

TAC: Structural

This document created by the Florida Department of Business and Professional Regulation -

850-487-1824

TAC: Structural

Total Mods for **Structural** in **Approved as Submitted : 10**

Total Mods for report: 37

Sub Code: Building

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S12196

Date Submitted	02/17/2025	**Section**	1405.6	**Proponent**	Joseph Belcher
Chapter	14	**Affects HVHZ**	Yes	**Attachments**	No
TAC Recommendation	Approved as Submitted				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Summary of Modification

Correct reference to updated TMS standard

Rationale

Correct the reference to the updated TMS standard

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
None.Corrects the reference to the updated TMS standard.
Impact to building and property owners relative to cost of compliance with code
None.Corrects the reference to the updated TMS standard.
Impact to industry relative to the cost of compliance with code
None.Corrects the reference to the updated TMS standard.
Impact to small business relative to the cost of compliance with code
None.Corrects the reference to the updated TMS standard.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
None.Corrects the reference to the updated TMS standard.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
None.Corrects the reference to the updated TMS standard.
Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
The change does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

The proposed change does not degrade the effectiveness of the code and improves the effectiveness of the code.

Alternate Language

2nd Comment Period

S12196-A1

Proponent Joseph Belcher **Submitted** 8/2/2025 2:16:00 PM **Attachments** No

Rationale:

The original Mod S12196 was submitted as a placeholder. The Alternate Language proposed is to update all the references to the updated edition of TMS, TMS 402-2016. No changes have been made to the technical provisions of either the Florida Building Code or TMS 402. The proposed Alternate Language is submitted as a complete replacement for the original Mod S12196 and contains the provisions of the original Mod. correcting the references to an updated standard

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None, updating references to a referenced standard with no changes to the technical provisions of the code.

Impact to building and property owners relative to cost of compliance with code

None, updating references to a referenced standard with no changes to the technical provisions of the code.

Impact to industry relative to the cost of compliance with code

None, updating references to a referenced standard with no changes to the technical provisions of the code.

Impact to small business relative to the cost of compliance with code

None.Corrects the reference to the updated TMS standard.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Updates references. to a standard adopted by the code.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Updates references. to a standard adopted by the code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not dicriminate.

Does not degrade the effectiveness of the code

Updates references. to a standard adopted by the code.

S12196-A1Text Modification

SECTIONS MODIFIED:

1405.6,1405.10, 2107.2, 2107.3, 2107.6, 2108.4., 2122.5, 2122.10

1405.6 Anchored masonry veneer. Anchored masonry veneer shall comply with the provisions of Sections 1405.6, 1405.7, 1405.8 and 1405.9 and Sections ~~12.1 and 12.2~~13.1 and 13.2 of TMS 402.

[BS] 1405.10 Adhered masonry veneer. Adhered masonry veneer shall comply with the applicable requirements in this section and Sections ~~12.1 and 12.3~~13.1 and 13.3 of TMS 402.

[BS] 1405.10 Adhered masonry veneer. Adhered masonry veneer shall comply with the applicable requirements in this section and Sections ~~12.1 and 12.3~~13.1 and 13.3 of TMS 402.

2107.2 TMS 402, Section ~~6.1.6.1.1~~6.1.7.1.2, lap splices. As an alternative to Section ~~6.1.6.1.1~~6.1.7.1.2, it shall be permitted to design lap splices in accordance with Section 2107.2.1.

2107.3 TMS 402, Section ~~6.1.6.1~~6.1.7.1, splices of reinforcement. Modify Section ~~6.1.6.1~~6.1.7.1 as follows:

~~6.1.6.1~~6.1.7.1 – Splices of reinforcement. Lap splices, welded splices or mechanical splices are permitted in accordance with the provisions of this section. All welding shall conform to AWS D1.4. Welded splices shall be of ASTM A706 steel reinforcement. Reinforcement larger than No. 9 (M#29) shall be spliced using mechanical connections in accordance with Section ~~6.1.6.1.3~~6.1.7.2.1.

2108.4 TMS 402, Section ~~6.1.5.1.1~~6.1.6.3.1 Development of bar reinforcement in tension or compression. Modify Section

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S12196-A1Text Modification

~~6.1.5.1.1~~6.1.6.3.1 as follows:

~~6.1.5.1.1~~6.1.6.3.1The required development length of reinforcing bars shall be determined by Equation (~~6-1~~6-2), but shall not be less than 12 inches or 40 *db* and need not be greater than 72 *db*.

Equation ~~6-1~~6.2, including the notations from TMS 402, is unchanged. Gamma factors are changed as follows:

?= 1.0 for No. 3 (M#10) through No. 5 (M#16) bars

?= 1.04 for No. 6 (M#19) through No. 7 (M#22) bars

?= 1.2 for No. 8 (M#25) through No. 11 (M#36) bars

2122.5 Concentrated loads. Bearing area and concentrated loads shall be in accordance with TMS 402 Sections ~~4.3.4~~4.4.4 and ~~5.1.3~~5.1.1.

2122.10 Intersecting walls. Intersecting walls shall comply with TMS 402 Section ~~5.1.1~~5.2.

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S12196Text Modification

1405.6 Anchored masonry veneer. Anchored masonry veneer shall comply with the provisions of Sections 1405.6, 1405.7, 1405.8 and 1405.9 and Sections ~~12.1 and 12.2~~13.1 and 13.2 of TMS 402.

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TAC: Structural

Total Mods for **Structural** in **Approved as Submitted : 10**

Total Mods for report: 37

Sub Code: Building

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S12342

Date Submitted	02/18/2025	**Section**	1405.16.1	**Proponent**	Alexander Haldeman
Chapter	14	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Approved as Submitted				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Residential - R703.10.1 - Same criteria in residential code would also need change proposed for code consistency.

Summary of Modification

Clarification on the means of supporting and attachment of edges/joints of fiber-cement siding panels.

Rationale

This proposal clarifies that means of support and attachment of edges/joints of fiber-cement siding panels can be achieved by multiple methods, including framing members, but also including furring wood structural panel, and other approved means/materials not falling into the above listed methods which may or may not require approval from the building official or approved agency.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
This clarification will not impact enforcement of code.
Impact to building and property owners relative to cost of compliance with code
no cost impact, as requirements are not changing.
Impact to industry relative to the cost of compliance with code
no cost impact, as requirements are not changing.
Impact to small business relative to the cost of compliance with code
no cost impact, as requirements are not changing.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This proposal is clarifying in nature, and will not affect health, safety and welfare of the general public
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposal improves the code by clarifying that materials and methods more than only framing may be used at panel joints to comply with this code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This does not discriminate, as it clarifies that approved materials and methods may be used equally to "framing members" and comply with this code.

Does not degrade the effectiveness of the code

These proposals do not degrade the effectiveness of this code.

Alternate Language

2nd Comment Period

Proponent Alexander Haldeman **Submitted** 8/22/2025 6:23:37 PM **Attachments** No

S12342-A1

Rationale:

nailable substrate is a defined term which more concisely captures the intent of the initial change proposal

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
no impact

Impact to building and property owners relative to cost of compliance with code
no impact

Impact to industry relative to the cost of compliance with code
no impact

Impact to small business relative to the cost of compliance with code
no cost impact, as requirements are not changing.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This proposal is clarifying in nature, and will not affect health, safety and welfare of the general public

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
This proposal improves the code by clarifying that materials and methods more than only framing may be used at panel joints to comply with this code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
This does not discriminate, as it clarifies that approved materials and methods may be used equally to "framing members" and comply with this code.

Does not degrade the effectiveness of the code
These proposals do not degrade the effectiveness of this code.

S12342-A1Text Modification

[BS] 1405.16.1 Panel siding.

Fiber-cement panels shall comply with the requirements of ASTM C1186, Type A, minimum Grade II (or ISO 8336, Category A, minimum Class 2). Panels shall be installed with the long dimension either parallel or perpendicular to framing. Vertical and horizontal joints shall occur over *nailable substrate* ~~framing members, furring, *wood structural panel* or other *approved* supporting material~~ and shall be protected with caulking, with battens or flashing, or be vertical or horizontal shiplap or otherwise designed to comply with Section 1403.2. Panel siding shall be installed with fasteners in accordance with the approved manufacturer's instructions.

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S12342Text Modification

[BS] 1405.16.1 Panel siding.

Fiber-cement panels shall comply with the requirements of ASTM C1186, Type A, minimum Grade II (or ISO 8336, Category A, minimum Class 2). Panels shall be installed with the long dimension either parallel or perpendicular to framing. Vertical and horizontal joints shall occur over framing members, furring, *wood structural panel* or other *approved* supporting material and shall be protected with caulking, with battens or flashing, or be vertical or horizontal shiplap or otherwise designed to comply with Section 1403.2. Panel siding shall be installed with fasteners in accordance with the approved manufacturer's instructions.

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TAC: Structural

Total Mods for **Structural** in **Approved as Submitted : 10**

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S12349

Date Submitted	02/18/2025	**Section**	1410.4	**Proponent**	Alexander Haldeman
Chapter	14	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Approved as Submitted				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Residential - Section R704.2.2 - Mod#12348 - Same criteria in residential code would also need change proposed for code consistency.

Summary of Modification

Clarification on the acceptable means of support and attachment of edges/joints of fiber-cement soffits.

Rationale

This proposal clarifies that means of support and attachment of edges/joints of fiber-cement soffit panels can be achieved by multiple methods, including framing members, but also including furring wood structural panel, and other approved means/materials not falling into the above listed methods.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
This clarification will not impact enforcement of code.
Impact to building and property owners relative to cost of compliance with code
no cost impact, as requirements are not changing.
Impact to industry relative to the cost of compliance with code
no cost impact, as requirements are not changing.
Impact to small business relative to the cost of compliance with code
no cost impact, as requirements are not changing.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This proposal is clarifying in nature, and will not affect health, safety and welfare of the general public
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposal improves the code by clarifying that materials and methods more than only framing and wood structural panel may be used at soffit panel joints.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This does not discriminate, as it clarifies that multiple materials may be used.

