warheads and rocket motors in shipping containers.
4. Metal cased or overpackaged bombs and AE.
5. Detonators and explosive actuators in metallic overpacks.

The following AE items must be stored in steel ISO containers that are protected with an external LPS:

1. Bulk explosives/propellants in non-conductive boxes or drums.
2. Rocket motors which have non-metallic cases.
3. Non-metal cased or overpackaged cartridges and ammunition.
4. Items shipped with open detonators or explosive actuators.

For personnel safety, a single earth electrode (e.g., a grounding rod) can be installed at or near the door of the container and bonded to it. If any electrical power, communications and/or signal wiring, metallic pipes and/or ducting are installed on an ISO container, LPS as specified in DoD 6055.09-STD and NFPA 780 must be installed, with surge protection as necessary.

Committee Meeting Action: Accept in Principle Add * to follow 8.6.5.

Add text to read as follows:

A 8.6.5 ISO containers are sometimes used for temporary storage of various explosives materials such as small arms in ammo boxes, various weapons system configurations in shipping containers, commercial explosives, fireworks, etc. Since the metal frame of a properly maintained ISO container does not meet the metal thickness requirement for strike termination devices, there could be some burn-through for some percentage of strikes. The metal frame would provide shielding from lightning electromagnetic effects and the surface area contact of the superstructure on the local earth will provide some impedance to earth. These could provide protection against the effects of lightning for some configurations and sensitivity of contents but not all. In some cases, it could be necessary to provide strike termination devices, additional bonding, and grounding of the ISO container. The decision as to whether the ISO container must be supplemented for the purpose of protection of lightning should be made by the authority having jurisdiction based on an assessment of the risk based on the sensitivity of the contents contained within the container.

Committee Statement: The scope of Chapter 8 is provided in Section 8.1.1. Earth-covered magazines are required to comply with the requirements of Section 8.6.1 and metal portable magazines with Section 8.6.5. The proposal seeks to obtain permission to utilize a less robust container than either of these with less stringent requirements. The submitter has not provided adequate technical substantiation. Data has not been provided to support inclusion of this text.

The Technical Committee does not necessarily agree with the submitter’s substantiation.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 27 Negative: 1

Explanation of Negative:

BATCHelor, C.: The working group had proposed doing some additional research that did not occur. The guidance provided needs more work before release.

Submitter: Mitchell Guthrie, Engineering Consultant

Recommendation: Relocate Clause 8.7 between the bonding requirements and requirements for specific facilities. Change the reference in 8.1.4 to 8.6 as shown below and renumber the remainder of the Chapter accordingly.

8.1.4 For those locations where no strike terminations are installed, bonding and SPDs shall be installed as described in Sections 8.4, 8.5, and 8.6.

8.4 Surge Protection. Surge protection as described in Section 4.18 shall be required for all power, communications, or data conductors entering or exiting a structure housing explosives.

8.5.1 Power and metallic communications lines (including intrusion detection lines) shall enter the facility in shielded cables or metallic conduit run underground for at least 15 m (50 ft) from the structure.

8.5.2 Conduits shall be bonded to the ground ring electrode where they cross.

8.5.3 Use of low-pass filters shall be permitted for added protection on critical electronic loads as determined by the AHJ.

Substantiation: The proposed arrangement of requirements makes the organization of this chapter in agreement with the remaining chapters as well as the document as a whole. The standard and associated chapters begin with general requirements of strike termination, conductors, grounding, bonding, surge protection, and options to discuss application of specific facilities.

Committee Meeting Action: Accept

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

Submitter: John Minker, 60th CES/CEOFE

Recommendation: Revise text to read as follows:

8.9.6 Lightning protection systems on explosives facilities shall be inspected visually at least 14-month 13-month intervals for evidence of corrosion or broken wires or connections.

Substantiation: Change in frequency of inspections aligns the inspections in a way to be more productive and coordinate work. Reduction in frequency of inspection aligns NFPA with AFI 32-1065 and the DoD Explosives Safety Board (DDES). Both the DDES and the Air Force have decades of experience with explosives storage and the recommended change meets the goals of NFPA and improves cost efficiency without reducing relative safety.

Committee Meeting Action: Reject

Committee Statement: The Technical Committee reaffirms its requirement for a 7-month inspection interval. The proposed period does not purport to DoDM 6055.09 and offers no proof that it improves relative safety.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

780-76 Log #31 Final Action: Reject (8.9.6,3)

Submitter: John Minker, 60th CES/CEOFE

Recommendation: Revise text to read as follows:

8.9.6.3 SPDs shall be inspected in accordance with the manufacturer’s instructions at intervals not exceeding 7 months or when the visual inspection is performed.

Substantiation: Change in frequency of inspections aligns the inspections in a way to be more productive and coordinate work. Reduction in frequency of inspection aligns NFPA with AFI 32-1065 and the DoD Explosives Safety Board (DDES). Both the DDES and the Air Force have decades of experience with explosives storage and the recommended change meets the goals of NFPA and improves cost efficiency without reducing relative safety.

Committee Meeting Action: Reject

Committee Statement: The Technical Committee reaffirms its requirement for a 7-month inspection interval. The proposed period does not purport to DoDM 6055.09 and offers no proof that it improves relative safety.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

Submitter: John Minker, 60th CES/CEOFE

Recommendation: Revise text to read as follows:

8.9.7 The lightning protection system shall be tested electrically at least every 44 months 28 months.

Substantiation: Change in frequency of inspections aligns the inspections in a way to be more productive and coordinate work. Reduction in frequency of inspection aligns NFPA with AFI 32-1065 and the DoD Explosives Safety Board (DDES). Both the DDES and the Air Force have decades of experience with explosives storage and the recommended change meets the goals of NFPA and improves cost efficiency without reducing relative safety.

Committee Meeting Action: Reject

Committee Statement: The Technical Committee reaffirms its requirement for a 14-month inspection interval. The proposed period does not purport to DoDM 6055.09 and offers no proof that it improves relative safety.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

780-77 Log #32 Final Action: Reject (8.9.7)

Submitter: John Minker, 60th CES/CEOFE

Recommendation: Revise text to read as follows:

8.9.7.7 SPDs shall be verified operable every 14 months 13-month when the system is tested electrically or after any suspected lightning strike.

Substantiation: Change in frequency of inspections aligns the inspections in a way to be more productive and coordinate work. Reduction in frequency of inspection aligns NFPA with AFI 32-1065 and the DoD Explosives Safety Board (DDES). Both the DDES and the Air Force have decades of experience with explosives storage and the recommended change meets the goals of NFPA and improves cost efficiency without reducing relative safety.

Committee Meeting Action: Reject

Committee Statement: The Technical Committee reaffirms its requirement for a 12-month inspection interval. The proposed period does not purport to DoDM 6055.09 and offers no proof that it improves relative safety.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

780-78 Log #33 Final Action: Reject (8.9.7,7)
Note: This proposal appeared as Comment 780-74 (Log #1) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: William Dean, SPAWAR Systems Center
Recommendation: I highly recommend it be adopted!!!
Substantiation: As a senior engineer/manager with Naval Facilities Engineering Command, I was a principal in hiring the University of Florida experts in lightning protection advise best approaches for design of lightning protection systems for airfield lighting systems. One of the main drivers of this effort was conflicting criteria between various government agencies including FAA, Air Force and Navy. The final study and standing good engineering practice are in concert with this proposed addition to the code.

Committee Meeting Action: Accept in Principle
Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Note: This proposal appeared as Comment 780-77 (Log #2) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: William Dean, SPAWAR Systems Center
Recommendation: I highly recommend it be adopted!!!
Substantiation: Please be aware the vast majority of airfield lighting circuits are ungrounded series circuits. Our need is not proper grounding practice, but proper lightning protection practice. This focus is the heart of Mr. Carl Johnson’s proposed addition to NFPA 780.

Committee Meeting Action: Accept in Principle
Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Note: This proposal appeared as Comment 780-78 (Log #3) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: Carl S. Johnson, II, AVCON, Inc.
Recommendation: We continue to support new Chapter 9 as contained in Proposal 780-77
Substantiation: The TC rejected the proposal stating “The TC sees this as bonding and grounding issues rather than lightning protection issues.” We respectfully disagree with the TC’s findings. We are in disagreement with the TC's conclusions based upon the following:
1. Canadian Electrical Code Section 74-002 Special Terminology; “Ground Counterpoise - a conductor installed over lighting cables for the purpose of interconnecting the system ground electrodes and promoting lightning protection for the cables.”
2. FAA AC 150/5370-10C, L-105S-3.6, first sentence: “If shown on the plans or included in the specifications, bare counterpoise copper wire shall be installed for lightning protection of the underground cables.”
3. FAA AC 150/5340-300, 12.5; “The purpose of the counterpoise or lightning protection system is to provide low resistance preferred paths for the energy of lightning discharges to enter the earth and safely dissipate without causing damage to equipment or injury to personnel.”
4. FAA SO-STO-71, cable detail note 4; “The #6 bare soft drawn copper (BSOC) cable counterpoise shall be installed above direct earth buried (OEB) cables to provide 45° cone of protection for all cables installed in the trench.”
5. NAVAIR 51-50AAA-2 Work Package 009 00 states; “Counterpoises are installed to protect the circuits and equipment from lightning damage.”
6. UEC 03-555-01, Part 12-1.5.1 last sentence states: “See the following paragraphs for providing a counterpoise system for lightning protection.”
7. An airfield lighting system counterpoise wire by definition is for lightning protection. In airfield lighting terminology “counterpoise” is synonymous with lightning protection.

Committee Meeting Action: Accept in Principle
Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Note: This proposal appeared as Comment 780-80 (Log #5) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: Carl S. Johnson, II, AVCON, Inc.
Recommendation: We continue to support new Chapter 9 as contained in Proposal 780-77.
Substantiation: The TC rejected the proposal stating “The TC sees this as bonding and grounding issues rather than lightning protection issues.” We respectfully disagree with the TC’s findings. We are in disagreement with the TC's conclusions based upon the following:
1. FAA SO-STO-71, cable detail note 4; “The #6 bare soft drawn copper (BSOC) cable counterpoise shall be installed above direct earth buried (OEB) cables to provide 45° cone of protection for all cables installed in the trench.”
2. NAVAIR 51-50AAA-2 Work Package 009 00 states; “Counterpoises are installed to protect the circuits and equipment from lightning damage.”
3. UEC 03-555-01, Part 12-1.5.1 last sentence states: “See the following paragraphs for providing a counterpoise system for lightning protection.”
4. An airfield lighting system counterpoise wire by definition is for lightning protection. In airfield lighting terminology “counterpoise” is synonymous with lightning protection.

Committee Meeting Action: Accept in Principle
Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28
The airfield signs, lights and other metallic items are the strike termination devices. Some NAVAIDs and other equipment outside the “aircraft safety area” are equipped with standard air terminals and down conductors. The interconnecting counterpoise conductors and other metallic items in contact with the earth perform as the down conductors and grounding electrodes.

All metallic items are interconnected to prevent side flash. The side flash distance in the earth can be up to 18 feet, three times the side flash distance in air. The signs, elevated fixtures and in pavement fixtures are the highest fixed points on an airfield.

For airfield lighting lighting protection systems the discharge medium for the lightning attachment can be the air or the earth.

The Proposed Chapter 9 provides a complete lightning protection system as described in NFPA 780 Chapter 4.

Note: Supporting material is available for review at NFPA Headquarters.

Committee Meeting Action: Accept in Principle

Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-85 Log #8
Final Action: Accept in Principle
(Chapter 9 (New))

Note: This proposal appeared as Comment 780-82 (Log #7) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: Carl S. Johnson, II, AVCON, Inc.

Recommendation: Add new item after 1.1.1(5):

60 Lightning Protection for Airfield Lighting Circuits

Substantiation: We are in disagreement with the TC’s conclusions based upon the following:

An airfield lighting system complies with the definition of an “ordinary structure” defined in NFPA 780-4.1.1. An airfield lighting system also complies with Merriam Webster’s definition of a structure -1: the action of building: 2 a : something (as a building) that is constructed b : something arranged in a definite pattern of organization <a rigid totalitarian structure.>

While not specifically included in 1.1.1 airfield lighting will fall within the general definition of a structure as provided by NFPA and Merriam Webster. The lightning protection system described in the proposed Chapter 9 is a traditional Franklin based lightning protection system providing a low resistance preferred path for the energy of lightning discharges to enter the earth and safely dissipate without causing damage to equipment or injury to personnel. The lightning protection of airfield lighting systems is no more unique or different from Chapter 4 requirements than the applications described in Chapters 5 through 8. Airfield lighting systems are not specifically excluded in 1.1.2 or 1.1.3.

Committee Meeting Action: Accept in Principle

Committee Statement: See Committee Proposal 780-4a (Log #CP11). The change satisfies the submitter’s intent.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-86 Log #10
Final Action: Accept in Principle
(Chapter 9 (New))

Note: This proposal appeared as Comment 780-83 (Log #8) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: Carl S. Johnson, II, AVCON, Inc.

Recommendation: We continue to support new Chapter 9 as contained in Proposal 780-77. The TC rejected the proposal stating “The proposal is beyond the scope of NFPA 780. The submitter is referred to 1.1.1.” We respectfully disagree with the TC’s findings.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-87 Log #11
Final Action: Accept in Principle
(Chapter 9 (New))

Note: This proposal appeared as Comment 780-84 (Log #9) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: Carl S. Johnson, II, AVCON, Inc.

Recommendation: We continue to support new Chapter 9 as contained in Proposal 780-77. The TC rejected the proposal stating “The TC sees this as bonding and grounding issues rather than lightning protection issues.” We respectfully disagree with the TC’s findings.

Substantiation: The airfield signs, lights and other metallic items at or above the earth’s surface are the strike attachment points. The signs, elevated fixtures and pavement fixtures are the highest fixed points on the airfield. These metallic items, by virtue of being buried in the earth, are grounded as defined by the NEC. However, only with the interconnection of these metallic items, by a properly sized conductor, can a complete lightning protection system be obtained.

One of the reasons all metallic items are interconnected is to prevent side flash. The side flash distance in the earth can be up to 18 feet, three times the side flash distance in air. Traditional bonding and grounding are not necessary to the safe electrical operation of a series lighting circuit. The bonding and grounding are necessary to prevent side flash.

The Proposed Chapter 9 provides a complete lighting protection system in absolute agreement with the physics and principles defined in NFPA 780 Chapter 4.

Committee Meeting Action: Accept in Principle

Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-88 Log #12
Final Action: Accept in Principle
(Chapter 9 (New))

Note: This proposal appeared as Comment 780-85 (Log #10) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: Carl S. Johnson, II, AVCON, Inc.

Recommendation: We continue to support new Chapter 9 as contained in Proposal 780-77. The TC rejected the proposal stating “There are four different standards that currently exist on this subject. The TC believes it would be improper to address this subject without coordination with other organizations such as FAA, NAVAIR, and Air Force program offices.”

We respectfully disagree with the TC’s findings. We are in disagreement with the TC’s conclusions based upon the following:

There are many more than four organizations with standards on lightning protection for airfield lighting and other underground circuits. However, the standards all vary in presentation, methods and effectiveness of protection.

A quote from “The Basis of Conventional Lightning Protection Technology” is appropriate in this context: “Recognizing the need for standardization to defeat substandard installations and the need to codify best practice for the protection of the public, our predecessors who were the eminent lightning protection experts of their day, enacted specifications.......... A situation where, in today’s language, authorities having jurisdiction and specifying engineers have little or no recourse. The end result will be a lack of lightning protection, resulting in a rise in lightning damage and possible loss of life or substandard protection to the same effect.”

We are at the same crossroads, without a standard such as NFPA 780 airfield lighting lightning protection is subject to a multitude of various codes whose implementation or lack thereof is subject to the funding agency.

Committee Meeting Action: Accept in Principle

Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-89 Log #13
Final Action: Accept in Principle
(Chapter 9 (New))

Note: This proposal appeared as Comment 780-75 (Log #11) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: Carl S. Johnson, II, AVCON, Inc.