Does not degrade the effectiveness of the code

These proposals do not degrade the effectiveness of this code.

Alternate Language

2nd Comment Period

Proponent Alexander Haldeman **Submitted** 8/22/2025 6:26:39 PM **Attachments** No

S12349-A1

Rationale:

nailable substrate is a defined term which more concisely captures the intent of the initial change proposal

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
This clarification will not impact enforcement of code.

Impact to building and property owners relative to cost of compliance with code
no cost impact, as requirements are not changing

Impact to industry relative to the cost of compliance with code
no cost impact, as requirements are not changing

Impact to small business relative to the cost of compliance with code
no cost impact, as requirements are not changing.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This proposal is clarifying in nature, and will not affect health, safety and welfare of the general public

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
This proposal improves the code by clarifying that materials and methods more than only framing and wood structural panel may be used at soffit panel joints

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
This does not discriminate, as it clarifies that multiple materials may be used

Does not degrade the effectiveness of the code
These proposals do not degrade the effectiveness of this code.

S12349-A1Text Modification

1410.4 Fiber-cement soffit panels.

Fiber-cement soffit panels shall comply with Section 1410.2 and shall be a minimum of $^{1}/_{4}$ inch (6.4 mm) in thickness and comply with the requirements of ASTM C1186, Type A, minimum Grade II, or ISO 8336, Category A, minimum Class 2. Panel joints shall occur over *nailable substrate* ~~framing, furring, or over wood structural panel sheathing, or other *approved* materials~~. Soffit panels shall be installed with spans and fasteners in accordance with the manufacturer's product approval specification and limitations of use. Fasteners shall be corrosion resistant. In the HVHZ, fiber-cement soffit panels shall also comply with TAS 202 and TAS 203.

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S12349Text Modification

1410.4 Fiber-cement soffit panels.

Fiber-cement soffit panels shall comply with Section 1410.2 and shall be a minimum of $^{1}/_{4}$ inch (6.4 mm) in thickness and comply with the requirements of ASTM C1186, Type A, minimum Grade II, or ISO 8336, Category A, minimum Class 2. Panel joints shall occur over framing, furring, ~~or over~~ wood structural panel sheathing, or other *approved* materials. Soffit panels shall be installed with spans and fasteners in accordance with the manufacturer's product approval specification and limitations of use. Fasteners shall be corrosion resistant. In the HVHZ, fiber-cement soffit panels shall also comply with TAS 202 and TAS 203.

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TAC: Structural

Total Mods for **Structural** in **Approved as Submitted : 10**

Total Mods for report: 37

Sub Code: Building

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SP11980

Date Submitted	02/11/2025	**Section**	1612.4.2	**Proponent**	Dallas Thiesen
Chapter	16	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Approved as Submitted				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language Yes**

Related Modifications

Summary of Modification

Modifies the requirements for pool equipment installed in Special Flood Hazard Zones.

Rationale

Swimming pool and spa equipment is designed for outdoor use and is generally weather resistant. Pool and spa equipment is not designed to work at a substantially different elevation than the pool or spa that it is serving, requiring pool and spa equipment to be installed above grade can cause loss of prime, can damage to the equipment, and can shorten the service life of the equipment. Pool and spa equipment is also expressly excluded from flood insurance coverage under the National Flood Insurance Program (NFIP) and there is no duty to mitigate or minimize damage to such equipment.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

This will save consumers the unnecessary cost of elevating swimming pool and spa equipment and by extending the service life of the equipment.

Impact to industry relative to the cost of compliance with code

This will save industry the unnecessary cost of elevating swimming pool and spa equipment and by extending the service life of the equipment.

Impact to small business relative to the cost of compliance with code

This will save industry the unnecessary cost of elevating swimming pool and spa equipment and by extending the service life of the equipment.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This will save consumers the unnecessary cost of elevating swimming pool and spa equipment and by extending the service life of the equipment.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Allows swimming pool and spa equipment to be installed in a manner that maximizes its efficiency and design limitations.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposal does not specify a product or material.

Does not degrade the effectiveness of the code

Allows swimming pool and spa equipment to be installed in a manner that maximizes its efficiency and design limitations.

Alternate Language

2nd Comment Period

SP11980-A1

Proponent Rebecca Quinn obo FL Div Emerg Mgnt **Submitted** 8/7/2025 10:11:05 AM **Attachments** No

Rationale:
Rather than completely remove any requirement (original proposal), this modification clarifies the requirements for pool equipment installed in Special Flood Hazard Areas to add that elevation to the extent practical should maintain functionality and safe conditions. This change is based on the original intent when “to the extent practical” requirement was proposed by FEMA, referring to guidance that advises full elevation to the BFE, but if that height “would result in problems with pump function and performance, equipment is to be elevated as high as possible while allowing safe functioning.” The objective of regulating development in flood hazard areas is to minimize the impact of flooding on the activity, and the impact of the activity on flooding. Partial elevation achieves some damage reduction during frequent, low-level flooding. Whether something is or isn’t insurable under NFIP flood insurance policies has no bearing on what is regulated (see NFIP definition for “development,” which is broad, including any man-made change).

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Adds clarify for determining practicality of elevation.

Impact to building and property owners relative to cost of compliance with code
No change from original requirement.

Impact to industry relative to the cost of compliance with code
Adds functionality and safety to determining practicality.

Impact to small business relative to the cost of compliance with code
This will save industry the unnecessary cost of elevating swimming pool and spa equipment and by extending the service life of the equipment.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Clarifies that safe conditions is part of determining practicality of elevation.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Adds clarity.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
Does not require any different equipment.

Does not degrade the effectiveness of the code
Improves interpretation and enforceability.

1st Comment Period History

SP11980-G1

Proponent Michael Weinbaum Submitted 4/9/2025 9:05:24 PM Attachments No

Comment:

Martin Aquatic Design and Engineering supports this code change.

SP11980-A1Text Modification

1612.4.2 Modification of ASCE 24 9.6 Pools. Modify Section 9.6 of ASCE 24 by adding an exception as follows:

9.6 Pools. In-ground and above ground pools shall be designed to withstand all flood-related loads and load combinations. Mechanical equipment for pools such as pumps, heating systems, and filtering systems, and their associated electrical systems shall comply with Chapter 7.

Exception: Equipment for pools, spas and water features shall be permitted below the elevation required in Table 7-1 provided it is elevated to the extent practical while maintaining functionality and safe conditions, ~~is~~ anchored to prevent flotation and resist flood forces, and ~~is~~ supplied by branch circuits that have ground-fault circuit interrupter protection.

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SP11980Text Modification

1612.4.2 Modification of ASCE 24 9.6 Pools.

Modify Section 9.6 in ASCE 24 by adding an exception as follows:

9.6 Pools. In-ground and above-ground pools shall be designed to withstand all flood-related loads and load combinations. Mechanical equipment for pools such as pumps, heating systems and filtering systems, and their associated electrical systems, shall comply with Chapter 7.

Exception: Equipment for pools, spas and water features shall be permitted below the elevation required in Table 7-1, provided it ~~is elevated to the extent practical,~~ is anchored to prevent flotation and resist flood forces, and is supplied by branch circuits that have ground-fault circuit-interrupter protection.

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TAC: Structural

Total Mods for **Structural** in **Approved as Submitted : 10**

Total Mods for report: 37

Sub Code: Building

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S12161

Date Submitted	02/16/2025	**Section**	1711	**Proponent**	Milad Shabanian
Chapter	17	**Affects HVHZ**	Yes	**Attachments**	**Yes**
TAC Recommendation	Approved as Submitted				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Adds a new section to chapter 17

Summary of Modification

This proposal adds a new section to the code and is based on the corrosion resistance requirements in ICC 600-2020.

Rationale

Reason statement provided in the attached document.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
No impact to local entities relative to the enforcement of code.
Impact to building and property owners relative to cost of compliance with code
Slight increase in construction cost during the construction time.
Impact to industry relative to the cost of compliance with code
No impact to industries relative to the cost of compliance with code.
Impact to small business relative to the cost of compliance with code
No impact to small business relative to the cost of compliance with code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This modification improve safety of buildings by providing corrosion resistance requirements for connections and fasteners located up to 3000 feet from coastal shoreline.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
This modification strengthen resistance of fasteners and connections for buildings located up to 3000 feet from coastal shoreline.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No this change does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not degrade the effectiveness of the code

This change improve the effectiveness of this code.

Alternate Language

2nd Comment Period

S12161-A1

Proponent Pataya Scott **Submitted** 8/24/2025 2:36:31 PM **Attachments** No

Rationale:

This comment simply provides some additional clarification to the original proposal. While the original proposal was approved as submitted, several groups requested a few clarifications. Primarily, the phrase “or other areas subject to salt corrosion” has been removed. This language was somewhat ambiguous, and the intent of this proposal is that the corrosion resistance requirements apply within 3000 ft of a saltwater coastline. Sections 11711.1.2.2 and 1711.1.2.3 were reformatted for clarity. Additionally, Table 1711.1 has been revised to clarify that the interior spaces referred to in the table are unconditioned spaces.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No impact to local entity relative to enforcement of code.

Impact to building and property owners relative to cost of compliance with code

No impact to building and property owners relative to cost of compliance with code.

Impact to industry relative to the cost of compliance with code

No impact to industry relative to the cost of compliance with code.

Impact to small business relative to the cost of compliance with code

No impact to small business relative to the cost of compliance with code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This clarifies the code.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This improves clarity of the code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

This improves the effectiveness of the code.

S12161-A1Text Modification

Further modified the original proposal as follows:

1711.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 ft (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.1.1 and 1711.1.2.

Exception: Fasteners and connectors fully embedded in concrete or mortar.

1711.1.2.2 Enhanced galvanizing. Where required by Table 1711.1, connectors and metal plates shall be in accordance with one of the following:

1. ~~h~~Hot-dipped galvanized prior to fabrication to meet ASTM A653, Coating Designation G185~~,~~.

2. ~~h~~Hot-dipped galvanized after fabrication to meet ASTM A123 providing a minimum average coating weight of 2.0 oz./ft^2 (total both sides).~~, or~~

3. ~~p~~Provided with a protective coating as specified by TPI 1.

1711.1.2.3 Standard Galvanizing. Where required by Table 1711.1, connectors and metal plates shall be in accordance with one of the following:

1. ~~h~~Hot-dipped galvanized prior to fabrication to meet ASTM A653, Coating Designation G90~~,~~.

2. ~~h~~Hot-dipped galvanized after fabrication to meet ASTM A123 providing a minimum average coating weight of 2.0 oz./ft^2 (total both sides).~~, or~~

3. ~~p~~Provided with a protective coating as specified by TPI 1.

TABLE 1711.1

CORROSION RESISTANCE OF FASTENERS AND CONNECTORS

Exposure Description[a]	Building Location			
	Less than or equal to 300 feet from coastal shoreline		Greater than 300 feet and up to 3000 feet from coastal shoreline	
	Screws, bolts, lag screws (including nuts and washers), nails and glulam rivets	Connectors and Metal Plates	Screws, bolts, lag screws (including nuts and washers), nails and glulam rivets	Connectors and Metal Plates
Exterior-Partially Sheltered and Exterior-Open Exposed	Stainless Steel in accordance with Section 1711.1.1.1	Stainless Steel in accordance with Section 1711.1.2.1	Galvanized in accordance with Section 1711.1.1.2	Enhanced Galvanized in accordance with Section 1711.1.2.2
Unconditioned Interior-Vented Enclosed	Galvanized in accordance with Section 1711.1.1.2	Enhanced Galvanized in accordance with Section 1711.1.2.2	Galvanized in accordance with Section 1711.1.1.2	Enhanced Galvanized in accordance with Section 1711.1.2.2
Unconditioned Interior-Unvented Enclosed	Galvanized in accordance with Section 1711.1.1.2	Standard Galvanized in accordance with Section 1711.1.2.3	Galvanized in accordance with Section 1711.1.1.2	Standard Galvanized in accordance with Section 1711.1.2.3

a. Exposure Descriptions:

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S12161-A1Text Modification

Exterior-Partially Sheltered locations are areas where fasteners and connectors are exposed to salt air, but not exposed to fresh rainwater to remove accumulated salt. **Exterior-Open Exposed locations** are areas where fasteners and connectors are exposed to salt air, but also exposed to rainwater to allow rinsing of the accumulated salt, and also more likely to dry after rain.

Unconditioned Interior-Vented Enclosed locations are those where fasteners and connectors inside a part of the building that also has vents to the outside environment that would allow salt air to enter.

Unconditioned Interior-Unvented Enclosed locations are those that are inside the building, but not in the conditioned space.

1403.9 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

1506.5 Nails. Nails shall be corrosion-resistant nails conforming to ASTM F1667 or an equal corrosion resistance by coating, electro galvanization, mechanical galvanization, hot dipped galvanization, stainless steel, nonferrous metal and alloys or other suitable corrosion-resistant material, or corrosion resistance shall be demonstrated in accordance with TAS114, Appendix E. In areas within 300 feet (914 m) of a saltwater coastline, nails shall comply with Section 1711.

1506.6 Screws. Wood screws conform to ANSI/ASME B18.6.1. Screws shall be corrosion resistant by coating, galvanization, stainless steel, nonferrous metal or other suitable corrosion-resistant material. The corrosion resistance shall be demonstrated through one of the following methods:

1. Corrosion resistance equivalent to ASTM A641, Class 1;

2. Corrosion resistance in accordance with TAS114, Appendix E; or

3. Corrosion-resistant coating exhibiting not more than 5 percent red rust after 1000 hours exposure in accordance with ASTM B117.

In areas within 3,000 feet (914 m) of a saltwater coastline, screws shall comply with Section 1711.

1506.7 Clips. Clips shall be corrosion-resistant clips. The corrosion resistance shall meet 0.90 ounce per square foot (0.458 kg/m2) measured according to ASTM A90/A90M, TAS 114, Appendix E or an equal corrosion-resistance coating, electro galvanization, mechanical galvanization, hot dipped galvanization, stainless steel, nonferrous metals and alloys or other suitable corrosion-resistant material. Stainless steel clips shall conform to ASTM A240/A240M, Type 304. In areas within 3,000 feet (914 m) of a saltwater coastline, clips shall comply with Section 1711.

1517.5.1.1.4 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 300 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

2210.4 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

2211.3 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

2222.6.3 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

2304.10 Connectors and fasteners. Connectors and fasteners shall comply with the applicable provisions of Sections 2304.10.1 through 2304.10.8.

2304.10.1 Fastener requirements. Connections for wood members shall be designed in accordance with the appropriate methodology in Section 2301.2. The number and size of fasteners connecting wood members shall not be less than that set forth in Table 2304.10.1.

2304.10.2 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

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S12161-A1Text Modification

2319.17.2.2.7 Connector plates shall be not less than 20 gauge galvanized steel meeting ASTM A653/ A653M or A924/A924M, and shall be identified by the manufacturer's stamp. In areas within 3,000 feet (914 m) of a saltwater coastline, connector plates shall have corrosion resistance in accordance with Section 1711. The size and location of all plates shall be shown on the truss design drawings. Connectors shall have product approval.

2319.7.2.2.9 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

2321.5.1.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

2321.6.1.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

2322.1.2 ~~Reserved~~ **Fasteners and connectors exposed to saltwater environments.** Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

2322.2.4 Plywood panels shall be nailed to supports with 8d ring shank nails. In areas within 300 feet (914 m) of a saltwater coastline, nails shall comply with Section 1711.

2322.3.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

2322.4.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

2324.2.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section 1711.

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1711 CORROSION RESISTANCE - SALTWATER ENVIRONMENTS

1711.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 ft (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.1.1 and 1711.1.2.

1711.1.1 Screws, bolts and nails. Screws, bolts and nails shall be corrosion resistant by composition (stainless steel or nonferrous metal) or by coating or galvanization as specified in this section and Table 1711.1.

1711.1.1.1 Stainless steel. Where required by Table R306.1, fasteners shall be manufactured from ASTM A240 Type 304, Type A305 or Type 316 stainless steel.

1711.1.1.2 Galvanized. Where required by Table 1711.1, fasteners shall be in accordance with the following:

1. For fasteners with diameters greater than 3/8 inch (9.5 mm), the minimum corrosion resistance shall comply with or be equivalent to ASTM A153, Class C.

2. For fasteners with diameters 3/8 inch (9.5 mm) and less, the minimum corrosion resistance shall comply with or be equivalent to one of the following methods:

2.1. ASTM A153, Class D.

2.2. ASTM A641, Class 3S.

2.3. Corrosion resistance exhibiting not more than 5 percent red rust after 1,000 hours of exposure in accordance with ASTM B117.

2.4. Corrosion resistance exhibiting not more the 5 percent red rust after 280 hours of exposure for nails, 1000 hours of exposure for roof tile fasteners or 360 hours of exposure for other carbon steel fasteners in accordance with ASTM G85, Annex 5.

1711.1.1.3 Compatibility. Fasteners used with connectors or other metal plates shall have a corrosion-resistant coating or composition that is compatible with the corrosion-resistant coating or composition of the connectors to prevent corrosion from galvanic action between dissimilar materials.

1711.1.2 Connectors and metal plates. Connectors and metal plates shall be corrosion resistant by composition (stainless steel or nonferrous metal) or by coating or galvanization as specified in this section and Table 1711.1.

1711.1.2.1 Stainless steel. Where required by Table 1711.1, connectors and metal plates shall be manufactured from ASTM A240 Type 316 stainless steel.

1711.1.2.2 Enhanced galvanizing. Where required by Table 1711.1, connectors and metal plates shall be hot-dipped galvanized prior to fabrication to meet ASTM A653, Coating Designation G185, hot-dipped galvanized after fabrication to meet ASTM A123, or provided with a protective coating as specified by TPI 1.

1711.1.2.3 Standard Galvanizing. Where required by Table R306.1, connectors and metal plates shall be hot-dipped galvanized prior to fabrication to meet ASTM A653, Coating Designation G90, hot-dipped galvanized after fabrication to meet ASTM A123, or provided with a protective coating as specified by TPI 1.

TABLE 1711.1

CORROSION RESISTANCE OF FASTENERS AND CONNECTORS

Exposure Description[a]	Building Location			
	Less than or equal to 300 feet from coastal shoreline		Greater than 300 feet and up to 3000 feet from coastal shoreline	
	Screws, bolts, lag screws (including nuts and washers), nails and glulam rivets	Connectors and Metal Plates	Screws, bolts, lag screws (including nuts and washers), nails and glulam rivets	Connectors and Metal Plates
Exterior-Partially Sheltered and Exterior-Open Exposed	Stainless Steel in accordance with	Stainless Steel in accordance with	Galvanized in	Enhanced Galvanized in

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		Section 1711.1.1.1	Section 1711.1.2.1	accordance with Section 1711.1.1.2	accordance with Section 1711.1.2.2
Interior-Vented Enclosed		Galvanized in accordance with Section 1711.1.1.2	Enhanced Galvanized in accordance with Section 1711.1.2.2	Galvanized in accordance with Section 1711.1.1.2	Enhanced Galvanized in accordance with Section 1711.1.2.2
Interior-Unvented Enclosed	Galvanized in accordance with Section 1711.1.1.2	Standard Galvanized in accordance with Section 1711.1.2.3	Galvanized in accordance with Section 1711.1.1.2	Standard Galvanized in accordance with Section 1711.1.2.3	

Exposure Descriptions:

Exterior-Partially Sheltered locations are areas where fasteners and connectors are exposed to salt air, but not exposed to fresh rainwater to remove accumulated salt. **Exterior-Open Exposed locations** are areas where fasteners and connectors are exposed to salt air, but also exposed to rainwater to allow rinsing of the accumulated salt, and also more likely to dry after rain.