Recommendation: We continue to support new Chapter 9 as contained in Proposal 780-77.
Substantiation: The TC rejected the proposal stating “There are four different standards that currently exist on this subject. The TC believes it would be improper to address this subject without coordination with other organizations such as FAA, NAVAIR, and Air Force program offices.” We respectfully disagree with the TC’s findings. We are in disagreement with the TC’s conclusions based upon the following:

There are many more than four organizations with standards on lightning protection for airfield lighting and other underground circuits. However, the standards all vary in presentation, methods and effectiveness of protection.

We are at a defining moment, without a standard such as NFPA 780 airfield lighting lightning protection is subject to a vast array of lightning protection criteria whose performance and implementation is subject to the public’s interpretation.

The proposed Chapter 9 is based upon solid and proven Franklin based conventional lightning protection techniques. The foundation for the proposed Chapter 9 is “Engineering Analysis of Airfield Lighting System Lightning Protection - Final Report.” The primary investigator of the report is Dr. Rakov a member of the TC.

The TC received comments on the proposal from the FAA prior its meeting in San Antonio. The U.S. Navy commissioned the “Engineering Analysis of Airfield Lighting System Lightning Protection - Final Report” and has implemented the reports recommendations in the Navy’s airfield lighting projects. The DOD, U.S. Army, DOE, U.S. Air Force and the U.S. Navy are all represented on the TC. The Proposed Chapter 9 should be incorporated into NFPA 780.

Committee Meeting Action: Accept in Principle
Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-90 Log #14 Final Action: Accept in Principle (Chapter 9 (New))

Note: This proposal appeared as Comment 780-86 (Log #12) which was held from the Annual 2010 ROC on Proposal 780-77.
Submitter: Carl S. Johnson, II, AVCON, Inc.
Recommendation: We continue to support new Chapter 9 as contained in Proposal 780-77.
Substantiation: The TC rejected the proposal stating “There are four different standards that currently exist on this subject. The TC believes it would be improper to address this subject without coordination with other organizations such as FAA, NAVAIR, and Air Force program offices.”

We respectfully disagree with the TC’s findings. We are in disagreement with the TC’s conclusions based upon the following:

There are many more than four organizations with standards on lightning protection for airfield lighting and other underground circuits. However, the standards all vary in presentation, methods and effectiveness of protection.

Military airfield lighting lightning protection systems are prescribed by the respective branch of service criteria and unique exceptions. FAA’s owned facilities address lightning protection in FAA “Standards”. The FAA Advisory Circulars are mandatory requirements for Part 139 Air Carrier airport owned lighting systems which are funded by AIP and PFC funding sources. Privately owned airports and general aviation airports are not required to comply with FAA Advisory Circulars.

The airfield lighting lightning protection standards and codes in use vary in their effectiveness and proper application of proven Franklin methods. AC 150/5340-30 requires the fixtures to be isolated (5 feet max) from the counterpoise. The “Engineering Analysis of Airfield Lighting System Lightning Protection - Final Report,” demonstrates that for isolation to be effective a distance of at least 18 feet in soil is necessary. UFC 3-535-01 states to not connect the counterpoise to the lighting vault power grounding system. This statement is in direct conflict with NFPA 70-250.106 and NFPA 780-4.14.

A single consensus airfield lighting lighting protection standard is a necessity for the safeguarding of persons and property from the hazards arising from exposure to lightning and should be instituted to replace the overabundance of ineffective and conflicting standards.

The breadth and depth of the NFPA 780 Technical Committee’s experience is unmatched. The TC is the consummate expert on lightning protection and therefore the obvious source for an airfield lighting lighting protection standard. The Proposed Chapter 9 should be incorporated into the next edition of NFPA 780.

Committee Meeting Action: Accept in Principle
Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-91 Log #15 Final Action: Accept in Principle (Chapter 9 (New))

Note: This proposal appeared as Comment 780-87 (Log #13) which was held from the Annual 2010 ROC on Proposal 780-77.
Submitter: Vladimir A. Rakov, University of Florida
Recommendation: Accept Proposal 780-77.
Substantiation: The NFPA Technical Committee’s action was to “Reject” proposal 780-77 (Log #8). The committee stated the following reasons for rejecting the proposal:
1. “The TC sees this as bonding and grounding issues rather than lighting protection issues.”
2. The proposal is beyond the scope of NFPA 780. The submitter is referred to 1.1.1.
3. “There are four different standards that currently exist on this subject. The TC believes it would be improper to address this subject without coordination with other organizations such as FAA, NAVAIR and Air Force program offices.”

These reasons do not appear valid to me, as explained in the item-by-item comments below.

1. Buried objects, such as underground cables, are usually protected against lightning by means of a counterpoise (and sometimes also by vertical ground rods connected to the counterpoise). The counterpoise is a bare horizontal conductor usually placed above the cable, and it serves to intercept the lightning current, similar to ground wires placed above phaseconductors of overhead power lines. However, as opposed to the overhead ground wire, the counterpoise also plays the role of a grounding electrode whose function is to dissipate the lightning current in the soil. Lightning termination on underground cables not protected by the counterpoise is illustrated in Fig. 1. Thus, the counterpoise combines the functions of lightning interceptor and grounding electrode, as opposed to being just the “bonding and grounding issues.”

2. Section 1.1 (Scope) of NFPA 780 is updated as needed. For example, section 1.1.2 proposed for the 2011 Edition differs from that in the 2008 Edition. Further, the NFPA Technical Committee has accepted in principle a new Chapter on Protection for Wind Turbines (780-78 Log #87), which is clearly outside the current scope of NFPA 780 and even explicitly excluded from this scope, because wind turbines are “electric generating systems”.

3. If the TC feels that an input from other organizations is needed, why not request that input instead of rejecting the proposal?

Note: Supporting material is available for review at NFPA Headquarters.

Committee Meeting Action: Accept in Principle
Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-92 Log #16 Final Action: Accept in Principle (Chapter 9 (New))

Note: This proposal appeared as Comment 780-88 (Log #44) which was held from the Annual 2010 ROC on Proposal 780-77.
Submitter: Dean Ralphs, Elcon Associates, Inc.
Recommendation: Accept proposal 780-77.
Substantiation: In its rejection of the proposal, one of the TC’s statements was, “The TC sees this as bonding and grounding issues rather than lightning protection issues.” Bonding and grounding is an essential and integral part of effective lightning protection. The requirements for bonding and grounding are pervasive throughout NFPA 780. The proposal is to apply proven grounding and bonding practices to a currently unaddressed condition for the purposes of lightning protection. There is nothing in this that is incompatible with the intent of NFPA 780.

Committee Meeting Action: Accept in Principle
Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-93 Log #17 Final Action: Accept in Principle (Chapter 9 (New))

Note: This proposal appeared as Comment 780-89 (Log #45) which was held from the Annual 2010 ROC on Proposal 780-77.
Submitter: Dean Ralphs, Elcon Associates, Inc.
Recommendation: Accept proposal 780-77.
Substantiation: In its rejection of the proposal, one of the TC’s statements was, “The proposal is beyond the scope of NFPA 780. The submitter is referred to 1.1.1.”

Section 1.1.1 does not exclude airfield lighting equipment. Section 1.2 states that the purpose of NFPA 780 is “to safeguard persons and property. Annex F details the methodology of lightning protection for trees (for informational
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purposes only). It is incomprehensible that the protection of trees is within the purview of NFPA 780, but that airfield lighting systems which may cost over a million dollars at a large airport and are an essential life-safety system are not within the scope of NFPA 780.

Committee Meeting Action: Accept in Principle

Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

Ballot Results: Affirmative: 28

Note: This proposal appeared as Comment 780-90 (Log #46) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: Dean Ralphs, Elcon Associates, Inc.

Recommendation: Accept proposal 780-77.

Substantiation: In its rejection of the proposal, one of the TC’s statements was, “There are four different standards that currently exist on this subject. The TC believes it would be improper to address this subject without coordination with other organizations such as FAA, NAIAIR and Air Force program offices."

Other agencies have produced their own airfield lighting lightning protection requirements in part because there is no standard issued by a higher authority that they could defer to. It is appropriate that NFPA 780 become that standard. Ideally, development of the NFPA 780 requirements for airfield lighting systems would be a collaborative process with all stakeholders. Unfortunately, there is not the political will to force all the players to the table to discuss these issues.

The existing standards are a mish-mash of incompatible requirements, which change periodically and some of which are not in keeping with traditional methods with demonstrated effectiveness. Implementation of these inappropriate methodologies places airfield lighting systems and the flying public at risk. Leadership on this issue from the NFPA is needed now.

The FAA installation requirements for airfield lighting lighting protection apply to airports constructed or maintained with FAA funds. There are a large number of private airfields in the U.S. that are built and maintained per whatever standards the owner and designer and any local inspector feel are appropriate. The proposed Chapter 9 in NFPA 780 would fill a void in providing authoritative guidance for private airfields.

Committee Meeting Action: Accept in Principle

Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

Committee Meeting Action: Accept in Principle

Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

The afternoon thunderstorms bring thousands of lightning strikes to our area almost daily. With any changes to our lighting protection system we would suffer many more outages, greater equipment damage, and subject our maintenance personnel to greater electrical hazards.

Committee Meeting Action: Accept in Principle

Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

Note: This proposal appeared as Comment 780-93 (Log #51) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: Frank Barczak, Greater Orlando Aviation Authority

Recommendation: We unconditionally support and recommend the incorporation of this proposal into NFPA 780.

Substantiation: Pinecastle Army Airfield was founded in 1942. The base was renamed McCoy Air Force Base on May 7, 1958. In 1974, McCoy Air Force Base (MCO) was closed and the deed was transferred to the City of Orlando.

In 1975, The Greater Orlando Aviation Authority (GOAA) was created by a special legislative act. In 1976, the airport was renamed Orlando International Airport. Orlando, Florida is located in Central Florida. When reviewing historical satellite views of strike frequencies, the Central Florida area is blanketed with a significant amount of lightning. Some have even said that we live in the lightning capital of the United States.

GOAA received a 1940 to 1950 vintage military airfield lighting system. Lightning damage to the airfield lighting systems was a significant maintenance problem. A single lightning strike would damage or destroy from 20 to 100+ airfield lighting fixtures depending upon the severity of the strike.

During the design of the new third runway (R/W 17-35) in 1987, the Greater Orlando Aviation Authority and the design team researched FAA design standards, military design standards, and utility design standards to implement the best lightning protection system available.

The design included a copper counterpoise conductor routed over the center of each underground duct and conduit. The counterpoise was connected to each base can and ground rods were installed at 500 foot maximum intervals. The counterpoise was also connected to the base to rebar cages, manholes and all metallic elements within the airfield lighting system. Each ground rod was designed to have an earth resistance not to exceed 5 ohms. The counterpoise was connected to the airfield vault’s earth electrode system.

The airfield lighting vault’s lightning protection system was designed in accordance with NFPA 780. Each CCR was specified with input and output lightning protection. Transient voltage surge suppression (TVSS) was provided for all sensitive or critical loads. The goal was to provide a preferred path for lightning currents, achieve maximum earth impedance to a lightning strike, equipotential bonding and to provide maximum reliability for the airfield lighting system. Runway 17-35 was opened in 1989.

While exact quantities of items damaged by lightning are not kept, GOAA Maintenance soon noticed the Third Runway was not suffering the severity of lightning damage of either the other previous runways.

During the 90’s, the existing military runways two runways were rehabilitated. Experience dictated that the rehabilitation of the two runways include the same lightning protection measures incorporated for the Third Runway. Again, GOAA Maintenance noticed a significant decrease in the amount of damage caused by lightning.

In the year 2000, design of the fourth runway (R/W 171-35R) was started. Again, the design included the proven lightning protection measures, similar to those recommended in NFPA 780-1999.

The 4th runway opened to air carrier traffic on December 25, 2003. During the past five years, the 4th runway at Orlando International Airport has consistently and reliably performed after severe thunderstorms, while surrounding electrical systems such as street lighting, and structures/systems not protected against lightning suffered damage.

The consistent and reliable performance of the airfield lighting systems at Orlando International Airport is testament to proper airfield lighting operation and the lightning protection criteria proposed in the new NFPA 780 Chapter 9 (Proposal 780-77).

Committee Meeting Action: Accept in Principle

Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

Note: This proposal appeared as Comment 780-76 (Log #53) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: Seward Ford, Visual Aids Services Inc.

Recommendation: Accept Proposal 780-77.
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Substantiation: I have been involved with airport lighting for 45 years. The isolated constant current series circuit continues to be the most reliable power distribution system available. The incandescent lamp continues to be the major light source used on the series circuit. The FAA requires a minimum fixture candela output for each fixture application. A small percentage of current reduction results in a large reduction in fixture candela output. Multiple current leakages to ground caused by lightning transients resulting in either high resistance or low resistance paths will result in a non serviceable lighting system. The proposed bonding method for lightning protection provides the best overall lighting system protection against damage. The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Committee Meeting Action: Accept in Principle
Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Ballot Results: Affirmative: 28

780-99 Log #23 Final Action: Accept in Principle (Chapter 9 (New))

Note: This proposal appeared as Comment 780-94 (Log #55) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: Peter Robson, Naval Facilities Engineering Command

Recommendation: Accept Proposal 780-77

Substantiation: The NFPA Technical Committee’s action was to “Reject” the proposal for application and design requirements for air field lighting protection. The committee stated the following reasons for rejecting the proposal:
1. “The TC sees this as bonding and grounding issues rather than lightning protection issues.”
2. “The proposal is beyond the scope of NFPA 780. The submitter is referred to 1.1.1.”
3. “There are four different standards that currently exist on this subject. The TC believes it would be improper to address this subject without coordination with other organizations such as FAA, NAVAIR and Air Force program offices.”

The commenter agrees this is (in part) a bonding and grounding issue. However, the solution proposed provides an integrated solution that accounts for bonding, grounding, and lightning protection. This philosophy is consistent with 4.14.1.1 and 4.19 of NFPA 780 requirements which integrates bonding, grounding, flashover, side flash, and lightning protection.

The commenter agrees that this proposal is not within the scope as strictly defined by 1.1.1. However, since this is a controversial and complicated issue, this is an opportunity to add a new category, such as “air field lighting systems.”

Commenter agrees there are many different standards indicated. However, many of these standards have little or no public domain published engineering, scientific, and/or statistical basis for supporting their respective topology. For example, another alternative may be the integration of an approved shielded cable/connector solution. Shielded cable solutions used on underground power cables, CATV cables, and telecommunications cables have demonstrated a reliable underground design solution. This may be part of this standard. Considering the absence of substantial cable protection (metallic conduits) used in air field lighting systems, viable application and design criteria must be established to ensure air field lighting systems are properly protected from all natural and man made anomalies, including side flash, flashover, short circuit, touch voltage, and potential equalization.

The proposal is supported by a study conducted by the University of Florida. The attempts to coordinate this issue amongst the 000 were made. These attempts did not result in consensus. NFPA can provide guidance on this subject. The proposal identified as part of the new Chapter 9 submission is consistent with NFPA 780 concepts. This includes the principle of protection of life and property, intercepting, conducting, and dissipating the lightning strike discharge. This is an opportunity for the organization to provide leadership, coordination, application and installation guidance for a controversial issue.

Committee Meeting Action: Accept in Principle
Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

780-100 Log #24 Final Action: Accept in Principle (Chapter 9 (New))

Note: This proposal appeared as Comment 780-95 (Log #56) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: David Rainey, Navaid Lighting Associates, Inc.

Recommendation: I am in support of the inclusion of this new chapter on Lightning Protection for Airfield Lighting Circuits.

Substantiation: I am a licensed master electrical engineer and have been involved in the design, installation and maintenance of airfield lighting systems for over 30 years. The inclusion of this wording in the document is important because of the special circumstances and design requirements for ungrounded series lighting circuits as stated.

Committee Meeting Action: Accept in Principle
Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Ballot Results: Affirmative: 28

780-101 Log #25 Final Action: Accept in Principle (Chapter 9 (New))

Note: This proposal appeared as Comment 780-96 (Log #76) which was held from the Annual 2010 ROC on Proposal 780-77.

Submitter: James A. Kris, Pine Hill Airport

Recommendation: Support for inclusion of proposal NFPA 780-77.