Interior-Vented Enclosed locations are those where fasteners and connectors inside a part of the building that also has vents to the outside environment that would allow salt air to enter.

Interior-Unvented Enclosed locations are those that are inside the building, but not in the conditioned space.

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1403.9 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

1506.5 Nails. Nails shall be corrosion-resistant nails conforming to ASTM F1667 or an equal corrosion resistance by coating, electro galvanization, mechanical galvanization, hot dipped galvanization, stainless steel, nonferrous metal and alloys or other suitable corrosion-resistant material, or corrosion resistance shall be demonstrated in accordance with TAS114, Appendix E. In areas within 300 feet (914 m) of a saltwater coastline, nails shall comply with Section 1711.

1506.6 Screws. Wood screws conform to ANSI/ASME B18.6.1. Screws shall be corrosion resistant by coating, galvanization, stainless steel, nonferrous metal or other suitable corrosion-resistant material. The corrosion resistance shall be demonstrated through one of the following methods:

1. Corrosion resistance equivalent to ASTM A641, Class 1;

2. Corrosion resistance in accordance with TAS114, Appendix E; or

3. Corrosion-resistant coating exhibiting not more than 5 percent red rust after 1000 hours exposure in accordance with ASTM B117.

In areas within 3,000 feet (914 m) of a saltwater coastline, screws shall comply with Section 1711.

1506.7 Clips. Clips shall be corrosion-resistant clips. The corrosion resistance shall meet 0.90 ounce per square foot (0.458 kg/m2) measured according to ASTM A90/A90M, TAS 114, Appendix E or an equal corrosion-resistance coating, electro galvanization, mechanical galvanization, hot dipped galvanization, stainless steel, nonferrous metals and alloys or other suitable corrosion-resistant material. Stainless steel clips shall conform to ASTM A240/A240M, Type 304. In areas within 3,000 feet (914 m) of a saltwater coastline, clips shall comply with Section 1711.

1517.5.1.1.4 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 300 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

2210.4 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

2211.3 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

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2222.6.3 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

2304.10 Connectors and fasteners. Connectors and fasteners shall comply with the applicable provisions of Sections 2304.10.1 through ~~2304.10.7~~ 2304.10.8.

2304.10.1 Fastener requirements. Connections for wood members shall be designed in accordance with the appropriate methodology in Section 2301.2. The number and size of fasteners connecting wood members shall not be less than that set forth in Table 2304.10.1.

2304.10.2 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

(renumber remaining sections)

2319.17.2.2.7 Connector plates shall be not less than 20 gauge galvanized steel meeting ASTM A653/ A653M or A924/A924M, and shall be identified by the manufacturer's stamp. In areas within 3,000 feet (914 m) of a saltwater coastline, connector plates shall have corrosion resistance in accordance with Section 1711. The size and location of all plates shall be shown on the truss design drawings. Connectors shall have product approval.

2319.7.2.2.9 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

2321.5.1.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

2321.6.1.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

2322.1.2 ~~Reserved~~ **Fasteners and connectors exposed to saltwater environments.** Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

2322.2.4 Plywood panels shall be nailed to supports with 8d ring shank nails. In areas within 300 feet (914 m) of a saltwater coastline, nails shall comply with Section 1711.

2322.3.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

2322.4.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

2324.2.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section 1711.

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S12161Rationale

Rationale:

This proposal is submitted on behalf of the Insurance Institute for Business and Home Safety (IBHS).

Post-disaster assessments conducted by IBHS and other entities on wood-framed buildings affected by natural hazards, such as high winds, floods, and earthquakes, have consistently shown that structural failures often occur at connections rather than in the framing members. In coastal areas, where higher moisture and humidity levels exist and buildings are exposed to salt spray, corroded metal connectors and fasteners have been observed to contribute to the loss of an adequate load path. The loss of an adequate load path often results in damage to or failure of the structure.

This proposal is based on the corrosion resistance requirements in ICC 600-2020. While ICC 600-2020 is referenced in Section 1609.1.1, it is not required by the code and therefore not mandatory for buildings.

Research has shown that fasteners and connectors near the coastline exhibit corrosion where they are readily exposed to salt air and humidity, particularly if they are in a partially sheltered location where the salt is not washed off by rain. While the proposed table is adapted from ICC 600-2020 Section 505.3, the ICC 600 requirements and this proposal are based on the recommendations in the FEMA NFIP Technical Bulletin (TB) 8, Corrosion Protection for Metal Connectors and Fasteners in Coastal Areas in Accordance with the National Flood Insurance Program (June 2019). TB 8 can be viewed and downloaded at https://www.fema.gov/sites/default/files/2020-07/tb8-corrosion_protection_metal_connectors_coastal_areas.pdf.

Metal connectors and fasteners are important elements in transferring loads from natural hazards (e.g., flood, wind, seismic) through a building. Corrosion rates for metal are dramatically higher in coastal environments than in less harsh, non-coastal environments. Therefore, it is important to increase the corrosion protection for metal connectors and fasteners in coastal environments. Studies have shown that stainless steel and thick hot-dip galvanized (G185 or higher) metal connectors and fasteners improve corrosion protection.

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Mod_12161_Rationale_FBCB-Corrosion Resistance Rationale.pdf

TAC: Structural

Total Mods for **Structural** in **Approved as Submitted : 10**

Total Mods for report: 37

Sub Code: Building

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S12191

Date Submitted	02/16/2025	**Section**	2002.12003.1	**Proponent**	Joseph Belcher
Chapter	20	**Affects HVHZ**	Yes	**Attachments**	No
TAC Recommendation	Approved as Submitted				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language Yes**

Related Modifications

Summary of Modification

Establishes minimum standard of performance for alloys used as structural members in aluminum structures.

Rationale

The change establishes a minimum standard of performance for alloys for structural members in the design of aluminum structures. The minimum alloy specified complies with the AA standards and the referenced AAF Guide to Aluminum Construction in High Wind Areas. It has been noted in the field that substandard alloys are being imported and used in building aluminum structures. This change clearly establishes a minimum standard of performance for aluminum alloys used in designing the structural members of aluminum structures and requires documentation of the alloy delivered.The change is proposed because all the designs we've reviewed are engineered using 6005 T5 alloy or greater. The problem is that the industry is spreading to other states, that have lower wind speeds. Florida distributors may operate nationally and may unknowingly provide alloys with a lower standard of performance intended for use in other states and erroneously deliver them to contractors in Florida. The standard for resisting Florida's windspeeds is 6005 T5. Currently, there is very little accountability in the field. Contractors and inspectors are complacent and don't pay attention to bills of lading, or in some cases the alloy is not listed on the bill of lading. This becomes a hazard when key structural components are engineered for the superior alloy and substandard materials are used. Enclosures built in the state require the superior alloy due to the wind speeds in Florida. Use of substandard alloys often results in catastrophic failure at even the lower wind speeds.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

None, since 6005T5 is supposed to be in use.

Impact to industry relative to the cost of compliance with code

None, since 6005T5 is supposed to be in use.

Impact to small business relative to the cost of compliance with code

None, since 6005T5 is supposed to be in use.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

he change positively impacts the public welfare by reducing the potential for substandard design and construction by specifying a minimum standard of performance for alloys used for structural members of aluminum structures and requiring the identification of the alloys.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The change strengthens the code by specifying a minimum standard of performance for alloys used for structural members of aluminum structures and requiring the identification of the alloys.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The change does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

The proposed change does not degrade the effectiveness of the code and improves the effectiveness of the code.

Alternate Language

2nd Comment Period

S12191-A1

Proponent Joseph Belcher **Submitted** 8/24/2025 4:33:43 PM **Attachments** No

Rationale:

The intent of the original proposal was to establish a minimum standard of performance for alloys for structural members in the design of aluminum screen enclosures. It was noted by a distributor that the change would apply to all aluminum structural members. There are cases where alloys for aluminum structural members required for screen enclosures because of the wind load due to the screen are not required. Other alloys will perform adequately for open structures such as carports or covered patios. The minimum alloy specified for aluminum screen enclosures complies with the AA standards and the referenced AAF Guide to Aluminum Construction in High Wind Areas. It has been noted in the field that substandard alloys are being imported and used in building aluminum structures. This Alternate Language clearly establishes a minimum standard of performance for aluminum alloys used in designing the structural members of aluminum screen enclosures and requires documentation of the alloy delivered for the aluminum structural members of screen enclosures.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None.

Impact to building and property owners relative to cost of compliance with code

None, since 6005T5 is supposed to be in use.

Impact to industry relative to the cost of compliance with code

None, since 6005T5 is supposed to be in use.

Impact to small business relative to the cost of compliance with code

None, since 6005T5 is supposed to be in use.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

:The change positively impacts the public welfare by reducing the potential for substandard design and construction by specifying a minimum standard of performance for alloys used for structural members of aluminum screen enclosures and requiring the identification of the alloys. .

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The change strengthens the code by specifying a minimum standard of performance for alloys used for structural members of aluminum screen enclosures and requiring the identification of the alloys.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The change does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

The proposed change does not degrade the effectiveness of the code and improves the effectiveness of the code.

1st Comment Period History

S12191-G1

Proponent Jaime Gascon Submitted 4/9/2025 12:49:58 PM Attachments No

Comment:

Seems like there is a period missing between "means & Bills" to separate the two intended sentences.