Substantiation: I am writing in response to the request for comments on the pending review of NFPA 780. As an airport owner/operator in Western New York, and an airport consultant nationwide, we believe it is essential that the NFPA document be a recognized source of issues on airport lighting lightning protection. Although many documents refer generally to the NEC, the NFPA is widely regarded as the bible of hangar development at airports.

In addition, it allows for a single reference document to accommodate all of the requirements for hangar development at airports. There is always a concern for lightning impacts on airport lighting systems, hangars and facility buildings, including sophisticated and delicate electronic systems.

Without requiring multiple references in various construction and development bidding documents, we recommend that the NFPA continue to serve as the source of lightning protection (and potential fires resulting therefrom) and that the Technical Committee reconsider the requirements to include airfield lighting lightning protection as a supplemental chapter in NFPA 780. It will enable us in the airport development and management business to cite the overall requirements for the NFPA as the single source document for all matters pertaining to fire protection, including lightning protection and grounding, for our hangar and airfield lighting programs.

Committee Meeting Action: Accept in Principle
Committee Statement: The Technical Committee realizes that this proposal was placed on hold in the last cycle. The Technical Committee has addressed this subject. See action and statement on Proposal 780-108.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

780-102 Log #111 Final Action: Accept in Principle (10.4.1.3)

Submitter: John M. Tobias, US Army Communications Electronics Command

Recommendation: Add text to read as follows:

\[ A = \frac{3.4 \times 10^{2}}{\frac{\rho}{C_p D (MP)}} \text{ in}^2 \]

where:
- \( A \) = cross-sectional area, in.\(^2\)
- \(\rho\) = resistivity in \(\Omega\)-in.
- \(C_p\) = specific heat capacity in BTU/lb °F
- \(D\) = density in lb/in.\(^3\)
- \(MP\) = melting point in degrees Fahrenheit

Substantiation: Equivalent units provided in accordance with Manual of Style and NFPA 780 Editorial Task Group minutes, 4/11/2011.

780-37
Revise text to read as follows:

10.4.1.3* A conducting fitting constructed of metal other than copper or aluminum that neither contains electrical wiring nor connects conductors containing electrical wiring shall be permitted to be used as a main conductor if it has at least the cross-sectional area given by one of the following formulas:

\[ A = 3.4 \times 10^2 \frac{\rho}{C _p D(MP)} \text{in}^2 \]

Keep existing metric equation.

Revise A in the existing equation to read as follows:

\[ A = 1.3 \times 10^2 \frac{\rho}{C _p D(MP)} \text{in}^2 \]

where:

\[ A \] = cross-sectional area, in.²
\[ \rho \] = resistivity in Ω-in.
\[ C _p \] = specific heat capacity in BTU/lb°F
\[ D \] = density in lb/in.³
\[ MP \] = melting point in degrees Fahrenheit

Substantiation: Equivalent units provided in accordance with Manual of Style and NFPA 780 Editorial Task Group minutes, 4/11/2011.

Committee Meeting Action: Accept in Principle

Revise text to read as follows:

10.4.2.3* A conducting fitting constructed of metal other than copper or aluminum that neither contains electrical wiring nor connects conductors containing electrical wiring shall be permitted to be used as a bonding conductor if it meets the minimum cross-sectional area given by one of the following formulas:

\[ A = 1.3 \times 10^2 \frac{\rho}{C _p D(MP)} \text{in}^2 \]

Add existing metric equation here.

Revise A to read as follows:

\[ A = \text{cross-sectional area, mm}^2 \]

Committee Statement: The Technical Committee accepts the submitter’s text and revises the body of the text and A in the existing equation.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

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Submitter: John M. Tobias, US Army Communications Electronics Command

Recommendation: Add text to read as follows:

780-103 Log #112 Final Action: Accept in Principle

(10.4.2.3)

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Recommendation: Change value to read as follows:

10.5.3.1. “Conductor within 200 305 mm (8 ft) of the waterline.”

Substantiation: Change need to maintain consistency throughout the document as per the Manual of Style Section 4.1.2.

Committee Meeting Action: Accept

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

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Recommendation: Change value to read as follows:

10.5.3.1. “at least 1.8 m (6 ft) above the waterline.”

Substantiation: Change need to maintain consistency throughout the document as per the Manual of Style Section 4.1.2.

Committee Meeting Action: Accept

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

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Submitter: Carl S. Johnson II, AVCON, Inc.

Recommendation: Add new Section 1.1.1(6) to the document scope as follows:

1.1.1(6) Airfield lighting circuits

Add new Chapter 11 mandatory text and Annex A material as follows:

11.1 General.

11.1.1* This chapter shall provide the minimum requirements for the installation of a lightning protection system for airfield lighting systems and components.

11.1.2* Lightning protection systems for airfield lighting shall be installed entirely underground in accordance with the provisions of this chapter.

11.2 Application.

11.2.1* The airfield lighting counterpoise system shall be a separate and unique lightning protection system specifically suited for use with series (current driven) airfield lighting circuits.

11.2.2* The airfield lighting counterpoise system shall also provide lightning protection for parallel (voltage powered) circuits, control circuits, and monitoring circuits.

11.2.3 To reduce the potential for flashover and any inductive/capacitive coupling arising from a lightning strike, the counterpoise conductor shall be a separate conductor, and not be located within any raceway used for power, communications, control or signal conductors.

11.2.4 The requirements of 4.2 Materials, 4.3 Corrosion Protection, 4.4 Mechanical Damage or Displacement, 4.9.5 Conductor Bends, 4.13 Grounding Electrodes and 4.14 Common Grounding shall also apply, unless they conflict with this chapter.
11.2.5* An airfield lighting lightning protection system shall be permitted to be omitted when the average lightning flash density is 2 or less flashes per square kilometer per year and when permitted by the authority having jurisdiction (AHJ).

11.3 Purpose.

11.3.1 The airfield lighting counterpoise system shall provide protection for airfield lighting systems from energy arising from lightning strikes.

11.3.2* The airfield lighting counterpoise system shall provide a path for dissipation of lightning discharge energy to earth minimizing damage to equipment, raceway or cables and electrical shock to personnel.

11.4 Installation of Airfield Lighting Counterpoise System.

11.4.1* Counterpoise Conductor. The counterpoise conductor shall be a bare, annealed or soft drawn, solid copper conductor not smaller than 6 AWG. Bare copper counterpoise conductors are adversely affected by the installed environment, electrically conductive materials (Example; tinned copper) as permitted by the AHJ shall be utilized.

11.4.1.2 Electrically conductive materials shall possess the same performance, qualities and characteristics as the copper counterpoise conductor.

11.4.2 Counterpoise Conductor Location. The counterpoise conductor shall be installed in accordance with 11.4.2.1 through 11.4.2.7.

11.4.2.1 The counterpoise conductor shall be bonded to grounding electrodes at intervals not exceeding 150 m (500 ft).

11.4.2.2 The counterpoise conductor shall be bonded to grounding electrodes located on each side of a raceway crossing under the airfield pavement.

11.4.2.3 The airfield lighting counterpoise system shall connect to the airfield lighting vault or other airfield lighting circuit power source grounding electrode system.

11.4.2.4* Surge arresters shall be permitted to be installed in the airfield lighting circuit.

11.4.2.5 Reinforcing steel, when used as part of the light base installation, shall be bonded to the metallic light base using a 6 AWG bare solid copper conductor.

11.4.2.6* For edge light fixtures installed in turf (stabilized soils) and for raceways or cables adjacent to the full strength pavement edge, the counterpoise conductor shall either be installed halfway between the pavement edge and the light base, mounting stake, raceway or cable as shown in Figure 11.4.2.6 or in accordance with 11.4.2.7.

Note: Light base ground rod can be installed either through the bottom of the light base or exterior to the light base.

FIGURE 11.4.2.6 Edge Light Fixtures Installed in Turf (stabilized soils) and for Raceways or Cables Adjacent to the Full Strength Pavement Edge.
11.4.2.6.1 The counterpoise conductor shall be installed 203 mm (8 in.) minimum below grade.

11.4.2.6.2 Each light base or mounting stake shall be provided with a grounding electrode.

11.4.2.6.2.1 When a metallic light base is used, the grounding electrode shall be bonded to the metallic light base or mounting stake with a 6 AWG bare, annealed or soft drawn, solid copper conductor.

11.4.2.6.2.2 When a nonmetallic light base is used, the grounding electrode shall be bonded to the metallic light fixture or metallic base plate with a 6 AWG bare, annealed or soft drawn, solid copper conductor.

11.4.2.7 For raceways installed under pavement, for raceways and cables not installed adjacent to the full strength pavement edge, for fixtures installed in full strength pavement and shoulder pavement and for optional method of edge lights installed in turf (stabilized soils) and for raceways or cables adjacent to the full strength pavement edge, the counterpoise conductor shall be centered over the raceway or cable to be protected as described in this subsection and as shown in Figure 11.4.2.7.

11.4.2.7.1 The counterpoise conductor shall be installed no less than 203 mm (8 in.) above the raceway or cable to be protected, except as permitted in 11.4.2.7.2.

11.4.2.7.2 The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.

11.4.2.7.3 The counterpoise conductor shall be installed no more than 305 mm (12 in.) above the raceway or cable to be protected.

11.4.2.7.4 The counterpoise conductor height above the protected raceway(s) or cable(s) shall be calculated to ensure the raceway or cable is within a 45 degree area of protection.

11.4.2.7.5 The area of protection shall be determined only by the 45 degree triangular prism area of protection method.

11.4.2.7.6 The counterpoise conductor shall be bonded to each metallic light base, mounting stake and metallic airfield lighting component.

11.4.2.7.7 All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system.

11.4.3 Multiple Raceways or Cables in a Common Formation.

11.4.3.1 Multiple raceways or cables in a common formation or assembly wider than the area of protection provided by a single counterpoise conductor shall be provided with multiple counterpoise conductors.
11.4.3.2* As shown in Figure 11.4.3.2, the number of counterpoise conductors required shall be determined by the height of the counterpoise conductors over the raceways or cables being protected, while maintaining the 45 degree area of protection.

11.4.3.3 Where multiple counterpoise conductors are used they shall be interconnected longitudinally at intervals not exceeding 90 m (300 ft) as shown in Figure 11.4.3.3.
11.4.4 Counterpoise Conductor Interconnections.

11.4.4.1 Where raceways or cables cross, the counterpoise conductors shall be interconnected.

11.4.4.2* Where an existing airfield lighting system is being extended or modified, the new counterpoise conductors shall be interconnected to existing counterpoise conductors at each intersection of the new and existing airfield lighting counterpoise systems.

11.4.5 Grounding Electrodes.

11.4.5.1* The counterpoise conductor shall be bonded to grounding electrodes in accordance with 11.4.2.1.

11.4.5.2* Grounding electrodes shall comply with the requirements of 4.13.2 Ground Rods, 4.13.5 Radials, 4.13.6 Plate Electrode or Ground Plate Electrode, 4.13.7 Combinations, and 4.13.8 Grounding Electrode Selection Criteria, unless they conflict with this chapter.

11.4.5.3 Ground rods shall not be less than 15.9 mm (5/8 in.) in diameter and 2.4 m (8 ft) long.

11.4.5.4 The top of the installed ground rod shall be 152 mm (6 in.) minimum below grade.

11.4.5.5* Copper conductors and copper braids of equal current carrying capacity shall be permitted as an alternative to the 6 AWG bonding jumper as permitted by the AHJ.

11.4.5.6* All non-current-carrying electrically conductive materials having the potential to become energized by a lightning induced surge shall be bonded together and bonded to the airfield lighting counterpoise system.

11.4.5.7* Metallic Light Base Grounding.

11.4.5.7.1 New metallic light bases shall be provided with ground straps for internal and external grounding connections.

11.4.5.7.2 For existing metallic light bases without ground straps, the installation of ground straps shall not interfere with the structural integrity of the light base.

11.4.8 Connection Requirements.

11.4.8.1* All counterpoise conductor connectors, grounding connectors and bonding connectors shall be listed with relevant standards.

11.4.8.2 Counterpoise conductor connectors shall be listed for direct earth burial and concrete encasement.

11.4.8.3* Bimetallic connectors and fittings shall comply with 11.4.8.3.1 through 11.4.8.3.4.

11.4.8.3.1 Bimetallic connectors and fittings shall be used for splicing or bonding dissimilar metals.

11.4.8.3.2 Conductive oxide inhibitors shall be designed for the specific application and metals used in the connection.

11.4.8.3.3 Conductive oxide inhibitors shall be applied to the mating surfaces of all connections involving dissimilar metals.

11.4.8.3.4 Where corrosion-protective paint or coatings are removed, the electrical connection shall have corrosion protection equal to the original coating.

11.4.8.4 Listed equipment shall be installed and used in accordance with the manufacturer’s installation instructions included as part of the listing.

11.4.8.5* The metallic light base ground strap with ground clamp shall be used for connection of the counterpoise conductor to the light base.

11.4.8.6* Grounding, bonding and counterpoise conductor connections not included in 11.4.8.1 through 11.4.8.5 shall be made by exothermic weld or irreversible crimp method.

11.4.9 Bend Radius. The counterpoise conductor radius of bend shall not be less than 203 mm (8 in.), nor form an included (inside) angle of less than 90 degrees as shown in Figure 4.9.5.

ANNEX A

A.11.1.1 This chapter pertains to lightning protection of airfield lighting systems. These systems are installed underground in both paved (full strength pavement and shoulder pavement) and unpaved areas. The protected components include in-pavement fixtures, elevated fixtures, airfield signs, underground power, communications systems, control and signal circuits and components of runway, taxiway and apron lighting systems. These systems are installed on the portions of an airport that encompass the approach, departure, landing, takeoff, taxiing, and parking areas for aircraft and include runways, taxiways, and other parts of an airport used for taxiing, takeoff, and landing of aircraft, loading ramps and parking areas exclusive of building-mounted helipads, approach light structures and antennas. This chapter could apply to other areas with airfield lighting systems.

Two generally accepted methods are available for providing lightning protection for airfield lighting circuits. The two methods are ISOLATION and EQUIPOTENTIAL. The isolation method is described in 11.4.2.6 and is shown in Figure A.11.1.1(a). The equipotential method is described in 11.4.2.7 and is shown in Figure A.11.1.1(b). The two methods should not be employed on a single circuit. The designer should select the installation method based upon sound engineering practices and the success of the selected method in previous installations.

![Diagram of Lightning Protection System](image-url)
A.11.1.2 Above ground items such as approach light masts could be protected in accordance with Chapter 4.

A.11.2.1 A typical airfield lighting series (current driven) circuit is powered by a constant current regulator (CCR) or equivalent power supply. Current is the same at all points in the series circuit. The output voltage is directly proportional to the load and output current step. The CCR output (primary circuit) is normally ungrounded. The CCR's or equivalent power supply’s internal overcurrent protection monitors the actual output current. Series airfield lighting circuit overcurrent protection does not rely upon a low impedance return path or ground connection for proper operation.

The installation of an equipotential airfield lighting counterpoise system on a series circuit also provides equipotential bonding between all elements of the airfield lighting system. The airfield lighting counterpoise system maintains all interconnected components at earth potential and protects personnel from possible contact with energized metallic light bases, mounting stakes or fixtures.

Lightning strikes often occur on the pavement, the counterpoise conductor provides a method of dissipating the energy as it moves from the pavement surface to the earth.

A.11.2.2 The parallel (voltage powered) circuit is similar to the typical alternating current system used in homes and in industry. Voltage is nominally the same at all points in the parallel circuit. The parallel circuit current varies according to the load.

Parallel circuits must be installed in accordance with NFPA 70, National Electrical Code. The required equipment grounding conductor must be sized in accordance with NFPA 70, National Electrical Code, Article 250. Equipment grounding conductors for parallel circuits should be routed within the same raceway or cable with the parallel circuit conductors or in close proximity to direct buried conductors and cables to reduce the overall circuit impedance allowing expedited operation of the overcurrent device.

The equipment grounding conductor must be bonded to each metallic airfield lighting component and the airfield lighting vault building ground system in accordance with the NFPA 70, National Electrical Code. All metallic airfield lighting components must be bonded to the equipment grounding conductor.