1st Comment Period History

Proponent Jaime Gascon Submitted 4/9/2025 12:52:36 PM Attachments No

Comment:

Seems there is a period missing between "means & Bills" so that two sentences are formed as intended.

s12191-G2

S12191-A1Text Modification

ADD NEW SECTION AS FOLLOWS:

2002.1.1 Screen Enclosures. Aluminum for use as structural members containing spline grooves to receive screen shall be 6005 T5 Alloy or an alloy with a greater standard of performance. The alloy of aluminum extrusions for use as structural members shall be provided by the supplier on bills of lading, invoices or other approved means Bills of lading, invoices or other approved cetrification of the alloy shall be provided to the building official or inspector upon request.

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2002.1 General. Aluminum used for structural purposes in buildings and structures shall comply with AA ASM 35 and AA ADM 1. Aluminum for use as structural members shall be 6005 T5 Alloy or an alloy with a greater standard of performance. The alloy of aluminum extrusions for use as structural members shall be provided by the supplier on bills of lading, invoices or other approved means Bills of lading, invoices or other approved cetrification of the alloy shall be provided to the building official or inspector upon request. The *nominal loads* shall be the minimum design loads required by Chapter 16. ~~The use of aluminum alloys not listed in the manual shall be permitted provided their standard of performance is not less than those required in the manual and the performance is substantiated to the satisfaction of the building official.~~

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TAC: Structural

Total Mods for **Structural** in **Approved as Submitted : 10**

Total Mods for report: 37

Sub Code: Building

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S12194

Date Submitted	02/16/2025	**Section**	2003.1	**Proponent**	Joseph Belcher
Chapter	20	**Affects HVHZ**	Yes	**Attachments**	No
TAC Recommendation	Approved as Submitted				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Summary of Modification

Establishes a minimum standard of performance for alloys used for structural members of aluminum structures.

Rationale

The change establishes a minimum standard of performance for alloys for structural members in the design of aluminum structures. The minimum alloy specified complies with the AA standards and the referenced AAF Guide to Aluminum Construction in High Wind Areas. It has been noted in the field that substandard alloys are being imported and used in building aluminum structures. This change clearly establishes a minimum standard of performance for aluminum alloys used in designing the structural members of aluminum structures and requires documentation of the alloy delivered.The change is proposed because all the designs we've reviewed are engineered using 6005 T5 alloy or greater. The problem is that the industry is spreading to other states, that have lower wind speeds. Florida distributors may operate nationally and may unknowingly provide alloys with a lower standard of performance intended for use in other states and erroneously deliver them to contractors in Florida. The standard for resisting Florida's windspeeds is 6005 T5. Currently, there is very little accountability in the field. Contractors and inspectors are complacent and don't pay attention to bills of lading, or in some cases the alloy is not listed on the bill of lading. This becomes a hazard when key structural components are engineered for the superior alloy and substandard materials are used. Enclosures built in the state require the superior alloy due to the wind speeds in Florida. Use of substandard alloys often results in catastrophic failure at even the lower wind speeds

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None.

Impact to building and property owners relative to cost of compliance with code

None, since 6005T5 is supposed to be in use.

Impact to industry relative to the cost of compliance with code

None, since 6005T5 is supposed to be in use.

Impact to small business relative to the cost of compliance with code

None, since 6005T5 is supposed to be in use.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The change positively impacts the public welfare by reducing the potential for substandard design and construction by specifying a minimum standard of performance for alloys used for structural members of aluminum structures and requiring the identification of the alloys.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The change strengthens the code by specifying a minimum standard of performance for alloys used for structural members of aluminum structures and requiring the identification of the alloys.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The change does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

The proposed change does not degrade the effectiveness of the code and improves the effectiveness of the code.

Alternate Language

2nd Comment Period

S12194-A2

Proponent Joseph Belcher **Submitted** 8/24/2025 4:45:21 PM **Attachments** No

Rationale:

The intent of the original proposal was to establish a minimum standard of performance for alloys for structural members in the design of aluminum screen enclosures. It was noted by a distributor that the change would apply to all aluminum structural members. There are cases where alloys for aluminum structural members required for screen enclosures because of the wind load due to the screen are not required. Other alloys will perform adequately for open structures such as carports or covered patios. The minimum alloy specified for aluminum screen enclosures complies with the AA standards and the referenced AAF Guide to Aluminum Construction in High Wind Areas. It has been noted in the field that substandard alloys are being imported and used in building aluminum structures. This Alternate Language clearly establishes a minimum standard of performance for aluminum alloys used in designing the structural members of aluminum screen enclosures and requires documentation of the alloy delivered for the aluminum structural members of screen enclosures.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None.

Impact to building and property owners relative to cost of compliance with code

None, since 6005T5 is supposed to be in use.

Impact to industry relative to the cost of compliance with code

None, since 6005T5 is supposed to be in use.

Impact to small business relative to the cost of compliance with code

None, since 6005T5 is supposed to be in use.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The change positively impacts the public welfare by reducing the potential for substandard design and construction by specifying a minimum standard of performance for alloys used for structural members of screen enclosures and requiring the identification of the alloys. .

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The change strengthens the code by specifying a minimum standard of performance for alloys used for structural members of screen enclosures and requiring the identification of the alloys.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The change does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

The proposed change does not degrade the effectiveness of the code and improves the effectiveness of the code

2nd Comment Period

S12194-A1

Proponent Joseph Belcher **Submitted** 8/24/2025 4:21:15 PM **Attachments** No

Rationale:

The intent of the original proposal was to establish a minimum standard of performance for alloys for structural members in the design of aluminum screen enclosures. It was noted by a distributor that the change would apply to all aluminum structural members. There are cases where alloys for aluminum structural members required for screen enclosures because of the wind load due to the screen are not required. Other alloys will perform adequately for open structures such as carports or covered patios. The minimum alloy specified for aluminum screen enclosures complies with the AA standards and the referenced AAF Guide to Aluminum Construction in High Wind Areas. It has been noted in the field that substandard alloys are being imported and used in building aluminum structures. This Alternate Language clearly establishes a minimum standard of performance for aluminum alloys used in designing the structural members of aluminum screen enclosures and requires documentation of the alloy delivered for the aluminum structural members of screen enclosures. The Alternate Language is intended to completely replace the original proposal.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

None, since 6005T5 is supposed to be in use.

Impact to industry relative to the cost of compliance with code

None, since 6005T5 is supposed to be in use.

Impact to small business relative to the cost of compliance with code

None, since 6005T5 is supposed to be in use.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The change positively impacts the public welfare by reducing the potential for substandard design and construction by specifying a minimum standard of performance for alloys used for structural members of screen enclosures and requiring the identification of the alloys.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The change strengthens the code by specifying a minimum standard of performance for alloys used for structural members of screen enclosures and requiring the identification of the alloys.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The change does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

The proposed change does not degrade the effectiveness of the code and improves the effectiveness of the code.

S12194-A2Text Modification

2003.1 Design. Aluminum members shall be designed by ~~methods a~~dmitting of rational analysis according to established principles of mechanics. Aluminum used for structural purposes in buildings and structures shall comply with AA ASM 35 and AA ADM 1.

ADD NEW SECTION AS FOLLOWS:

2003.1.1 Screen Enclosures. Aluminum for use as structural members containing spline grooves shall be 6005 T5 Alloy or an alloy with a greater standard of performance. The alloy of aluminum extrusions for use as structural members shall be provided by the supplier on bills of lading, invoices or other approved means Bills of lading, invoices or other approved cetrification of the alloy shall be provided to the building official or inspector upon request.

Page: 1

Mod12194_A2_TextOfModification.pdf

S12194-A1Text Modification

2003.1 Design. Aluminum members shall be designed by ~~methods~~ admitting of rational analysis according to established principles of mechanics.Aluminum used for structural purposes in buildings and structures shall comply with AA ASM 35 and AA ADM 1.

ADD NEW SECTION AS FOLLOWS:

2003.1.1 Screen Enclosures. Aluminum for use as structural members containing spline grooves shall be 6005 T5 Alloy or an alloy with a greater standard of performance. The alloy of aluminum extrusions for use as structural members shall be provided by the supplier on bills of lading, invoices or other approved means Bills of lading, invoices or other approved cetrification of the alloy shall be provided to the building official or inspector upon request.

Page: 1

Mod12194_A1_TextOfModification.pdf

S12194Text Modification

2003.1 Design. Aluminum members shall be designed by

methods admitting of rational analysis according to established

principles of mechanics.Aluminum used for structural purposes in

buildings and structures shall comply with AA ASM 35 and

AA ADM 1. Aluminum for use as structural members shall be 6005 T5 Alloy or an alloy with a greater standard of performance. The alloy of aluminum extrusions for use as structural members shall be provided by the supplier on bills of lading, invoices or other approved means. Bills of lading, invoices or other approved certification of the alloy shall be provided upon request by the building official or inspector.

Page: 1

Mod12194_TextOfModification.pdf

TAC: Structural

Total Mods for **Structural** in **Approved as Submitted : 10**

Total Mods for report: 37

Sub Code: Residential

8

S12163

Date Submitted	02/16/2025	**Section**	306	**Proponent**	Milad Shabanian
Chapter	3	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Approved as Submitted				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Adds a new section to chapter 3

Summary of Modification

This proposal adds a new section to the code and is based on the corrosion resistance requirements in ICC 600-2020.

Rationale

Reason statement provided in the attached document.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
No impact to local entities relative to the enforcement of code.
Impact to building and property owners relative to cost of compliance with code
Slight increase in construction cost during the construction time.
Impact to industry relative to the cost of compliance with code
No impact to industries relative to the cost of compliance with code.
Impact to small business relative to the cost of compliance with code
No impact to small business relative to the cost of compliance with code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This modification improve safety of buildings by providing corrosion resistance requirements for connections and fasteners located up to 3000 feet from coastal shoreline.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
This modification strengthen resistance of fasteners and connections for buildings located up to 3000 feet from coastal shoreline.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No this change does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not degrade the effectiveness of the code

This change improve the effectiveness of this code.