The lightning protection system for a parallel (voltage powered) airfield lighting circuit should be installed in the same manner as a lightning protection system for a series (current driven) airfield lighting circuit.

A.11.2.5 A lightning protection system for airfield lighting circuits could still be required for the conditions described in 11.2.5 to comply with funding agency requirements. The AHJ could also require compliance with this standard for conditions described in 11.2.5.

A.11.3.2 The function of an airfield lighting counterpoise system is to provide a preferred, low impedance path for lightning energy to earth.

A.11.4.1 The copper counterpoise conductor size should be determined by the Engineer of Record based upon sound engineering practices. A 2 AWG bare solid copper counterpoise conductor is recommended for high priority airfield lighting systems and airfield lighting systems installed in areas with a lightning flash density greater than 2 flashes per square kilometer per year.

The following factors should be evaluated when considering a larger size counterpoise conductor:

1. The airport's ability to maintain airport operations after an airfield lighting circuit/system failure
2. Accessibility of the copper counterpoise conductor for repairs as the counterpoise conductor could be installed under pavement
3. Availability of qualified persons to perform airfield lighting system repairs
4. Life cycle cost of the larger size counterpoise conductor including consideration of counterpoise conductor replacement prior to expected 20 year life
5. Results of a Lightning Risk Assessment performed in accordance with Annex L
6. Past performance of the airfield lighting counterpoise system at the airport or geographic area

The AHJ could determine/approve the size of the copper counterpoise conductor.

A.11.4.2.4 A Chapter 4 compliant lightning protection system and surge protective devices (SPD) could be installed at the airfield lighting vault or other airfield lighting circuit power source.
The need for an airfield lighting vault building lightning protection system, SPDs or surge arresters should be determined by the Engineer of Record, based upon engineering practices. Lightning protection systems, SPDs and surge arresters are recommended for high priority airfield lighting systems and airfield pavement systems installed in areas with a lightning flash density greater than 2 flashes per square kilometer per year.

Criteria in A.11.4.1 could be used to determine if the airfield lighting field circuits should be provided with surge arresters.

A Lightning Risk Assessment performed in accordance with Annex L could be used to determine if the airfield lighting vault building or equivalent electrical equipment protective structure should be provided with a lightning protection system and SPDs in accordance with Chapter 4.

The AHJ could determine/approve the need for the airfield lighting vault building or equivalent electrical equipment protective structure lightning protection system, SPDs and airfield lighting circuit surge arresters.

A.11.4.2.6 This subsection addresses items installed in turf adjacent to the full strength pavement edge. Items within 4.6 m (15 ft) of the full strength pavement edge could be considered adjacent to the full strength pavement edge for the purpose of this subsection. The exact routing of the counterpoise conductor could be subject to field conditions such as rock or other obstructions. The counterpoise conductor should be routed as close as practical to the midpoint between the full strength pavement edge and item being protected.

A.11.4.2.6.2 The light base grounding electrode could be installed in the same excavation as the light base or mounting stake. If a ground rod is used as the light base grounding electrode, the ground rod could be installed exterior to the light base or installed within the light base, through a hole provided by the manufacturer in the bottom of the light base.

A.11.4.2.7 Airfield pavement systems design is an intricate engineering solution involving large numbers of complex variables. Operating aircraft and pavement systems interact with each other. This interaction must be addressed by the pavement design process. Structural designs of airfield pavement systems include determination of the overall pavement system thickness to achieve the final design objectives. Airfield pavement systems are normally constructed in courses or layers. The type of pavement and the load bearing capacity of the supporting materials are key components that impact the structural design of the pavement system. These are among many factors that influence the pavement system layer thicknesses required to provide satisfactory pavement system design.

An example of a typical pavement system design could consist of the following layers:
1. Condition and compaction of the earth fill and subgrade below the pavement system (typically 100% compaction required);
2. Enhance subbase course material, including additional layering or further enhancement of existing subgrade;
3. Construction of the pavement base course (either flexible or semi-rigid materials to support the pavement surface materials);
4. Final pavement surface materials comprising Hot Mix Asphalt (HMA) or Portland Cement Concrete (PCC) pavement. HMA (flexible pavement) is typically installed in multiple layers, whereas PCC (rigid pavement) is typically installed in one layer.

The thicknesses of each of the overall pavement layers is determined by the structural requirements of the pavement system based on existing conditions, aircraft size and weights, numbers of repetitions, environmental factors, and other features.

The airfield lighting system is incorporated into the airfield pavement system. The design of the depth and height of the various airfield lighting system components, including light bases, light base accessories, conduits, counterpoise conductors, and the like, must be adjusted to integrate the components into the varying pavement system layer thicknesses. Although reasonable effort should be made to comply with the 203 mm (8 in.) requirement contained in 11.4.2.7.1, it is for these reasons the variation described in 11.4.2.7.2 is necessary.

A.11.4.2.7.5 The area of protection is considered to be an equilateral triangular cross-sectional area (triangular prism) with the apex located at the center of the counterpoise conductor, having its two sides formed by a 45 degree angle from vertical. The width of the protected area is twice the height of the counterpoise conductor above the roadway or cable being protected. See Figure A.11.4.2.7.5 below for a typical area of protection application.

A.11.4.2.7.7 The intent of this subsection is that all metallic light bases, metallic fixtures, metal manhole cover/frames and the like be bonded to the counterpoise conductor. The phrase “output side of the constant current regulator (CCR) or power source” refers to the field circuit. The input power to the CCR or airfield lighting power source would be grounded in accordance with NFPA 70, National Electrical Code.

A.11.4.3.1 Multiple raceways in a common assembly are also known as duct banks. This subsection addresses individual raceways or cables installed in a common excavation but separated by a greater than normal distance. For example, a control circuit and airfield lighting series circuit could be installed in a common trench but separated by 305 mm (12 in.) or more to prevent interference on the control circuit.

A.11.4.3.2 Standard trigonometric functions could be used to calculate the width of the “area of protection” with the counterpoise conductor at a specified height above the roadway or cable being protected. The maximum width of the area of protection is twice the height of the counterpoise conductor above the protected roadway or cable. A conservative design would have an overlap of adjacent areas of protection.

A.11.4.4.2 One purpose of an equipotential airfield lighting counterpoise system is to provide equipotential bonding between all elements of the airfield lighting system. To achieve this objective, existing counterpoise conductors should be located and interconnected to new counterpoise conductors. Every reasonable and prudent means should be utilized to locate existing counterpoise conductors.
A.11.4.5.1 The grounding electrode could be installed in the same excavation as the counterpoise conductor.

A.11.4.5.2 NFPA 70, National Electrical Code, 250.53 requires a second grounding electrode if the earth resistance of the single grounding electrode exceeds 0.5 ohm value is the maximum acceptable earth resistance and should not be interpreted as satisfactory for all installations, refer to Annex B.4.4. Reduced earth resistance values could be necessary to provide effective lightning protection where the lightning risk assessment is high. A.11.4.1 could be used to determine if reduced earth resistance is necessary for the airfield lighting system. The AHJ could define the required grounding electrode earth resistance value.

One common means of lowering the ground rod earth resistance is to add length to the ground rod. One simple means of adding length to the ground rod is accessible by trenching sectional ground rods. Additional sections of ground rod are added to the original ground rod and driven deeper into the earth to lower the earth resistance. An alternative is to lay rods horizontally and bond together, forming a grid below grade. Other means of obtaining a satisfactory earth resistance are discussed in 4.13.8.

A.11.4.6.5 Fixtures or exposed metal parts that might present a shock hazard must be bonded to the airfield lighting counterpoise system.

A.11.4.7 A ground strap with a ground clamp is the terminology typically used by light base manufacturers for a light base grounding connection. Metallic light bases should be provided with internal and external ground straps, such as provided by the light base manufacturer for a light base grounding connection. The length of the stake and fitting do not exceed 762 mm (30 in.).

A.11.4.8.1 Relevant standards could be standards such as UL 467, Grounding and Bonding Equipment or UL 96, Standard for Lightning Protection Components or other standards applicable to this application.

A.11.4.8.3 Corrugated dissimilar metal mates require special consideration. See NFPA 70, National Electrical Code, Article 110.

A.11.4.8.5 A ground strap with a ground clamp provided by the light base manufacturer is an acceptable means of bonding the counterpoise conductor to the metallic light base. Each manufacturer-provided ground clamp is acceptable for protection of a single counterpoise conductor.

A.11.4.8.6 Exothermic welding is not the recommended method of connecting the counterpoise conductor to a galvanized steel light base. Refer to FAA Advisory Circular 150/5340-30, Design and Installation Details for Airport Visual Aids, Part 12.5.

Chapter 3 Definitions

Insert new definitions and renumber existing definitions as necessary.

3.3.a Bonded (Bonding). Connected to establish electrical continuity and conductivity. [70.2011]

3.3.b Counterpoise Conductor. A bare underground electrical conductor providing an area of protection from lightning for underground raceway(s) or cable(s).

3.3.c* Light Base. An enclosure used as a mounting base for airport light fixtures and assemblies. The unit serves as an isolation transformer housing and as a support structure for the light fixture. The light base is cylindrical in shape with a closed bottom, provisions for cable or conduit entry and exit, provisions for grounding and provided with a top flange to mate with the fixture or cover.

3.3.d* Mounting Stake. A steel angle iron driven vertically into the earth with provisions for the mounting of an elevated airfield lighting fixture. [70.2011]

3.3.e Pavement. A hard layered surface constructed to provide support for the loads imposed by airplanes and to produce a firm, stable, smooth, all weather surface free of debris or other particles blown or picked up by propeller wash or jet blast.

3.3.e.3 Shoulder Pavement. Pavement designed to provide support of an aircraft for intentional or emergency operations of the aircraft.

3.3.f* Raceway. An enclosed channel of metal or nonmetallic materials designed expressly for raceway wiring, cables, and additional conduits and raceways of nominally circular cross-sectional area designed to provide protection for parallel circuits, control circuits, and other services for the dissipation of lightning discharge energy to earth minimizing damage to equipment, raceway or cables and electrical shock to personnel.

3.3.g Turf. Grass, stabilized soil, asphalt, or any other hard surface not intended as a paved shoulder, installed from the edge of the runway or taxiway full strength pavement to just outside the airfield lighting circuits.

Annex

Insert new annex material in support of definitions and renumber existing sections as necessary.

A.3.3.c Type L-867 light bases and extensions are used for applications subject to occasional light vehicular loading but no aircraft or other heavy vehicular loading. Type L-868 light bases and extensions are used for applications subject to aircraft and other heavy vehicular loading. Light bases could be fabricated from metallic or nonmetallic materials. Light bases serve as a connection point for the raceway and housing for mounting the light fixture. Light bases are subject to direct earth burial with or without concrete backfill. Drain connections, load rings and other options are available for the light base.

Additional information can be found in FAA Advisory Circular 150/5345-42, Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories.

A.3.3.d When not installed on a light base, an elevated light fixture is installed on a mounting stake. The mounting stake is made of 50.8 × 50.8 × 4.8 mm (2 × 2 × 3/16 in.) steel angle stock or equivalent. The mounting stake is provided with a fitting attached at the top to receive the light fixture and frangible coupling. The length of the stake and fitting do not exceed 762 mm (30 in.).

A.3.3.f The definition provided for raceway is taken directly from NFPA 70, National Electrical Code and includes some raceway types not typically used in airfield lighting. The terms conduit, duct or duct bank should be considered raceways of nominally circular cross-sectional area designed to provide protection for parallel circuits, control circuits, and other services. Where a requirement of this standard would be applicable to one, it should be considered applicable to all combinations of raceways included in this chapter. Electrical Ducts, as used in NFPA 70, National Electrical Code, Article 310, include electrical conduits, or other raceways round in cross section, that are suitable for use underground or embedded in concrete.

Annex O

O.1.0.1 References

Add new definition for FAA publications:

O.1.2.2 Federal Aviation Administration (FAA) Publications. U.S. Department of Transportation, Subsequent Business Office, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785. FAA Advisory Circulars are also available at: http://www.faa.gov/airports/resources/advisory_circulars/.


Renumber existing O.1.2.2 through O.1.2.6.

O.1.2.6 UL Publications. (Renumbered from O.1.2.5)

Add new UL publication:


Substantiation: NFPA 780 does not address lightning protection for airfield lighting circuits. The proposed new Chapter 11, Protection for Airfield Lighting Circuits provides lightning protection criteria for airfield lighting circuits.

Committee Meeting Action: Accept in Principle

Add new Chapter 11 mandatory text and Annex A material as follows:

Chapter 11 Protection for Airfield Lighting Circuits

11.1 General.

11.1.1* This chapter shall provide the minimum requirements for the installation of a lightning protection system for airfield lighting systems and 70.2011

11.1.1* This chapter shall provide the minimum requirements for the installation of a lightning protection system for airfield lighting systems and equipment, raceway or cables and electrical shock to personnel.

11.1.2 Lightning protection systems for airfield lighting shall be installed entirely underground in accordance with the provisions of this chapter.

11.2 Application.

11.2.1* The airfield lighting counterpoise system shall be a separate and independent protection system specifically used for use with series (current driven) airfield lighting circuits.

11.2.2 The airfield lighting counterpoise system shall also provide lightning protection for parallel (voltage powered) circuits, control circuits, and monitoring circuits.

11.2.3 To reduce the potential for flashlight and any inductive/capacitive coupling arising from a lightning strike, the counterpoise conductor shall be a separate conductor, and not be located within any raceway used for power, communications, control or signal conductors.

11.2.4 All the requirements of 4.2 Materials, 4.3 Corrosion Protection, 4.4 Mechanical Damage or Displacement, 4.9.5 Conductor Bends, 4.13 Grounding Electrodes and 4.14 Common Grounding shall also apply, except as modified by, unless they conflict with this chapter.

11.2.5* An airfield lighting protection system shall be permitted to be omitted by the authority having jurisdiction (AHJ) when the average lightning flash density is 2 or less flashes per square kilometer per year and when permitted by the authority having jurisdiction (AHJ).

11.3 Purpose.

11.3.1 The airfield lighting counterpoise system shall provide protection for airfield lighting systems from energy arising from lightning strikes.

11.3.2 The airfield lighting counterpoise system shall provide a path for dissipation of lightning discharge energy to earth minimizing damage to equipment, raceway or cables and electrical shock to personnel.

11.4 Installation of Airfield Lighting Counterpoise System

11.4.1 Counterpoise Conductor. The counterpoise conductor shall be a bare annealed or soft drawn, solid copper conductor not smaller than 6 AWG.

11.4.1.1 If bare copper counterpoise conductors are adversely affected by the installed environment, electrically conductive materials (Example: tinned copper) as permitted by the AHJ shall be utilized.

11.4.1.2 Electrically conductive materials shall possess the same performance, qualities and characteristics as the copper conductor.

11.4.2 Counterpoise Conductor Location. The counterpoise conductor shall be installed in accordance with 11.4.2.1 through 11.4.2.7.
11.4.2.1 The counterpoise conductor shall be bonded to grounding electrodes at intervals not exceeding 150 m (500 ft).

11.4.2.2 The counterpoise conductor shall be bonded to grounding electrodes located on each side of a raceway crossing under the airfield pavement.

11.4.2.3 The airfield lighting counterpoise system shall connect to the airfield lighting vault or other airfield lighting circuit power source grounding electrode system.

11.4.2.4* Surge arresters shall be permitted to be installed in the airfield lighting circuit.

11.4.2.5 Reinforcing steel, when used as part of the light base installation, shall be bonded to the metallic light base using a 6 AWG bare solid copper conductor.

11.4.2.6* For edge light fixtures installed in turf (stabilized soils) and for raceways or cables adjacent to the full strength pavement edge, the counterpoise conductor shall either be installed halfway between the pavement edge and the light base, mounting stake, raceway or cable as shown in Figure 11.4.2.6 or in accordance with 11.4.2.7.

Note: Light base ground rod can be installed either through the bottom of the light base or exterior to the light base.

11.4.2.6.1 The counterpoise conductor shall be installed 203 mm (8 in.) minimum below grade.

11.4.2.6.2* Each light base or mounting stake shall be provided with a grounding electrode.

11.4.2.6.2.1 When a metallic light base is used, the grounding electrode shall be bonded to the metallic light base or mounting stake with a 6 AWG bare, annealed or soft drawn, solid copper conductor.

11.4.2.6.2.2 When a nonmetallic light base is used, the grounding electrode shall be bonded to the metallic light fixture or metallic base plate with a 6 AWG bare, annealed or soft drawn, solid copper conductor.

11.4.2.7 For raceways installed under pavement, for raceways and cables not installed adjacent to the full strength pavement edge, for fixtures installed in full strength pavement and shoulder pavement and for optional method of edge lights installed in turf (stabilized soils) and for raceways or cables adjacent to the full strength pavement edge, the counterpoise conductor shall be centered over the raceway or cable to be protected as described in this subsection and as shown in Figure 11.4.2.7.

Figure 11.4.2.6

Figure 11.4.2.7
11.4.2.7.1 The counterpoise conductor shall be installed no less than 203 mm (8 in.) above the raceway or cable to be protected, except as permitted in 11.4.2.7.2.

11.4.2.7.2* The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.

11.4.2.7.3 The counterpoise conductor shall be installed no more than 305 mm (12 in.) above the raceway or cable to be protected.

11.4.2.7.4 The counterpoise conductor height above the protected raceway(s) or cable(s) shall be calculated to ensure the raceway or cable is within a 45 degree area of protection.

11.4.2.7.5* The area of protection shall be determined only by the 45 degree triangular prism area of protection method.

11.4.2.7.6 The counterpoise conductor shall be bonded to each metallic light base, mounting stake and metallic airfield lighting component.

11.4.2.7.7* All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system.

11.4.3 Multiple Raceways or Cables in a Common Formation.

11.4.3.1* Multiple raceways or cables in a common formation or assembly wider than the area of protection provided by a single counterpoise conductor shall be provided with multiple counterpoise conductors.

11.4.3.2* As shown in Figure 11.4.3.2, the number of counterpoise conductors required shall be determined by the height of the counterpoise conductors over the raceways or cables being protected, while maintaining the 45 degree area of protection.

11.4.3.3 Where multiple counterpoise conductors are used they shall be interconnected longitudinally at intervals not exceeding 90 m (300 ft) as shown in Figure 11.4.3.3.

11.4.4 Counterpoise Conductor Interconnections.

11.4.4.1 Where raceways or cables cross, the counterpoise conductors shall be interconnected.

11.4.4.2* Where an existing airfield lighting system is being extended or modified, the new counterpoise conductors shall be interconnected to existing counterpoise conductors at each intersection of the new and existing airfield lighting counterpoise systems.

11.4.5 Grounding Electrodes.

11.4.5.1* The counterpoise conductor shall be bonded to grounding electrodes in accordance with 11.4.2.1.

11.4.5.2* Grounding electrodes shall comply with all the requirements of 4.13.2 Ground Rods, 4.13.5 Radials, 4.13.6 Plate Electrode or Ground Plate Electrode, 4.13.7 Combinations, and 4.13.8 Grounding Electrode Selection Criteria, except as modified by unless they conflict with this chapter.

11.4.5.3 Ground rods shall not be less than 15.9 mm (5/8 in.) in diameter and 2.4 m (8 ft) long.

11.4.5.4 The top of the installed ground rod shall be 152 mm (6 in.) minimum below grade.

11.4.6 Bonding Jumpers.

A 6 AWG stranded copper green insulated bonding jumper shall be installed between the following items:

1. In-pavement airfield lighting fixture and the metallic light base
2. Elevated fixture base plate and metallic light base
3. Surge arrestors and metallic light base

11.4.6.1 A bonding jumper shall be installed between the metallic frame of the airfield lighting sign(s) or other system components that are not listed in 11.4.6 and its respective metallic light base.

11.4.6.2 Bonding jumper length shall permit direct removal and maintenance of the airfield lighting component without damage to or disconnection of the bonding jumper and not interfere with the intended operation of a frangible coupling.

11.4.6.3 Copper conductors and copper braids of equal current carrying capacity shall be permitted as an alternative to the 6 AWG bonding jumper as permitted by the AHJ.

11.4.6.4 Frangible couplings shall be conductive.

11.4.6.5* All non-current-carrying electrically conductive materials having the potential to become energized by a lightning induced surge shall be bonded together and bonded to the airfield lighting counterpoise system.

11.4.7 Metallic Light Base Grounding.

11.4.7.1 New metallic light bases shall be provided with ground straps for internal and external grounding connections.

11.4.7.2 For existing metallic light bases without ground straps, the installation of ground straps shall not interfere with the structural integrity of the light base.
ANNEX A

A.11.1.1 This chapter pertains to lightning protection of airfield lighting systems. These systems are installed underground in both paved (full strength pavement and shoulder pavement) and unpaved areas. The protected components include in-pavement fixtures, elevated fixtures, airfield signs, underground power, communications systems, control and signal circuits and components of runway, taxiway and apron lighting systems. These systems are installed on the portions of an airport that encompass the approach, departure, landing, takeoff, taxiing, and parking areas for aircraft and include runways, taxiways, and other parts of an airport used for tuxing, takeoff, and landing of aircraft, loading ramps and parking areas exclusive of building-mounted helipads, approach light structures and antennas. This chapter could apply to other areas with airfield lighting systems.

Two generally accepted methods are available for providing lightning protection for airfield lighting circuits. The two methods are ISOLATION and EQUIPOTENTIAL. The isolation method is described in 11.4.2.6 and is shown in Figure A.11.1.1(a). The equipotential method is described in 11.4.2.7 and is shown in Figure A.11.1.1(b). The two methods should not be employed on a single circuit. The designer should select the installation method based upon sound engineering practices and the success of the selected method in previous installations.

11.4.8 Connection Requirements.

11.4.8.1* All counterpoise conductor connectors, grounding connectors and bonding connectors shall be listed with relevant standards.

11.4.8.2 Counterpoise conductor connectors shall be listed for direct earth burial and concrete encasement.

11.4.8.3* Galvanically compatible Bimetallic connectors and fittings shall comply with 11.4.8.3.1 through 11.4.8.3.4.

11.4.8.3.1 Galvanically compatible Bimetallic connectors and fittings shall be used for splicing or bonding dissimilar metals.

11.4.8.3.2 Conductive oxide inhibitors shall be designed for the specific application and metals used in the connection.

11.4.8.3.3 Conductive oxide inhibitors shall be applied to the mating surfaces of all connections involving dissimilar metals.

11.4.8.4 Listed equipment shall be installed and used in accordance with the manufacturer’s installation instructions included as part of the listing.

11.4.8.5* The metallic light base ground strap with ground clamp shall be used for connection of the counterpoise conductor to the light base.

11.4.8.6* Grounding, bonding and counterpoise conductor connections not included in 11.4.8.1 through 11.4.8.5 shall be made by exothermic weld or irreversible crimp method.

11.4.9 Bend Radius. The counterpoise conductor radius of bend shall not be less than 203 mm (8 in.), nor form an included (inside) angle of less than 90 degrees as shown in Figure 4.9.5.

Notes:
1. Provide a second trench for the edge light counterpoise conductor. Normally the edge light counterpoise conductor is routed around the light base a minimum of 305 mm (12 in.) toward the full strength pavement.
2. The centerline light counterpoise conductor is shown parallel to the raceway or cable being protected for graphic simplicity. The centerline light counterpoise conductor is actually installed above and centered over the raceway or cable to be protected in accordance with 11.4.2.7. [See Figure 11.4.2.7].
3. Grounding electrodes can be any of those described in 11.4.5.2. Ground rods are typically used for this application.
A.11.1.2 Above ground items such as approach light masts could be protected in accordance with Chapter 4.

A.11.2.1 A typical airfield lighting series (current driven) circuit is powered by a constant current regulator (CCR) or equivalent power supply. Current is the same at all points in the series circuit. The output voltage is directly proportional to the load and output current step. The CCR output (primary circuit) is normally ungrounded. The CCR's or equivalent power supply's internal overcurrent protection monitors the actual output current. Series airfield lighting circuit overcurrent protection does not rely upon a low impedance return path or ground connection for proper operation.

The installation of an equipotential airfield lighting counterpoise system on a series circuit also provides equipotential bonding between all elements of the airfield lighting system. The airfield lighting counterpoise system maintains all interconnected components at earth potential and protects personnel from possible contact with energized metallic light bases, mounting stakes or fixtures.

Lightning strikes often occur on the pavement, the counterpoise conductor provides a method of dissipating the energy as it moves from the pavement surface to the earth.

A.11.2.2 The parallel (voltage powered) circuit is similar to the typical alternating current system used in homes and in industry. Voltage is nominally the same at all points in the parallel circuit. The parallel circuit current varies according to the load.

Parallel circuits must be installed in accordance with NFPA 70, National Electrical Code. The required equipment grounding conductor must be sized in accordance with NFPA 70, National Electrical Code, Article 250. Equipment grounding conductors for parallel circuits should be routed within the same raceway or cable with the parallel circuit conductors or in close proximity to direct buried conductors and cables to reduce the overall circuit impedance allowing expedited operation of the overcurrent device.

The equipment grounding conductor must be bonded to each metallic airfield lighting component and the airfield lighting vault building ground system in accordance with the NFPA 70, National Electrical Code. All metallic airfield lighting components must be bonded to the equipment grounding conductor. The lightning protection system for a parallel (voltage powered) airfield lighting circuit should be installed in the same manner as a lightning protection system for a series (current driven) airfield lighting circuit.

A.11.2.5 A lightning protection system for airfield lighting circuits could still be required for the conditions described in 11.2.5 to comply with funding agency requirements. The AHJ could also require compliance with this standard for conditions described in 11.2.5.

A.11.3.2 The function of an airfield lighting counterpoise system is to provide a preferred, low impedance path for lightning energy to earth.

A.11.4.1 The copper counterpoise conductor size should be determined by the Engineer of Record based upon sound engineering practices. A 2 AWG bare solid copper counterpoise conductor is recommended for high priority airfield lighting systems and airfield lighting systems installed in areas with a lightning flash density greater than 2 flashes per square kilometer per year.

The following factors should be evaluated when considering a larger size counterpoise conductor:

1. The airport's ability to maintain airport operations after an airfield lighting circuit/system failure
2. Accessibility of the copper counterpoise conductor for repairs as the counterpoise conductor could be installed under pavement
3. Availability of qualified persons to perform airfield lighting system repairs
4. Life cycle cost of the larger size counterpoise conductor including consideration of counterpoise conductor replacement prior to expected 20 year life
5. Results of a Lightning Risk Assessment performed in accordance with Annex L
6. Past performance of the airfield lighting counterpoise system at the airport or geographic area

The AHJ could determine/approve the size of the copper counterpoise conductor.

A.11.4.2.4 A Chapter 4 compliant lightning protection system and surge protective devices (SPD) could be installed at the airfield lighting vault or other airfield lighting circuit power source.

The need for an airfield lighting vault building lightning protection system, SPDs or surge arresters should be determined by the Engineer of Record, based upon sound engineering practices. Lightning protection systems, SPDs and surge arresters are recommended for high priority airfield lighting systems and airfield lighting systems installed in areas with a lightning flash density greater than 2 flashes per square kilometer per year.

Criteria in A.11.4.1 could be used to determine if the airfield lighting field circuits should be provided with surge arresters.

A Lightning Risk Assessment performed in accordance with Annex L could be used to determine if the airfield lighting vault building or equivalent electrical equipment protective structure lightning protection system, SPDs and airfield lightning circuit surge arresters.

A.11.4.2.6 This subsection addresses items installed in turf adjacent to the full strength pavement edge. Items within 4.6 m (15 ft) of the full strength pavement edge could be considered adjacent to the full strength pavement.
A.11.4.2.7.7 The intent of this subsection is that all metallic light bases, metallic fixtures, metal manhole cover/frames and the like be bonded to the counterpoise conductor. The fixtures and assemblies are key components that impact the structural design of the pavement system. These are among many factors that influence the pavement system layer thicknesses required to provide satisfactory pavement system design. An example of a typical pavement system design could consist of the following layers:

1. Condition and compaction of the earth fill and subgrade below the pavement system (typically 100% compaction required);
2. Enhance subbase course material, including additional layering or further enhancement of existing subgrade;
3. Construction of the pavement base course (either flexible or semi-rigid materials to support the pavement surface materials; (3) Construction of the pavement base course (either flexible or semi-rigid materials to support the pavement surface materials;
4. Final pavement surface materials comprising Hot Mix Asphalt (HMA) or Portland Cement Concrete (PCC) pavement. HMA (flexible pavement) is typically installed in multiple layers, whereas PCC (rigid pavement) is typically installed in one layer.

The thickness of each of the overall pavement layers is determined by the structural requirements of the pavement system based on existing conditions, aircraft size and weights, numbers of repetitions, environmental factors, and other features.

The airfield lighting system is incorporated into the airfield pavement system. The design of the depth and height of the various airfield lighting system components, including light bases, light base accessories, conduits, counterpoise conductors, and the like, must be adjusted to integrate the components into the varying pavement system layer thicknesses. Although reasonable effort should be made to comply with the 203 mm (8 in.) requirement contained in 11.4.2.7.1, it is for these reasons the variations described in 11.4.2.7.2 is necessary.

A.11.4.2.7.8 The area of protection is considered to be an equilateral triangular cross-sectional area (triangle prism) with the apex located at the center of the counterpoise conductor, having its two sides formed by a 45 degree angle from vertical. The width of the protected area is twice the height of the counterpoise conductor above the raceway or cable being protected. See Figure A.11.4.2.7.8 for a typical area of protection.

A.11.4.2.7.9 The extent of this subsection is that all metallic light bases, metallic fixtures, metal manhole cover/frames and the like be bonded to the counterpoise conductor. The fixtures and assemblies are key components that impact the structural design of the pavement system. These are among many factors that influence the pavement system layer thicknesses required to provide satisfactory pavement system design. An example of a typical pavement system design could consist of the following layers:

1. Condition and compaction of the earth fill and subgrade below the pavement system (typically 100% compaction required);
2. Enhance subbase course material, including additional layering or further enhancement of existing subgrade;
3. Construction of the pavement base course (either flexible or semi-rigid materials to support the pavement surface materials;
4. Final pavement surface materials comprising Hot Mix Asphalt (HMA) or Portland Cement Concrete (PCC) pavement. HMA (flexible pavement) is typically installed in multiple layers, whereas PCC (rigid pavement) is typically installed in one layer.

The thickness of each of the overall pavement layers is determined by the structural requirements of the pavement system based on existing conditions, aircraft size and weights, numbers of repetitions, environmental factors, and other features.

The airfield lighting system is incorporated into the airfield pavement system. The design of the depth and height of the various airfield lighting system components, including light bases, light base accessories, conduits, counterpoise conductors, and the like, must be adjusted to integrate the components into the varying pavement system layer thicknesses. Although reasonable effort should be made to comply with the 203 mm (8 in.) requirement contained in 11.4.2.7.1, it is for these reasons the variations described in 11.4.2.7.2 is necessary.

A.11.4.2.7.5 The area of protection is considered to be an equilateral triangular cross-sectional area (triangle prism) with the apex located at the center of the counterpoise conductor, having its two sides formed by a 45 degree angle from vertical. The width of the protected area is twice the height of the counterpoise conductor above the raceway or cable being protected. See Figure A.11.4.2.7.5 for a typical area of protection application.

A.11.4.8.1 Multiple raceways in a common assembly are also known as duct banks. This subsection addresses individual raceways or cables installed in a common excavation but separated by a greater than normal distance. For example, a control circuit and airfield lighting series circuit could be installed in a common trench but separated by 365 mm (12 in.) or more to prevent interference on the control circuit.

A.11.4.8.2 One purpose of an equipment protective airfield lighting counterpoise system is to provide equipment protection between airfield lighting system. To achieve this objective, existing counterpoise conductors should be located and interconnected to new counterpoise conductors. Every reasonable and prudent means should be utilized to locate existing counterpoise conductors.

A.11.4.8.3 The grounding electrode could be installed in the same excavation as the light base or mounting stake. If a ground rod is used as the light base grounding electrode, the ground rod could be installed exterior to the light base or installed within the light base, through a hole provided by the manufacturer in the bottom of the light base.