Alternate Language

2nd Comment Period

S12163-A1

Proponent Pataya Scott **Submitted** 8/24/2025 2:28:28 PM **Attachments** No

Rationale:

This comment simply provides some additional clarification to the original proposal. While the original proposal was approved as submitted, several groups requested a few clarifications. Primarily, the phrase “or other areas subject to salt corrosion” has been removed. This language was somewhat ambiguous and the intent of this proposal is that the corrosion resistance requirements apply within 3000 ft of a saltwater coastline. Sections R306.1.2.2 and R306.1.2.3 were reformatted for clarity. Additionally, Table R306.1 has been revised to clarify that the interior spaces referred to in the table are unconditioned spaces.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No impact to local entity relative to enforcement of code.

Impact to building and property owners relative to cost of compliance with code

No impact to building and property owners relative to cost of compliance with code.

Impact to industry relative to the cost of compliance with code

No impact to industry relative to the cost of compliance with code.

Impact to small business relative to the cost of compliance with code

No impact to small business relative to the cost of compliance with code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This is a clarification of the code.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This improves the code by clarifying the intent.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

This improves the effectiveness of the code.

S12163-A1Text Modification

Further revised the original proposal as follows:

R306.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 ft (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section R306.1.1 and R306.1.2.

Exception: Fasteners and connectors fully embedded in concrete or mortar.

R306.1.2.2 Enhanced galvanizing. Where required by Table R306.1, connectors and metal plates shall be in accordance with one of the following:

1. ~~h~~Hot-dipped galvanized prior to fabrication to meet ASTM A653, Coating Designation G185~~,~~.

2. ~~h~~Hot-dipped galvanized after fabrication to meet ASTM A123 providing a minimum average coating weight of 2.0 oz./ft^2 (total both sides)~~,~~ ~~or~~

3. ~~p~~Provided with a protective coating as specified by TPI 1.

R306.1.2.3 Standard Galvanizing. Where required by Table R306.1, connectors and metal plates shall be in accordance with one of the following:

1. ~~h~~Hot-dipped galvanized prior to fabrication to meet ASTM A653, Coating Designation G90~~,~~.

2. ~~h~~Hot-dipped galvanized after fabrication to meet ASTM A123 providing a minimum average coating weight of 2.0 oz./ft^2 (total both sides)~~,~~ ~~or~~

3. ~~p~~Provided with a protective coating as specified by TPI 1.

TABLE R306.1

CORROSION RESISTANCE OF FASTENERS AND CONNECTORS

Exposure Description[a]	Building Location			
	Less than or equal to 300 feet from coastal shoreline		Greater than 300 feet and up to 3000 feet from coastal shoreline	
	Screws, bolts, lag screws (including nuts and washers), nails and glulam rivets	Connectors and Metal Plates	Screws, bolts, lag screws (including nuts and washers), nails and glulam rivets	Connectors and Metal Plates
Exterior-Partially Sheltered and Exterior-Open Exposed	Stainless Steel in accordance with Section R306.1.1.1	Stainless Steel in accordance with Section R306.1.2.1	Galvanized in accordance with Section R306.1.1.2	Enhanced Galvanized in accordance with Section R306.1.2.2
Unconditioned Interior-Vented Enclosed	Galvanized in accordance with Section R306.1.1.2	Enhanced Galvanized in accordance with Section R306.1.2.2	Galvanized in accordance with Section R306.1.1.2	Enhanced Galvanized in accordance with Section R306.1.2.2
Unconditioned Interior-Unvented Enclosed	Galvanized in accordance with Section R306.1.1.2	Standard Galvanized in accordance with Section R306.1.2.3	Galvanized in accordance with Section R306.1.1.2	Standard Galvanized in accordance with Section R306.1.2.3

a. Exposure Descriptions:

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Mod12163_A1_TextOfModification.pdf

S12163-A1Text Modification

Exterior-Partially Sheltered locations are areas where fasteners and connectors are exposed to salt air, but not exposed to fresh rainwater to remove accumulated salt. **Exterior-Open Exposed locations** are areas where fasteners and connectors are exposed to salt air, but also exposed to rainwater to allow rinsing of the accumulated salt, and also more likely to dry after rain.

Unconditioned Interior-Vented Enclosed locations are those where fasteners and connectors inside a part of the building that also has vents to the outside environment that would allow salt air to enter.

Unconditioned Interior-Unvented Enclosed locations are those that are inside the building, but not in the conditioned space.

-

R501.3 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section R306.

R601.3 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section R306.

R701.3 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section R306.

R801.4 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline~~, or other areas subject to salt corrosion,~~ shall comply with Section R306.

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Mod12163_A1_TextOfModification.pdf

S12163Text Modification

R306 CORROSION RESISTANCE - SALTWATER ENVIRONMENTS

R306.1 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 ft (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section R306.1.1 and R306.1.2.

R306.1.1 Screws, bolts and nails. Screws, bolts and nails shall be corrosion resistant by composition (stainless steel or nonferrous metal) or by coating or galvanization as specified in this section and Table R306.1.

R306.1.1.1 Stainless steel. Where required by Table R306.1, fasteners shall be manufactured from ASTM A240 Type 304, Type 305 or Type 316 stainless steel.

R306.1.1.2 Galvanized. Where required by Table R306.1, fasteners shall be in accordance with the following:

1. For fasteners with diameters greater than 3/8 inch (9.5 mm), the minimum corrosion resistance shall comply with or be equivalent to ASTM A153, Class C.

2. For fasteners with diameters 3/8 inch (9.5 mm) and less, the minimum corrosion resistance shall comply with or be equivalent to one of the following methods:

2.1. ASTM A153, Class D.

2.2. ASTM A641, Class 3S.

2.3. Corrosion resistance exhibiting not more than 5 percent red rust after 1,000 hours of exposure in accordance with ASTM B117.

2.4. Corrosion resistance exhibiting not more the 5 percent red rust after 280 hours of exposure for nails, 1000 hours of exposure for roof tile fasteners or 360 hours of exposure for other carbon steel fasteners in accordance with ASTM G85, Annex 5.

R306.1.1.3 Compatibility. Fasteners used with connectors or other metal plates shall have a corrosion-resistant coating or composition that is compatible with the corrosion-resistant coating or composition of the connectors to prevent corrosion from galvanic action between dissimilar materials.

R306.1.2 Connectors and metal plates. Connectors and metal plates shall be corrosion resistant by composition (stainless steel or nonferrous metal) or by coating or galvanization as specified in this section and Table R306.1.

R306.1.2.1 Stainless steel. Where required by Table R306.1, connectors and metal plates shall be manufactured from ASTM A240 Type 316 stainless steel.

R306.1.2.2 Enhanced galvanizing. Where required by Table R306.1, connectors and metal plates shall be hot-dipped galvanized prior to fabrication to meet ASTM A653, Coating Designation G185, hot-dipped galvanized after fabrication to meet ASTM A123, or provided with a protective coating as specified by TPI 1.

R306.1.2.3 Standard Galvanizing. Where required by Table R306.1, connectors and metal plates shall be hot-dipped galvanized prior to fabrication to meet ASTM A653, Coating Designation G90, hot-dipped galvanized after fabrication to meet ASTM A123, or provided with a protective coating as specified by TPI 1.

TABLE R306.1

CORROSION RESISTANCE OF FASTENERS AND CONNECTORS

Exposure Description[a]	Building Location			
	Less than or equal to 300 feet from coastal shoreline		Greater than 300 feet and up to 3000 feet from coastal shoreline	
	Screws, bolts, lag screws (including nuts and washers), nails and glulam rivets	Connectors and Metal Plates	Screws, bolts, lag screws (including nuts and washers), nails and glulam rivets	Connectors and Metal Plates
Exterior-Partially Sheltered and Exterior-Open Exposed	Stainless Steel in accordance with Section R306.1.1.1	Stainless Steel in accordance with Section R306.1.2.1	Galvanized in accordance with Section R306.1.1.2	Enhanced Galvanized in accordance with Section R306.1.2.2

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Mod12163_TextOfModification.pdf

S12163Text Modification

Interior-Vented Enclosed	Galvanized in accordance with Section R306.1.1.2	Enhanced Galvanized in accordance with Section R306.1.2.2	Galvanized in accordance with Section R306.1.1.2	Enhanced Galvanized in accordance with Section R306.1.2.2
Interior-Unvented Enclosed	Galvanized in accordance with Section R306.1.1.2	Standard Galvanized in accordance with Section R306.1.2.3	Galvanized in accordance with Section R306.1.1.2	Standard Galvanized in accordance with Section R306.1.2.3

-

Exposure Descriptions:

Exterior-Partially Sheltered locations are areas where fasteners and connectors are exposed to salt air, but not exposed to fresh rainwater to remove accumulated salt. **Exterior-Open Exposed locations** are areas where fasteners and connectors are exposed to salt air, but also exposed to rainwater to allow rinsing of the accumulated salt, and also more likely to dry after rain.
Interior-Vented Enclosed locations are those where fasteners and connectors inside a part of the building that also has vents to the outside environment that would allow salt air to enter.
Interior-Unvented Enclosed locations are those that are inside the building, but not in the conditioned space.

-

R501.3 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section R306.

R601.3 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section R306.

R701.3 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section R306.

R801.4 Fasteners and connectors exposed to saltwater environments. Fasteners and connectors in areas within 3,000 feet (914 m) of a saltwater coastline, or other areas subject to salt corrosion, shall comply with Section R306.

R904.5.1 Nails. Nails shall be corrosion-resistant nails conforming to ASTM F1667 or an equal corrosion resistance by coating, electro galvanization, mechanical galvanization, hot dipped galvanization, stainless steel, nonferrous metal and alloys or other suitable corrosion resistant material, or corrosion resistance shall be demonstrated in accordance with TAS 114, Appendix E. In areas within 3,000 feet (914 m) of a saltwater coastline, nails shall comply with Section R306.