A.11.4.8.4 The area of protection is considered to be an equilateral triangular cross-sectional area (triangle prism) with the apex located at the center of the counterpoise conductor, having its two sides formed by a 45 degree angle from vertical. The width of the protected area is twice the height of the counterpoise conductor above the raceway or cable being protected. See Figure A.11.4.2.7.5 for a typical area of protection application.

A.11.4.8.5 The grounding electrode could be installed in the same excavation as the light base or mounting stake. If a ground rod is used as the light base grounding electrode, the ground rod could be installed exterior to the light base or installed within the light base, through a hole provided by the manufacturer in the bottom of the light base.

A.11.4.8.6 The area of protection is considered to be an equilateral triangular cross-sectional area (triangle prism) with the apex located at the center of the counterpoise conductor, having its two sides formed by a 45 degree angle from vertical. The width of the protected area is twice the height of the counterpoise conductor above the raceway or cable being protected. See Figure A.11.4.2.7.5 for a typical area of protection application.
liquidtight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical nonmetallic tubing, electrical metallic tubing, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface raceways, wireways, and busways. [70:2011]

A.3.c. Type L-886 light bases are used for applications subject to occasional light vehicular loading. Type L-886 light bases and extensions are used for applications subject to aircraft and other heavy vehicular loading. Light bases could be fabricated from metallic or nonmetallic materials. Light bases serve as a connection point for the raceway and housing for mounting the light fixture. Light bases are subject to direct earth burial with or without concrete backfill. Drain connections, load rings and other options are available for the light base.

Additional information can be found in FAA Advisory Circular 150/5345-42; Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories.

A.3.d. When not installed on a light base, an elevated light fixture is installed on a mounting stake. The mounting stake is made of 50.8 ~ 50.8 ~ 4.8 mm (2 ~ 2 ~ 3/16 in.) steel angle stock or equivalent. The mounting stake is provided with a fitting attached at the top to receive the light fixture and frangible coupling. The length of the stake and fitting do not exceed 762 mm (30 in.).

A.3.f. The definition provided for raceway is taken directly from NFPA 70, National Electrical Code and includes some raceway types not typically used in airfield lighting. The terms conduit, duct or duct bank should be considered raceways of nominally circular cross-sectional area designed to provide physical protection and routing for conductors. Where a requirement of this standard would be applicable to one, it should be considered applicable to all combinations of raceways included in this item. Electrical Ducts, as used in NFPA 70, National Electrical Code, Article 310, include electrical conduits, or other raceways round in cross section, that are suitable for use underground or embedded in concrete.

Annex O

O.1 Referenced Publications

Add new section for FAA publications:

O.1.2.2 Federal Aviation Administration (FAA) Publications. U.S. Department of Transportation, Subsequent Business Office, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785. FAA Advisory Circulars are also available at: http://www.faa.gov/airports/resources/advisory_circulars/

FAA Advisory Circular 150/5340-30F; Design and Installation Details for Airport Visual Aids, September 29, 2011


Renumber existing O.1.2.2 through O.1.2.6.

O.1.2.6 UL Publications. (Renumbered from O.1.2.5)

Add new UL publications:


Committee Statement: The Technical Committee accepts the submitter’s text and edits for clarity.

The Technical Committee revises note 3 in Figure A.11.1.1(a) and note 2 in Figure A.11.1.1(b) to correctly reference Section 11.4.5.2 rather than Section 4.13.

The Technical Committee edits the number and date references in Annex O.1.2.2.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28

Comment on Affirmative:

D. A. L. E. Y., R.: Charged main and bonding conductors in AWG. Current tables 4.1.1.1.1 and 4.1.1.1.2 size main and bonding conductors in cir. mils. Change sizes in new chapter from AWG to cir. mils for consistency. New 11.4.6.3 calls for “equal current carrying capacity” but does not reference a standard to locate the capacities.

F. R. A. N. K. L. I. N., D.: Within X.3.6 delete “or panel frames.” This could be confused with the structural supports when mounting is appropriate.

P. R. T. O. F. L. E. E. T., T.: Some text does not comply with the manual of style 11.4.2.6 has a note without mandatory language, making it Annex material. This section also adds another definition of Bonded (bonding) as 3.3a where one already exist under subsection 3.3.2. The committee needs to decide which definition it wants.
X.5 Grounding

Content still under development, to be completed and reviewed by the task group before presentation at the Jan 2012 TC meeting. However intention is to cover the requirements for ground mounts and roof top systems.

The requirements for ground mount will cover practice to mitigate damages caused from lightning due to ground potential rise, and routing of grounding conductors to minimize ground loops, bonding practice of tracking type systems, and the resulting induced and conducted effects to the system. The requirements for roof top mount systems will cover layout with a mind addressing the latter, however also wording on the interconnection to exposed metal objects and co-ordinating with the electrical ground as defined in NEC.

Substantiation: Presently there exists no specific recommendations or requirements to address the lightning protection of Solar PV (or other types) on roof top or ground mount. This proposal seeks to address this application.

Committee Meeting Action: Accept in Principle

Title of new Chapter 12 to read as follows:

Chapter 12 Protection for Solar Arrays

Add new Chapter 12 to read as follows:

12.1 General. The intent of this chapter shall be to provide lightning protection requirements for roof mounted or ground mounted solar (photovoltaic and thermal) panels.

12.2 Fundamental Principles of Protection.

12.2.1 Roof mounted or ground mounted solar panels subject to direct lightning strike shall be protected in accordance with Chapter 4 and as supplemented in this chapter.

12.2.2 Protection shall be provided by one or more of the following methods:

(1) Direct mounting of strike termination devices to the solar panel
(2) Direct mounting of strike termination devices to the solar panel framing
(3) Locating strike termination devices (including air terminals, masts, and overhead ground wires) adjacent to the solar panels in such a manner as to place the solar panels in a zone of protection as defined in Section 4.7

12.3 Strike Termination Devices.

12.3.1 Strike termination devices shall extend a minimum of 254 mm (10 in.) above the surface of the solar panel.

12.3.2 Strike termination devices shall be located at the ends of the uppermost edge or nearest support of solar panels or panel arrays not to exceed 0.6 m (2 ft) unless the uppermost edge or nearest support is within a zone of protection.

12.3.3 Strike termination devices shall be located along the uppermost edge of solar panels or panel arrays at intervals not exceeding 6 m (20 ft) unless the panel arrays are within a zone of protection.

12.3.4 Solar panels or panel arrays that have a slope of less than 1/8 shall have strike termination devices located within 6 m (20 ft) of outermost corners and at intervals not exceeding 6 m (20 ft) along edges unless the corners or edges are within a zone of protection.

12.3.4.1 Solar panel arrays that exceed 15 m (50 ft) in width or length shall comply with one of the following:

12.3.4.1.1 Have additional strike termination devices located at intervals not to exceed 15 m (50 ft) on the solar panel arrays, similar to Figure 4.8.3(a) and Figure 4.8.3(b)

12.3.4.1.2 Such area can be protected using taller strike termination devices that create zones of protection using the rolling sphere method so the sphere does not contact the panel arrays.

12.3.5 Solar panels or panel arrays that have a slope of less than ½ and the distance from the uppermost edge to the lowest edge along the face of the panel or array exceeds 6 m (20 ft) shall have strike termination devices located within 0.6 m (2 ft) of outermost corners and at intervals not exceeding 6 m (20 ft) along edges unless the corners or edges are within a zone of protection.

12.3.6 Strike termination devices shall not be secured directly to the panels or panel frames of photovoltaic panels and arrays.

12.3.7 Consideration shall be given to the effects of shadowing of the solar panels due to the location of strike termination devices.

12.4 Protection of Electrical and Mechanical Systems.

12.4.1 Consideration shall be given to the protection of the electrical and/or electro-mechanical control systems with bonding, shielding, isolation and surge protection in accordance with the following:

(1) Separation distance and bonding techniques maintained in accordance with Sections 4.20 and 4.21
(2) Maximum distance between lightning conductors and the solar array panels, electrical based control systems and cables
(3) SPDs installed as close as practicable to the solar arrays and electrical systems (inverters) and panel tracking control systems.

(4) DC solar array cabling magnetically shielded by either braided wire sheath or wire mesh screen or installed within electrically bonded metallic conduit, cable tray or raceways

(5) Ground conductors that are exposed to the direct or partial lightning currents run separately and outside of the cable path of the DC cabling

12.4.2 Surge Protection.

12.4.2.1 Surge protection in accordance with 4.18 shall be provided on the dc output of the solar panel from positive to ground and negative to ground, at the combiner and re-combener box for multiple solar panels, and at the ac output of the inverter.

12.4.2.2 Surge protective devices shall have a nominal discharge current rating as specified in 4.18.3.1.2.

12.4.2.3 If the system inverter is more than 30m (100 ft) from the closest combiner or re-combener box then additional SPDs shall be required at the dc input of the inverter.

12.4.2.4 Maximum Continuous Operating Voltage (MCOV).

12.4.2.4.1 The SPD provided on the dc output shall have a dc MCOV equal to or greater than the panel/s maximum photovoltaic system voltage as specified in Article 690 of NFPA 70.

12.4.2.4.2 The SPD provided on the ac output shall have an ac MCOV equal to or greater than the inverter output voltage.

12.4.2.5 The short circuit current rating of the dc SPD shall be coordinated with the available fault current of the solar panel(s).

12.4.2.5.1 The short circuit current rating of the ac SPD shall be coordinated with the available fault current of the inverter.

12.4.6 Voltage Protection System (VPS).

12.4.6.1 The VPR of the dc SPD shall be a maximum of 3 times the panel’s maximum photovoltaic system voltage.

12.4.6.2 The VPR of the ac SPD shall be based on Table 4.18.4.

12.4.6.3 For voltages exceeding the values in Table 4.18.4, the VPR shall be permitted to be 3 times the output voltage of the inverter.

12.5 Grounding.

12.5.1 Ground Mounted Systems.

12.5.1.1 Systems that rely on the metallic structure to form part of the lightning protection system shall be grounded in accordance with 4.13.4 utilizing a ground ring electrode encompassing the perimeter of each array.

12.5.1.2 Systems that rely on the metallic structure to form part of the lightning protection system shall be made electrically continuous.

12.5.1.3 For solar arrays that do not rely on the metallic structure to form part of the lightning protection system, each separate row or structure shall be bonded at one location direct to the ground ring electrode.

12.5.1.4 Solar arrays that do not rely on the metallic structure to form part of the lightning protection system shall be made electrically continuous by means of bonding in accordance with the NEC.

12.5.2 Roof Mounted Systems.

12.5.2.1 Solar arrays shall be bonded in accordance with 4.20.3.

12.5.2.2 Solar arrays shall be made electrically continuous by means of bonding in accordance to the NEC.

12.5.2.3 If the structure forms part of, or is within the required separation distance from the lightning protection system, the metallic structure of the system shall be made electrically continuous in accordance with Chapter 4.

Committee Statement: The Technical Committee accepts the submitter’s text with revisions for clarity.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 26 Negative: 1 Abstain: 1

Explanation of Negative: RAPP, R.: This information is not ready to be a part of the 780 installation standard and should be included in the appendix at this time. Coordination between the industry and this committee should be more complete and studied before we publish it in the standard.

Explanation of Abstention: GUTHRIE, M.: I agree with the concept of this chapter but do not feel that it is in sufficient condition to be published in the standard. Some additional work is required.

Comment on Affirmative: PORTFLEET, T.: 12.3.4.1 does not meet the manual of style. It mandates compliance with one of the following, then only lists 12.3.4.1.1. There is no 12.3.4.1.2. either add other options or rewrite the text.

870-110 Log #35 Final Action: Accept in Principle

(A.1.4.2 (New))

Submitter: Tom Scholtens, City of Charleston / Rep. NFPA Building Code Development Committee (BCDC)

Recommendation: Add a section A1.4.2 to Annex A as follows:

1.4.2.5 The individual(s) responsible for the installation shall be certified for fitness on the requirements of this standard by the authority having jurisdiction.

1.4.2.6 Certification for Fitness may include Underwriters Laboratories (UL) Master Label Certification of Inspection, Certified Master Installation and Design Certification or equivalent. In order to verify the quality of work, the Finished Lightning Protection System should have a UL Certificate of Inspection or equivalent.
A.3.3.22 Lightning Protection System. The term refers to systems as described in the referenced standard edition and detailed in this chapter. Lightning protection systems are described in Chapter 8. Mast and catenary systems are described in Chapter 6. Lightning protection systems for watercraft are given in Chapter 10. Lightning protection systems for heavy-duty stacks are described in Chapter 4. Mast and catenary systems typically used for special occupancies and constructions are described in Chapter 7. Lightning protection systems for use in structures containing flammable vapors, gases or liquids that can give off flammable vapors are described in Chapter 8. Lightning protection systems for wind turbines are described in Chapter 9. Lightning protection systems for watercraft are given in Chapter 10.

Substantiation: The Technical Committee agrees to provide additional guidance to the AHJ but revises the submitter’s text.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-111 Log #78 Final Action: Accept in Principle
(A.3.3.22)

Submitter: Mitchell Guthrie, Engineering Consultant
Recommendation: Revise A.3.3.22 as follows:
A.3.3.22 Lightning Protection System. The term refers to systems as described and detailed in this chapter. Mast and catenary Lightning protection systems used in ordinary structures are described in Chapter 4. Mast and catenary system types typically used for special occupancies and constructions are described in Chapter 6. Lightning protection systems for use in structures containing flammable vapors, gases or liquids that can give off flammable vapors are described in Chapter 7. Lightning protection systems for use in structures housing explosives materials are described in Chapter 8. Lightning protection systems for wind turbines are described in Chapter 9. Lightning protection systems for watercraft are given in Chapter 10.

Substantiation: Mast and catenary systems have been moved into the general requirements of Chapter 4 to make it clear that they may be used in any application and not just for special occupancies such as flammable facilities or explosives applications. If it is necessary to indicate where to find protection requirements for ordinary structures, then a listing of where to find protection of special consideration for other occupancies should be provided.

Committee Meeting Action: Accept in Principle
Committee Statement: See Committee Proposal 780-111a (Log #CP3). The Technical Committee formulated the appropriate language in Proposal 780-111a (Log #CP3). The Technical Committee accepts the submitter’s text and relocates to Section A.4.8.11. The Technical Committee revises the text for clarity.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-111a Log #CP3 Final Action: Accept
(A.3.3.22)

Submitter: Technical Committee on Lightning Protection, Recommendation: Delete last sentence in A.3.3.22.
Substantiation: The TC deletes the last sentence as the requirements are not only in Chapter 7.

Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-112 Log #39 Final Action: Accept
(A.3.3.37)

Submitter: John F. Bender, Underwriters Laboratories Inc.
Recommendation: Revise text to read as follows:
A.3.3.37 Voltage Protection Rating (VPR). The VPR is a rating (or ratings) selected by the manufacturer based on the measured limiting voltage determined during the transient voltage surge suppression test specified in ANSI/UL 1449, UL Standard for Safety for Surge Protective Devices. This rating is the maximum voltage developed when the SPD is exposed to a 1 kA, 8/20 μ current limited waveform through the device. It is a specific measured limiting voltage rating assigned to an SPD by testing done in accordance with UL 1449. Edition 2. Nominal VPR values include 330 V, 400 V, 500 V, 600 V, 700 V, and so forth.

Substantiation: Delete reference to edition of the UL standard in the text of this document. Instead, refer to the referenced edition as listed in O.1.2.5 so the referenced standard edition is consistent throughout the document.

Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-117 Log #45 Final Action: Accept in Principle
(A.4.14.3 (New))


Substantiation: Add a note to Annex paragraph A.4.14.3

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-115 Log #50 Final Action: Accept in Principle
(A.4.14.2)

Recommendation: Insert new text to read as follows:
A.4.14.2. When separate but adjacent buildings and/or facilities are interconnected directly (not through a utility) by electric, CATV, CCTV, data, or communications wiring, the grounding systems of those buildings should be directly interconnected to each other using a main-size conductor. The need for this interconnection can be eliminated by the use of fiber optic cable, shielded wire, wire run in grounded metallic conduit, or redundant surge protection (SPD’s installed at entrance /exit of both buildings/facilities).