R904.5.2 Screws. Wood screws shall conform to ANSI/ ASME B 18.6.1. Screws shall be corrosion resistant by coating, galvanization, stainless steel, nonferrous metal or other suitable corrosion-resistant material. The corrosion resistance shall be demonstrated through one of the following methods:

1. Corrosion resistance equivalent to ASTM A641, Class 1;
2. Corrosion resistance in accordance with TAS 114, Appendix E;
3. Corrosion-resistant coating exhibiting not more than 5-percent red rust after 1000 hours exposure in accordance with ASTM B117.

In areas within 3,000 feet (914 m) of a saltwater coastline, screws shall comply with Section R306.

R904.5.3 Clips. Clips shall be corrosion-resistant clips. The corrosion resistance shall meet 0.90 ounce per square foot (0.458 kg/m2) measured according ASTM A90/ A90M, TAS 114 Appendix E or an equal corrosion resistance coating, electro galvanization, mechanical galvanization, hot dipped galvanization, stainless steel, nonferrous metals and alloys or other suitable corrosion resistant material. Stainless steel clips shall conform to ASTM A240/A240M, Type 304. In areas within 3,000 feet (914 m) of a saltwater coastline, clips shall comply with Section R306.

Add new standard(s) as follows:

ASTM
ASTM International
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428

B117-19 Standard Practice for Operating Salt Spray (Fog) Apparatus

Page: 2

Mod12163_TextOfModification.pdf

S12163Text Modification

G85-19 Standard Practice for Modified Salt Spray (Fog) Testing

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Mod12163_TextOfModification.pdf

S12163Rationale

Rationale:

This proposal is submitted on behalf of the Insurance Institute for Business and Home Safety (IBHS).

Post-disaster assessments of wood-framed buildings following natural hazard events such as high winds, floods, and earthquakes have revealed that structural failures frequently occur at connections rather than in framing members. In coastal areas, where higher moisture and humidity levels exist and buildings are exposed to salt spray, corroded metal connectors and fasteners have been observed to contribute to the loss of an adequate load path. The loss of an adequate load path often results in damage to or failure of the structure.

This proposal is based on the corrosion resistance requirements in ICC 600-2020. While ICC 600-2020 is referenced in Section R301.2.1.1, it is not required by the code and therefore not mandatory for buildings.

Research has shown that fasteners and connectors near the coastline exhibit corrosion where they are readily exposed to salt air and humidity, particularly if they are in a partially sheltered location where the salt is not washed off by rain. While the proposed table is adapted from ICC 600-2020 Section 505.3, the ICC 600 requirements and this proposal are based on the recommendations in the FEMA NFIP Technical Bulletin (TB) 8, Corrosion Protection for Metal Connectors and Fasteners in Coastal Areas in Accordance with the National Flood Insurance Program (June 2019). TB 8 can be viewed and downloaded at https://www.fema.gov/sites/default/files/2020 07/tb8-corrosion_protection_metal_connectors_coastal_areas.pdf.

Metal connectors and fasteners are important elements in transferring loads from natural hazards (e.g., flood, wind, seismic) through a building. Corrosion rates for metal are dramatically higher in coastal environments than in less harsh, non-coastal environments. Therefore, it is important to increase the corrosion protection for metal connectors and fasteners in coastal environments. Studies have shown that stainless steel and thick hot-dip galvanized (G185 or higher) metal connectors and fasteners improve corrosion protection.

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Mod_12163_Rationale_FBCR-Corrosion Resistance_Rationale.pdf

TAC: Structural

Total Mods for **Structural** in **Approved as Submitted : 10**

Total Mods for report: 37

Sub Code: Residential

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S12345

Date Submitted	02/18/2025	**Section**	703.10.1	**Proponent**	Alexander Haldeman
Chapter	7	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Approved as Submitted				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Building - Section 1405.16.1 - Mod# 12342 - Same criteria in residential code would also need change proposed for code consistency.

Summary of Modification

Clarification on the means of supporting and attachment of edges/joints of fiber-cement siding panels.

Rationale

This proposal clarifies that means of support and attachment of edges/joints of fiber-cement siding panels can be achieved by multiple methods, including framing members, but also including furring wood structural panel, and other approved means/materials not falling into the above listed methods which may or may not require approval from the building official or approved agency.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
This clarification will not impact enforcement of code.
Impact to building and property owners relative to cost of compliance with code
no cost impact, as requirements are not changing.
Impact to industry relative to the cost of compliance with code
no cost impact, as requirements are not changing.
Impact to small business relative to the cost of compliance with code
no cost impact, as requirements are not changing.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This proposal is clarifying in nature, and will not affect health, safety and welfare of the general public

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposal improves the code by clarifying that materials and methods more than only framing may be used at panel joints to comply with this code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This does not discriminate, as it clarifies that approved materials and methods may be used equally to "framing members" and comply with this code.

Does not degrade the effectiveness of the code

These proposals do not degrade the effectiveness of this code.

Alternate Language

2nd Comment Period

Proponent Alexander Haldeman **Submitted** 8/22/2025 6:30:08 PM **Attachments** No

S12345-A1

Rationale:

nailable substrate is a defined term which more concisely captures the intent of the initial change proposal

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
This clarification will not impact enforcement of code.

Impact to building and property owners relative to cost of compliance with code
no cost impact, as requirements are not changing

Impact to industry relative to the cost of compliance with code
no cost impact, as requirements are not changing

Impact to small business relative to the cost of compliance with code
no cost impact, as requirements are not changing.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This proposal is clarifying in nature, and will not affect health, safety and welfare of the general public

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
This proposal improves the code by clarifying that materials and methods more than only framing may be used at panel joints to comply with this code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
This does not discriminate, as it clarifies that approved materials and methods may be used equally to "framing members" and comply with this code.

Does not degrade the effectiveness of the code
These proposals do not degrade the effectiveness of this code.

S12345-A1Text Modification

R703.10.1 Panel siding.

Fiber-cement panels shall comply with the requirements of ASTM C1186, Type A, minimum Grade II or ISO 8336, Category A, minimum Class 2. Panels shall be installed with the long dimension either parallel or perpendicular to framing. Vertical and horizontal joints shall occur over *nailable substrate* ~~framing members, furring, *wood structural panel* or other *approved* supporting material~~ and shall be protected with caulking, or with battens or flashing, or be vertical or horizontal shiplap, or otherwise designed to comply with Section R703.1. Panel siding shall be installed with fasteners in accordance with Table R703.3(1) or the approved manufacturer's instructions.

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Mod12345_A1_TextOfModification.pdf

S12345Text Modification

R703.10.1 Panel siding.

Fiber-cement panels shall comply with the requirements of ASTM C1186, Type A, minimum Grade II or ISO 8336, Category A, minimum Class 2. Panels shall be installed with the long dimension either parallel or perpendicular to framing. Vertical and horizontal joints shall occur over framing members, furring, *wood structural panel* or other *approved* supporting material and shall be protected with caulking, or with battens or flashing, or be vertical or horizontal shiplap, or otherwise designed to comply with Section R703.1. Panel siding shall be installed with fasteners in accordance with Table R703.3(1) or the approved manufacturer's instructions.

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Mod12345_TextOfModification.pdf

TAC: Structural

Total Mods for **Structural** in **Approved as Submitted : 10**

Total Mods for report: 37

Sub Code: Residential

10

S12348

Date Submitted	02/18/2025	**Section**	704.2.2	**Proponent**	Alexander Haldeman
Chapter	7	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Approved as Submitted				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Building - Section 1410.4 - Same criteria in residential code would also need change proposed for code consistency.

Summary of Modification

Clarification on the acceptable means of support and attachment of edges/joints of fiber-cement soffits.

Rationale

This proposal clarifies that means of support and attachment of edges/joints of fiber-cement soffit panels can be achieved by multiple methods, including framing members, but also including furring wood structural panel, and other approved means/materials not falling into the above listed methods.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
This clarification will not impact enforcement of code.
Impact to building and property owners relative to cost of compliance with code
no cost impact, as requirements are not changing.
Impact to industry relative to the cost of compliance with code
no cost impact, as requirements are not changing.
Impact to small business relative to the cost of compliance with code
no cost impact, as requirements are not changing.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This proposal is clarifying in nature, and will not affect health, safety and welfare of the general public
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposal improves the code by clarifying that materials and methods more than only framing and wood structural panel may be used at soffit panel joints.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This does not discriminate, as it clarifies that multiple materials may be used.

Does not degrade the effectiveness of the code

These proposals do not degrade the effectiveness of this code.

Alternate Language

2nd Comment Period

Proponent Alexander Haldeman **Submitted** 8/22/2025 6:32:17 PM **Attachments** No

S12348-A1

Rationale:

nailable substrate is a defined term which more concisely captures the intent of the initial change proposal

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
This clarification will not impact enforcement of code.

Impact to building and property owners relative to cost of compliance with code
no cost impact, as requirements are not changing.

Impact to industry relative to the cost of compliance with code
no cost impact, as requirements are not changing.

Impact to small business relative to the cost of compliance with code
no cost impact, as requirements are not changing.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This proposal is clarifying in nature, and will not affect health, safety and welfare of the general public

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
This proposal improves the code by clarifying that materials and methods more than only framing and wood structural panel may be used at soffit panel joints.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
This does not discriminate, as it clarifies that multiple materials may be used.

Does not degrade the effectiveness of the code
These proposals do not degrade the effectiveness of this code.

S12348-A1Text Modification

R704.2.2 Fiber-cement soffit panels.

Fiber-cement soffit panels shall be a minimum of $^{1}/_{4}$ inch thick and shall comply with the requirements of ASTM C1186, Type A, minimum Grade II or ISO 8336, Category A, minimum Class 2. Panel joints shall occur over *nailable substrate* ~~framing, furring, or over wood structural panel sheathing, or other *approved* materials~~. Soffit panels shall be installed with spans and fasteners in accordance with the manufacturer's product approval specification and limitations of used to comply with Section 1403.2. Lap siding courses shall be installed with the fastener heads exposed or concealed in accordance with the approved manufacturer's instructions.