Substantiation: When facilities are inspected for lightning protection after a lightning event, damage is typically seen on devices in other adjacent structures/facilities on devices that share a common interconnected wire between those structures/facilities.

Committee Meeting Action: Accept in Principle
Add * following 4.14.2.
Committee Statement: The Technical Committee accepts the submitter’s text and adds an * to 4.14.2.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-113 Log #59 Final Action: Accept in Principle
(A.4.6.1.6 (New))

Recommendation: Add new section A.4.6.1.6 and A.4.6.1.6 Consideration should be taken when using a moveable metallic object as a Strike Termination Devices. If lightning is to attach to metallic objects with moveable parts, there is a possibility that arc might occur at the point of articulation between the component parts which is likely to fuse the parts together.

Substantiation: This paragraph provides cautionary language identifying areas of concern associated with this practice.

Committee Meeting Action: Accept in Principle
Add * following 4.8.11.
Add new section A.4.8.11 to read as follows:
A.4.8.11 Consideration should be taken when using a moveable metallic object as a strike termination device. If lightning is to attach to metallic objects with moveable parts, there is a possibility that arcing could occur at the point of articulation between the component parts which could possibly fuse the parts together.

Committee Statement: The Technical Committee accepts the submitter’s text and relocates to Section A.4.8.11. The Technical Committee revises the text for clarity.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-114 Log #86 Final Action: Accept in Part
(A.4.7.3.4)

Recommendation: Change the value under 40 from (131.2) to (130). Remove H (m). Place m and ft. notation next to each number. Change the value in the note 2. As follows:
A.4.7.3.4. note 2. “H below 1.8 m (6 ft).”

Substantiation: Change is need to maintain consistency throughout the document as per the Manual of Style Section 4.1.2.

Committee Meeting Action: Accept in Part
Change the value in the note 2 as follows:
A.4.7.3.4. note 2. “H below 1.8 m (6 ft)”

Committee Statement: The Technical Committee accepts the change to note 2 only.

The Technical Committee does not accept the remainder of the submitter’s text.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28
NEC paragraph 250.50 (Grounding Electrode System and Grounding Electrode Conductor) requires all electrodes present at each building or structure be bonded together to form the grounding electrode system. The differences occur in NEC Annex paragraph 250.52 which allows grounding electrode devices not shown in Section 4.13. Grounding electrode devices allowed in 250.52, but not referenced in this document include:

250.52 (A) (10) 10 ft. of metallic underground water pipe extending from the structure in contact with earth.  
250.52 (A) (3) The metal frame of the structure in contact with earth.  
250.52 (A) (3) The concrete encased electrode described as #4 AWG would need to be a main size conductor per Paragraph 4.13.3.2.  
250.52 (A) (4) The ground ring electrode not smaller than #2 AWG is acceptable for Class I, but would not be acceptable for Class II (See Table 4.1.1.1.2).  
250.52 (A) (5) Pipe electrodes shown under section (a) are not included. Rod electrodes described in (b) as zinc coated steel are not covered (4.13.2.5).  
250.52 (A) (6) Other listed electrodes would need to comply with the various sections of 4.13.  
250.52 (A) (7) Plate electrodes would need to comply with 4.13.6.  
250.52 (A) (8) “Other local metal underground systems or structures” are not referenced as grounding electrodes in this Standard.

The lightning protection system designer must be familiar with these differences for coordination of interconnection with other building grounding electrodes or the structural grounding electrode system as required by paragraph 4.14.3.  

Substantiation: Annex materials to identify alternate grounding electrodes specified in NEC (NFPA 70 - 2011) to assist users of this document (780) with proper bonding interconnections for lightning protection and qualified grounding electrodes identified by (new) 4.14.3.

Committee Meeting Action: Accept in Principle

Add * following 4.14.3.

New text to read as follows:

Annex paragraph A.4.14.3  
Definitions in the NEC (NFPA 70) and 780 for bonding or bonded, grounded or grounding and grounding electrode are similar. The actual standards sections that define what constitutes these various items point to differences in application, equipment, and requirements.

NEC paragraph 250.50 (Grounding Electrode System) requires all electrodes present at each building or structure be bonded together to form the grounding electrode system. This coordinates to the requirements of Section 4.14. The differences occur in NEC Section 250.52 which describes grounding electrode devices not shown in Section 4.13. Grounding electrode devices described in Section 250.52, but not referenced in this document include:

1) 250.52 (A) (1) 10 ft. of metallic underground water pipe extending from the structure in contact with earth  
2) 250.52 (A) (2) (1) The metal frame of the structure in contact with earth  
3) 250.52 (A) (3) (2) The concrete encased electrode described as #4 AWG would need to be a main size conductor per Paragraph 4.13.3.2.  
4) 250.52 (A) (4) The ground ring electrode not smaller than #2 AWG is acceptable for Class I, but would not be acceptable for Class II (See Table 4.1.1.1.2).  
5) 250.52 (A) (5) Pipe electrodes shown under section (a) are not included. Rod electrodes described in (b) as zinc coated steel are not covered (4.13.2.5).  
6) 250.52 (A) (6) Other listed electrodes would need to comply with the various sections of 4.13.  
7) 250.52 (A) (7) Plate electrodes would need to comply with 4.13.6.  
8) 250.52 (A) (8) “Other local metal underground systems or structures” are not referenced as grounding electrodes in this Standard.

The lightning protection system designer must be familiar with these differences for coordination of interconnection with other building grounding electrodes or the structural grounding electrode system as required by paragraph 4.14.3.

Committee Meeting Statement: The Technical Committee accepts the submitter’s text and edits to comply with Manual of Style.

The Technical Committee notes that the references in this proposal correlate with Proposal 70-50.

Number Eligible to Vote: 28

Ballot Results: Affirmative: 28
Committee Statement: The Technical Committee accepts the submitter's text and adds "previously." 780-121 Log #53  Final Action: Reject (A.8.6.5.5)

Submitter: Josephine Covino, DoD Explosives Safety Board

Recommendation: Add the following section A.8.6.5.5.1. For personnel safety, a single earth electrode (e.g., a grounding rod) can be installed at-or-near the door of the container and bonded to it.


Introduction

Above is a proposed addition to the subject document that defines US Department of Defense (DoD) guidelines for storage of ammunition and explosives (AE) in steel ISO containers. In particular it delineates two storage categories: one list of AE categories that can be safely stored in a steel ISO container without the need for any LPS installed; the second list is those AE categories that must be stored in an ISO container that has NFPA-compliant LPS installed.

Discussion:

A detailed study of the electromagnetic effects of lightning strikes on steel ISO containers has been performed. The study includes a mathematical analysis of direct and indirect lightning effects, and corroborative electromagnetic transfer impedance testing. Aside from the potential of burn-through due to a direct strike attachment, the report and subsequent private communications between the authors, Dr. John Tobias and Mr. Mitchell Guthrie conclude that the ISO will provide adequate electromagnetic shielding to its contents. Risk levels to the stored AE are equal to or less than that of other authorized storage structures, with the exception of burn-through.

The two AE categories delineated below are:

1. AE that are not adversely affected by burn-through effects (no LPS required and)
2. AE that could be adversely affected by burn-through (LPS required).

Based on the study and the categorization presented, the DoD Explosives Safety Board recommends that these guidelines be added to NFPA 780, Chapter 8, specifically for as well as applicable to DoD AE storage in steel ISO Containers.

The theoretical calculations and electromagnetic measurements of a typical steel ISO container indicate that it can provide adequate protection for most AE against all lightning threats without the application of any external lightning protection means. The level of protection provided by an ISO container against all lightning threats is consistent with all other DoD-approved lightning protected structures that contain AE with the exception of a small possibility of burn-through.

Proposed Addition to NFPA 780:

This assumes that the container is in good condition, all welds and joints are sound, and that any damage has been repaired per MIL HDBK-138B.

DoD steel ISO containers can be used to safely store the following AE items, with a minimum Safe Separation Distance of 0.6 inch, without the need for any external LPS:

1. Small arms in ammo boxes.
2. All-up weapon systems in shipping containers.
3. Warheads and rocket motors in shipping containers.
4. Metal cased or overpacked bombs and AE.
5. Detonators and explosive actuators in metallic overpacks.

The following AE items must be stored in steel ISO containers that are protected with an external LPS:

1. Bulk explosives/propellants in non-conductive boxes or drums.
2. Rocket motors which have non-metallic cases.
3. Non-metal cased or overpacked cartridges and ammunition.
4. Items shipped with open detonators or explosive actuators. For personnel safety, a single earth electrode (e.g., a grounding rod) can be installed at-or-near the door of the container and bonded to it. If any electrical power, communications and/or signal wiring, metallic pipes and/or ducting are installed on an ISO container, LPS as specified in DoD 6055.09-STD and NFPA-780 must be installed, with surge protection as necessary.

Committee Meeting Action: Reject

Committee Statement: The Technical Committee added Annex material on
Submittor: Technical Committee on Lightning Protection.
Recommendation: Delete note following Table A.10.4.1.3.
Substantiation: The TC deletes the note as it provides no guidance for the user of the table.
Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Submittor: John M. Tobias, US Army Communications Electronics Command
Recommendation: Revise text as follows:
A.10.4.1.3 If a metal with the area given by the equation in 10.4.1.3 is subject to the lightning heating (action integral) required to raise the temperature of a copper conductor with 21 mm2 (0.033 in.2) from a nominal temperature of 298 K (77 °F) to the melting point of copper, then its temperature would be raised to the melting point of the metal. Values for silicon bronze and stainless steel are given in Table A.10.4.1.3.
Revise title of the submitter’s proposed table to read as follows:
Table A.10.4.1.3(a) Areas for Main Conductor Not Containing Electrical Wiring (inch-pound units)
Revise the headings in the submitter’s table so the following are italic:
Cp, D, p and MP
Change title of Table A.10.4.1.3 to read as follows:
Table A.10.4.1.3(b) Areas for Main Conductor Not Containing Electrical Wiring (metric units)
(See Pages A.10.4.1.3(a) and A.10.4.1.3(b) on the following page.)
Committee Statement: The Technical Committee accepts the submitter’s text and edits to editorially insert the new table and revise its heading.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Recommendation: Change the values as follows: “at a depth of at least 0.546 m (18 in.) and a distance of approximately 11.2 m (36 ft.) around the external walls.”
Substantiation: Change is need to maintain consistency throughout the document as per the Manual of Style Section 4.1.2
Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Recommendation: Change value to read as follows: “is approximately 46 m (150 ft)” third Paragraph “standard 46 m (150 ft)”
Substantiation: Change is need to maintain consistency throughout the document as per the Manual of Style Section 4.1.2
Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1

Recommendation: Change value to read as follows: “is approximately 46 m (150 ft)” third Paragraph “standard 46 m (150 ft)”
Substantiation: Change is need to maintain consistency throughout the document as per the Manual of Style Section 4.1.2
Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1

Comment on Affirmative:
PORTFLEET, T.: Values are to be changed expressing the “English” values first.

780-125 Log #93 Final Action: Accept
(Figure B.3.2.2)

Recommendation: Figure B.3.2.2. Change dimension on the radius from 45 m to 46 m.
Substantiation: Change is need to maintain consistency throughout the document as per the Manual of Style Section 4.1.2.
Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 27 Negative: 1
Explanation of Negative:
GUTHRIE, M.: This change is not necessary because action taken on 780-1a indicates the equivalent values shall be approximate.

780-126 Log #89 Final Action: Accept in Principle
(B.3.3.2)

Recommendation: Change values to read as follows:
B.3.3.2. second paragraph “is approximately 46 m (150 ft)” third Paragraph “standard 46 m (150 ft)”
Substantiation: Change is need to maintain consistency throughout the document as per the Manual of Style Section 4.1.2
Committee Meeting Action: Accept
Number Eligible to Vote: 28
Table A.10.4.1.3(a) Areas for Main Conductor Not Containing Electrical Wiring (inch-pound units)

<table>
<thead>
<tr>
<th>Metal</th>
<th>( C_p ) (BTU/lbm°F)</th>
<th>( D ) (lbm/in²)</th>
<th>( \rho ) (Ω in)</th>
<th>( MP ) (°F)</th>
<th>Area (in²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicon bronze</td>
<td>0.086</td>
<td>0.32</td>
<td>9.95 × 10⁻⁶</td>
<td>1981</td>
<td>0.13</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>0.122</td>
<td>0.29</td>
<td>3.74 × 10⁻⁵</td>
<td>2781</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Note: Conductors with these areas have a larger resistance per unit length than a main conductor made of copper and so should not be used where potential equalization is required.

Table A.10.4.1.3(b) Areas for Main Conductor Not Containing Electrical Wiring (metric units)

<table>
<thead>
<tr>
<th>Metal</th>
<th>( C_p ) (J kg⁻¹ K⁻¹)</th>
<th>( D ) (kg m⁻³)</th>
<th>( \rho ) (Ω m)</th>
<th>( MP ) (K)</th>
<th>Area (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicon bronze</td>
<td>360</td>
<td>8800</td>
<td>2.55 × 10⁻⁷</td>
<td>1356</td>
<td>85</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>510</td>
<td>7930</td>
<td>9.6 × 10⁻⁷</td>
<td>1800</td>
<td>125</td>
</tr>
</tbody>
</table>

Proposal 780-123 (Log #113) Committee Action
Table C.2.3 Sample Calculations of Bonding Distances

<table>
<thead>
<tr>
<th>h</th>
<th>(n=1.0)</th>
<th>(n=1.5)</th>
<th>(n=2.25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>m ft</td>
<td>m ft</td>
<td>m ft</td>
<td>m ft</td>
</tr>
<tr>
<td>3.05</td>
<td>10</td>
<td>10.5</td>
<td>10.22</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>0.5</td>
<td>0.22</td>
</tr>
<tr>
<td>6.10</td>
<td>20</td>
<td>20.1</td>
<td>17.11</td>
</tr>
<tr>
<td></td>
<td>1.01</td>
<td>1.01</td>
<td>1.11</td>
</tr>
<tr>
<td>9.15</td>
<td>30</td>
<td>30.5</td>
<td>29.22</td>
</tr>
<tr>
<td></td>
<td>1.52</td>
<td>1.52</td>
<td>1.62</td>
</tr>
<tr>
<td>12.2</td>
<td>40</td>
<td>40.5</td>
<td>38.81</td>
</tr>
<tr>
<td></td>
<td>2.03</td>
<td>2.03</td>
<td>2.13</td>
</tr>
</tbody>
</table>

Substantiation: Equivalent units provided in accordance with Manual of Style and NFPA 780 Editorial Task Group minutes, 4/11/2011.

Committee Meeting Action: Accept in Principle
Revise the submitter’s value to be 1 ft 8 in. A minor typographical error in the recommend value of 1 ft 1.3/8 in. from the base of the tree. This change will allow use of the A300 specified trench depth and distance from the trunk.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Substantiation: The Technical Committee notes that the submitter is not necessary because action taken on 780-1a indicates the equivalent values shall be approximate.

Committee Meeting Action: Reject
Committee Statement: The submitter has not provided the specific proposed text in the recommendation for this proposal in accordance with 4.3.3(c) of the NFPA 780 future submittals.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Substantiation: The submitter is encouraged to utilize the most recent edition of NFPA 780 in future submittals.

Committee Meeting Action: Accept in Principle
Revise text to read as follows:

Committee Statement: The Technical Committee choices do not delete Annex F and replace it with a normative reference to ANSI A300 Part 4.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Committee Statement: The Technical Committee notes that the submitter is referring to Figure F.1.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Committee Statement: The Technical Committee notes that the submitter is referring to Figure F.1.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Committee Meeting Action: Reject

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Committee Meeting Action: Accept in Principle

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28
Submitter: E. Thomas Smiley, Bartlett Tree Research Laboratory
Recommendation: Revise text to read as follows:
F 2.1 Conductor should conform to the requirements of Chapter 4 for bonding conductors: 16 strands of 17 gauge wire.
Substantiation: ANSI A300 has been using the smaller conductor for nearly 10 years, this is easier to install in trees and has functioned without problems. The larger diameter conductor is not needed in trees.
Committee Meeting Action: Accept in Principle
Recommendation: Revise text to read as follows:
F 2.1 Conductors should conform to the requirements of Chapter 4 for bonding conductors.
Committee Statement: The submitter is encouraged to utilize the most recent edition of NFPA 780 in future submittals.
The Technical Committee accepts the submitter’s text and adds English units as required by the Manual of Style.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Submitter: E. Thomas Smiley, Bartlett Tree Research Laboratory
Recommendation: Delete the following text:
F 2.2 “If the tree trunk is 0.9 m in diameter or larger, two down conductors should be run on opposite sides of the trunk and interconnected.”
Substantiation: One conductor is sufficient since most strikes occur high in the tree where the trunk diameter is smaller. The only tree damage we see is above the air terminal, not on side branches or the trunk on the opposite side of the tree.
Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Submitter: E. Thomas Smiley, Bartlett Tree Research Laboratory
Recommendation: Revise text to read as follows:
F 2.5 (1) Be connected to all conductors that descend the trunk of the tree, extend three or more radial conductors in trenches of 0.2 m and be spaced at equal intervals about the base to a distance not less than 5 m or a single driven ground rod installed outside the dripline of at least 4 m from the tree trunk.
Substantiation: We have found that one ground rod installed at 10 feet (3m) from the trunk has been sufficient and results in minimal root and tree damage. Eight inch (0.2 m) trench depth is practical and achieves our goal of minimizing tree root damage. Deeper trenches damages more roots.
Committee Meeting Action: Accept in Principle
Recommendation: Revise text to read as follows:
F 2.5 (1) Be connected to all conductors that descend the trunk of the tree, extend three or more radial conductors in trenches of at least 0.2 m (8 in.) and be spaced at equal intervals about the base to a distance not less than 3 m (10 ft) or a single driven ground rod installed outside the dripline of at least 4 m (12 ft) from the tree trunk.
Committee Statement: The submitter is encouraged to utilize the most recent edition of NFPA 780 in future submittals.
The Technical Committee accepts the submitter’s text and adds English units as required by the Manual of Style. The Technical Committee also changes “three” to “one.”
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Submitter: E. Thomas Smiley, Bartlett Tree Research Laboratory
Recommendation: Revise text to read as follows:
F 2.5 (2) Have radial conductors extend to the branch line not less than 7.6 m (25 ft).
Substantiation: This distance has been effective at minimizing root damage, greater length adds cost and is not necessary.
Committee Meeting Action: Accept in Principle
Recommendation: Revise text to read as follows:
F 2.5 (2) Have radial conductors extend to the branch line not less than 7.6 m (25 ft).
Committee Statement: The submitter is encouraged to utilize the most recent edition of NFPA 780 in future submittals.
The Technical Committee accepts the submitter’s text and added English units as required by the Manual of Style.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Submitter: E. Thomas Smiley, Bartlett Tree Research Laboratory
Recommendation: Revise text to read as follows:
G.1.1.3 (2) “no greater than 459 mm (18 in.)”
Substantiation: Change is need to maintain consistency throughout the document as per the Manual of Style Section 4.1.2.
Committee Meeting Action: Accept
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28
Final Action: Accept in Principle
(Figure L.2)

Submitter: David E. McAfee, Fire and Lightning Consultants

Recommendation: Replace existing figure with the following revised figure:
Substantiation: Updated flash density values available for National Lightning Detection Network and Vaisala.

Committee Meeting Action: Accept in Principle
- Replace existing figure with the following revised figure:


**Average flash density**
- ft/sq mi/yr
  - 33+ to 9 to 12
  - 27 to 33 to 6 to 9
  - 21 to 27 to 3 to 6
  - 18 to 21 to 1 to 3
  - 15 to 18 to 0.25 to 1
  - 12 to 15 to 0+ to 0.25

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Committee Statement: The Technical Committee accepts the submitter’s recommendation and provides an updated map providing cloud-to-ground lightning incidence.

Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

Comment on Affirmative:
- FRANKLIN, D.: Confirm that, per committee discussion, the map will be converted to a “line type” illustration to denote boundaries. The shaded version is not usable or accurate as shown.
Submitter: Technical Committee on Lightning Protection.

Recommendation: Revise Tables L.6.7.8, L.6.7.9, L.6.7.10 and Figure L.6.8 as follows:

### Table L.6.7.8

<table>
<thead>
<tr>
<th>Line Type</th>
<th>Routing, shielding and bonding conditions</th>
<th>Withstand Voltage $U_W$ in kV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Aerial or buried line, unshielded or shielded whose shield is not bonded to the same bonding bar as equipment</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Shielded aerial or buried whose shield bonded to the same bonding bar as equipment</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>$\Omega/km &lt; R_S &lt; 20\Omega/km$</td>
<td>0.95</td>
<td></td>
</tr>
<tr>
<td>$\Omega/km &lt; R_S &lt; 5\Omega/km$</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>$R_S &lt; 1\Omega/km$</td>
<td>0.6</td>
<td></td>
</tr>
</tbody>
</table>

Note 1: $R_S$ is the resistance of the cable shield which can be obtained from the cable manufacturer.

NOTE 2 In suburban/urban areas, an LV power line uses typically unshielded buried cable whereas a telecommunication line uses a buried shielded cable with a shield resistance of 5 $\Omega$ km. In rural areas, an LV power line uses an unshielded aerial cable whereas a telecommunication line uses an aerial unshielded cable. An HV buried power line uses typically a shielded cable with a shield resistance in the order of 1 $\Omega$ km to 5 $\Omega$ km.

Note 3 Values for $U_W$ can be obtained from manufactures and equipment suppliers. If the actual values are not readily available from other sources the following typical values may be utilized:

1. For structures containing computer equipment; $U_W = 1.5$ kV
2. For a typical residential structure; $U_W = 2.5$ kV
3. For a typical business, hotel, hospital etc. structure; $U_W = 2.5$ kV
4. For a typical light industrial structure; $U_W = 4.0$ kV
5. For a typical heavy industrial structure; $U_W = 6.0$ kV
6. Default value: $U_W = 1.5$ kV

Table title remains unchanged.

### Table L.6.7.9

<table>
<thead>
<tr>
<th>Line type</th>
<th>Withstand voltage $U_W$ in kV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Power lines</td>
<td>1</td>
</tr>
<tr>
<td>TLC lines</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>0.04</td>
</tr>
</tbody>
</table>

Note: Values for $U_W$ can be obtained from manufactures and equipment suppliers. If the actual values are not readily available from other sources the following typical values may be utilized:

1. For structures containing computer equipment; $U_W = 1.5$ kV
2. For a typical residential structure; $U_W = 2.5$ kV
3. For a typical business, hotel, hospital etc. structure; $U_W = 2.5$ kV
4. For a typical light industrial structure; $U_W = 4.0$ kV
5. For a typical heavy industrial structure; $U_W = 6.0$ kV
6. Default value: $U_W = 1.5$ kV

Table title remains unchanged.

Revise Table L.6.7.10 to add the following values under the Failure of Systems ($LO$) column to read as follows:

- no entry, no entry, $10^{-3}$, $10^{-6}$, $10^{-6}$, $10^{-6}$, $10^{-1}$
## DETAILED RISK ASSESSMENT WORKSHEET

### Equivalent Collective Area

\[ A_e = LW + 6H(L + W) + 9H \]

- \( L = \) ____________
- \( W = \) ____________
- \( H = \) ____________

- (for rectangular structure)
- (substitute formula for other structures)

### Probability of Damage

#### Injury Due to a Direct Strike – \( P_a \)

\[ N_g = (N_d)(A_e)(C_1)(10^{-6}) \]

\( N_g = \) ____________

\( A_e = \) ____________

\( C_1 = \) ____________

See Table L.6.7.3.

\( P_a = \) ____________

#### Physical Damage Due to a Direct Strike – \( P_b \)

\[ N_g = (N_d)(A_e)(C_1)(10^{-6}) \]

\( N_g = \) ____________

\( A_e = \) ____________

\( C_1 = \) ____________

See Table L.6.7.4.

\( P_b = \) ____________

#### Failure of Internal Systems Due to a Direct Strike – \( P_c \)

\[ K = (K_a)(K_b)(K_c)(K_d) \]

\( K_a = \) ____________

\( K_b = \) ____________

\( K_c = \) ____________

\( K_d = \) ____________

See Table L.6.7.5.

\( P_c = \) ____________

#### Failure of Internal Systems Due to a Direct Strike – \( P_m \)

\[ K_s = (K_s)(K_s)(K_s)(K_s) \]

\( K_s = \) ____________

\( K_s = \) ____________

\( K_s = \) ____________

\( K_s = \) ____________

See Table L.6.7.6.

\( P_m = \) ____________

\( U_w = \) the lowest withstand voltage of protected equipment.

Without coordinated surge protective devices – \( P_m = 1.0 \)

#### Injury Due to Strike to Incoming Service – \( P_i \)

See Table L.6.7.8.

\( P_i = \) ____________

With SPDs installed: Use lowest value of \( P_c \) or \( P_i \)

With unshielded service (no additional SPDs installed) \( P_i = 1.0 \)

#### Physical Damage from Strike to Incoming Service – \( P_v \)

With no SPDs installed \( P_v = P_v \)

With SPDs installed: Use lowest value of \( P_c \) or \( P_i \)

#### Failure of Internal Systems from Strike to Incoming Service – \( P_w \)

With SPDs installed: Use lowest value of \( P_c \) or \( P_i \)

With no SPDs installed \( P_w = P_v \)
### DETAILED RISK ASSESSMENT WORKSHEET (continued)

<table>
<thead>
<tr>
<th>Probability of Damage (continued)</th>
<th>Risk Components (continued)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Failure of Internal Systems from Strike Near Incoming Service – ( P_z )</strong></td>
<td><strong>Risk of Physical Damage Due to a Direct Strike</strong></td>
</tr>
<tr>
<td>With SPDs installed; Use lowest value of ( P_z ) or ( P_Z )</td>
<td>to Structure – ( R_u )</td>
</tr>
<tr>
<td>With no SPDs installed – See Table L.6.7.9.</td>
<td>( N_u = )</td>
</tr>
<tr>
<td>( P_Z = )</td>
<td>( N_u = )</td>
</tr>
<tr>
<td>( P_z = )</td>
<td>( P_u = ) ( R_u = )</td>
</tr>
<tr>
<td>( L_z = )</td>
<td>( L_u = )</td>
</tr>
</tbody>
</table>

#### Loss Factors

**Injury or Loss of Life – \( L_A \)**

\[ L_A = \left( \frac{n_p}{n_t} \right) \left( \frac{t_p}{8760} \right) \]

- \( n_p = \) number of endangered persons
- \( n_t = \) expected total number of persons in facility
- \( t_p = \) time in hours per year when persons are in a dangerous place inside or outside the structure

Use \( L_z \), \( L_A \), or \( L_L \) from Table L.6.7.10 when \( n_p \), \( n_t \), or \( t_p \) is uncertain or difficult to determine.

**Injury to Humans – \( L_A \) or \( L_L \)**

\[ L_A = L_L = \left( r_p \right) \left( \frac{r_v}{L_z} \right) \]

- \( r_p = \) See Table L.6.7.11.

**Physical Damage – \( L_v \) or \( L_L \)**

\[ L_v = L_L = \left( r_p \right) \left( \frac{r_v}{L_z} \right) \]

- \( r_p = \) See Table L.6.7.10.
- \( r_v = \) See Table L.6.7.12.
- \( h_z = \) See Table L.6.7.13.
- \( h_L = \) See Table L.6.7.14.

**Failure of Internal Systems – \( L_O \)**

\[ L_O = \]

- See Table L.6.7.10.

#### Risk Components

**Risk of Injury or Loss of Life from a Direct Strike to a Structure – \( R_A \)**

\[ R_A = \left( \frac{N_A \cdot P_A}{L_A} \right) \]

| \( N_A = \) | \( P_A = \) \( R_A = \) |
| \( L_A = \) | \( L_A = \) |

**Risk of Physical Damage Due to a Direct Strike to Incoming Service – \( R_Y \)**

\[ R_Y = \left( \frac{N_Y \cdot P_Y}{L_Y} \right) \]

| \( N_Y = \) | \( P_Y = \) \( R_Y = \) |
| \( L_Y = \) | \( L_Y = \) |

**Risk of Failure of Internal Systems Due to Direct Strike to Incoming Service – \( R_W \)**

\[ R_W = \left( \frac{N_W \cdot P_W}{L_W} \right) \]

| \( N_W = \) | \( P_W = \) \( R_W = \) |
| \( L_W = \) | \( L_W = \) |
### DETAILED RISK ASSESSMENT WORKSHEET (continued)

#### Risk Components (continued)

<table>
<thead>
<tr>
<th>Risk of Failure of Internal Systems Due to Strike Near Incoming Service – $R_x$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$N_x = \frac{P_x}{L_x}$</td>
</tr>
<tr>
<td>$R_x = (N_x - N_x) \times P_x \times L_x$</td>
</tr>
<tr>
<td>$P_x = \frac{P_x}{L_x}$</td>
</tr>
<tr>
<td>$L_x = L_x$</td>
</tr>
</tbody>
</table>

#### Risk Calculations (continued)

##### Risk of Injury or Loss of Life – $R_1$

- $R_x = R_x + R_y + R_z + R_w + R_v + R_z^{**}$
- $R_y = R_y^{**}$
- $R_z^{**} = R_z^{**}$
- $R_w = R_w$
- $R_v = R_v$
- $R_z^{**} = R_z^{**}$

- $R_x^{**} = R_x^{**}$
- $R_y^{**} = R_y^{**}$
- $R_z^{**} = R_z^{**}$

##### Risk of Loss of Service (Power, Phone, Water, etc.) – $R_2$

- $R_x = R_x + R_y + R_z + R_w + R_v + R_z^{**}$
- $R_y = R_y^{**}$
- $R_z^{**} = R_z^{**}$
- $R_w = R_w$
- $R_v = R_v$
- $R_z^{**} = R_z^{**}$

##### Risk of Loss of Historical Significance – $R_3$

- $R_x = R_x + R_y + R_z + R_w + R_v + R_z^{**}$
- $R_y = R_y^{**}$
- $R_z^{**} = R_z^{**}$
- $R_w = R_w$
- $R_v = R_v$
- $R_z^{**} = R_z^{**}$

##### Risk of an Economic Loss – $R_4$

- $R_x = R_x + R_y + R_z + R_w + R_v + R_z^{**}$
- $R_y = R_y^{**}$
- $R_z^{**} = R_z^{**}$
- $R_w = R_w$
- $R_v = R_v$
- $R_z^{**} = R_z^{**}$

##### Overall Risk to the Structure

- $R = R_1 + R_2 + R_3 + R_4$
- $R_1 = R_1$
- $R_2 = R_2$
- $R_3 = R_3$
- $R_4 = R_4$

*Applicable only for structures with life-critical electrical equipment, risk of explosion, or where failure of internal system immediately endangers life.

**Applicable only to structures where animals could be lost.

---

Figure title remains unchanged.

**Substantiation:** The TC edits Tables L.6.7.8, L.6.7.9, L.6.7.10 and Figure L.6.8 to make the information easier to utilize and to correlate with changes made by the IEC.

**Committee Meeting Action:** Accept

**Number Eligible to Vote:** 28

**Ballot Results:** Affirmative: 28
780-139 Log #41 Final Action: Accept in Principle

(O.1.2.5)

Submitter: John F. Bender, Underwriters Laboratories Inc.
Recommendation: Revise text to read as follows:

O.1.2.5 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.
Committee Meeting Action: Accept in Principle
Revise text to read as follows:

O.1.2.5 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.
Committee Statement: The Technical Committee retains the document date (by year) but not the revision date.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28

780-140 Log #42 Final Action: Reject

(O.2.4)

Submitter: John F. Bender, Underwriters Laboratories Inc.
Recommendation: Revise text to read as follows:

O.2.4 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.
Substantiation: Update the referenced standard to the most recent edition.
Committee Meeting Action: Reject
Committee Statement: The Technical Committee retains the document date (by year) but not the revision date.
Number Eligible to Vote: 28
Ballot Results: Affirmative: 28