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Mod12348_A1_TextOfModification.pdf

S12348Text Modification

R704.2.2 Fiber-cement soffit panels.

Fiber-cement soffit panels shall be a minimum of $^{1}/_{4}$ inch thick and shall comply with the requirements of ASTM C1186, Type A, minimum Grade II or ISO 8336, Category A, minimum Class 2. Panel joints shall occur over framing, furring, ~~or over~~ wood structural panel sheathing, or other *approved* materials. Soffit panels shall be installed with spans and fasteners in accordance with the manufacturer's product approval specification and limitations of used to comply with Section 1403.2. Lap siding courses shall be installed with the fastener heads exposed or concealed in accordance with the approved manufacturer's instructions.

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Mod12348_TextOfModification.pdf

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

11

SP11962

Date Submitted	02/13/2025	**Section**	107.3.5	**Proponent**	Rebecca Quinn obo FL Div Emerg Mgnt
Chapter	1	**Affects HVHZ**	No	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language Yes**

Related Modifications

11963

Summary of Modification

Certain documentation is required for construction in flood hazard areas: elevation to which Lowest Floors are elevated, the elevation to which dry floodproofing will extend, and design of dry floodproofing. Proposal specifies use of FEMA certificates specifically designed for those purposes.

Rationale

Certain documentation is required to be submitted for construction in flood hazard areas: elevation to which Lowest Floors are elevated, the elevation to which dry floodproofing will extend, and design of dry floodproofing measures. The proposal specifies use of FEMA certificates that are specifically designed for those purposes. More than half of Florida NFIP communities participate in the NFIP Community Rating System (244 out of 469). A basic requirement for all CRS Communities is use of the FEMA Elevation Certificate. FDEM reports use of the Elevation Certificate by non-CRS Communities. FEMA requires use of the Dry Floodproofing Certificate when building owners obtain NFIP flood insurance policies that take into account the dry floodproofing measures. NFIP Elevation Certificate: FEMA Form FF-206-FY-22-152 (3/22) - fema_form-ff-206-fy-22-152.pdf NFIP Non-Residential Certificate for Non-Residential Structures: https://www.fema.gov/sites/default/files/documents/fema_form-ff-206-fy22-153.pdf

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Lessens burden caused when permittees use other forms of certification.
Impact to building and property owners relative to cost of compliance with code
None, because owners must submit the documentation in some form.
Impact to industry relative to the cost of compliance with code
The change does not affect the technical requirements of the code.
Impact to small business relative to the cost of compliance with code

The change does not affect the technical requirements of the code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Yes, especially the FEMA Dry Floodproofing Certificate because it requires certification of compliance with ASCE 24.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The change does not affect the technical requirements of the code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The change does not affect the technical requirements of the code.

Does not degrade the effectiveness of the code

No; improves effectiveness because the FEMA Forms are designed to collect the information necessary to help determine compliance

Alternate Language

2nd Comment Period

SP11962-A3

Proponent Rebecca Quinn obo FL Div Emerg Mgnt **Submitted** 8/7/2025 7:57:00 AM **Attachments** No

Rationale:
Two things are changed in the comment. First, we removed the requirement to use the FEMA Elevation Certificate at the plan review stage. At that time, there is nothing to be surveyed and certified. Many communities request that the top sections of the form be completed (property location, FIRM panel, flood zone, BFE, etc.) so they can verify the information. This avoids having to make corrections when the form is submitted as required for inspections. We note that sec. 42.0366, F.S., requires surveyors to submit Elevation Certificates to FDEM (certificates are posted online and accessible to the public). Second, in every instance where a FEMA form is specified we added “or equivalent.” The value of the forms is the completeness of the requested information, which is still valuable even if provided in a substantially equivalent format.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Lessens burden because whether FEMA form or equivalent is used, the information necessary is provided.

Impact to building and property owners relative to cost of compliance with code
None, because owners must submit the documentation in some form.

Impact to industry relative to the cost of compliance with code
The change does not affect the technical requirements of the code.

Impact to small business relative to the cost of compliance with code
The change does not affect the technical requirements of the code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Improves compliance and ensures records are complete whether the FEMA forms or equivalents are used. The FEMA Dry Floodproofing Certificate because it requires certification of compliance with ASCE 24.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
The change does not affect the technical requirements of the code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
The change does not affect the technical requirements of the code.

Does not degrade the effectiveness of the code
No; improves effectiveness because whether the FEMA Forms or equivalent are used, the are designed to collect the information necessary to help determine compliance is provided.

2nd Comment Period

SP11962-G1

Proponent Rosanna Catalano Submitted 7/16/2025 8:41:45 AM Attachments Yes

Comment:

Please see the attached letter from my client, Garrison Flood. Thank you. Rosanna Catalano, Esq. rcatalano.arrow@gunster.com

SP11962-A3Text Modification

107.3.5 [Examination of Documents] Minimum plan review criteria for buildings. The examination of the documents by the building official shall include the following minimum criteria and documents: a floor plan; site plan; foundation plan; floor/roof framing plan or truss layout; all fenestration penetrations; flashing; and rough opening dimensions; and all exterior elevations:

Commercial Buildings: ***[partial shown]***

Building

1. Site requirements:

Flood hazard areas, flood zones, base flood elevations, and design flood elevations

8. Structural requirements shall include:

Flood requirements in accordance with Section 1612, including proposed lowest floor elevations, enclosures, flood damage-resistant materials, and dry floodproofing design certification on a FEMA Dry Floodproofing Certificate or equivalent

* * *

Residential (one- and two-family): ***[partial shown]***

6. Structural requirements shall include:

Flood hazard areas, flood zones, base flood elevations, design flood elevations, proposed lowest floor elevations, enclosures, equipment, and flood damage-resistant materials.

110.3 Required inspections. The building official upon notification from the permit holder or his or her agent shall make the following inspections, and shall either release that portion of the construction or shall notify the permit holder or his or her agent of any violations which must be corrected in order to comply with the technical codes. The building official shall determine the timing and sequencing of when inspections occur and what elements are inspected at each inspection.

Building *[partial shown]*

1. Foundation inspection. To be made after trenches are excavated and forms erected and shall at a minimum include the following building components:

·Stem-wall

·Monolithic slab-on-grade

·Piling/pile caps

·Footers/grade beams

1.1. In flood hazard areas, upon placement of the lowest floor, including basement, and prior to further vertical construction, the FEMA Elevation Certificate or equivalent ~~elevation certification~~ shall be submitted to the building official ~~authority having jurisdiction~~.

6. Final inspection. To be made after the building is completed and ready for occupancy.

6.1. In flood hazard areas, as part of the final inspection, a final FEMA Elevation Certificate or equivalent ~~certification~~ of the lowest floor elevation or an as-built FEMA Dry Floodproofing Certificate or equivalent for the elevation to which a building is dry floodproofed, as applicable, shall be submitted to the building official ~~authority having jurisdiction~~.

111.2 [Certificate of Occupancy] Certificate issued. After the *building official* inspects the building or structure and does not find violations of the provisions of this code or other laws that are enforced by the department of building safety, the *building official* shall issue a certificate of occupancy that contains the following: *[partial shown]*

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SP11962-A3Text Modification

6. For buildings and structures in flood hazard areas, a statement that documentation of the as-built lowest floor elevation has been provided and is retained in the records of the building official ~~authority having jurisdiction~~.

1612.5 Flood hazard documentation. The following documentation shall be prepared and sealed by a licensed professional surveyor and mapper or a registered design professional, as applicable, and submitted to the building official:

1. For construction in flood hazard areas other than coastal high hazard areas or coastal A zones:

1.1 The elevation of the lowest floor, including the basement, provided on a FEMA Elevation Certificate or equivalent as required by the lowest floor elevation inspection in Section 110.3, Building, 1.1 and for the final inspection in Section 110.3, Building, 6.1.

1.2 For fully enclosed areas below the design flood elevation where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.

1.3. For dry floodproofed nonresidential buildings, construction documents shall include a statement provided on a FEMA Dry Floodproofing Certificate or equivalent that the dry floodproofing is designed in accordance with ASCE 24 and shall include the flood emergency plan specified in Chapter 6 of ASCE 24.

1.4 For *dry floodproofed* nonresidential buildings, the elevation to which the building is *dry floodproofed* provided on a FEMA Dry Floodproofing Certificate or equivalent as required for the final inspection in Section 110.3, Building, 6.1.

2. For construction in coastal high hazard areas and coastal A zones:

2.1 The elevation of the bottom of the lowest horizontal structural member provided on a FEMA Elevation Certificate or equivalent as required by the lowest floor elevation inspection in Section 110.3, Building, 1.1 and for the final inspection in Section 110.3, Building, 5.1.

2.2 Construction documents shall include a statement that the building is designed in accordance with ASCE 24, including that the pile or column foundation and building or structure to be attached thereto is designed to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and flood loads acting simultaneously on all building components, and other load requirements of Chapter 16.

2.3 For breakaway walls designed to have a resistance of more than 20 psf (0.96 kN/m2) determined using allowable stress design, construction documents shall include a statement that the breakaway wall is designed in accordance with ASCE 24.

2.4 For breakaway walls where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.

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SP11962Text Modification

107.3.5 [Examination of Documents] Minimum plan review criteria for buildings. The examination of the documents by the building official shall include the following minimum criteria and documents: a floor plan; site plan; foundation plan; floor/roof framing plan or truss layout; all fenestration penetrations; flashing; and rough opening dimensions; and all exterior elevations:

Commercial Buildings: ***[partial shown]***

Building

1. Site requirements:

Flood hazard areas, flood zones, base flood elevations, and design flood elevations

8. Structural requirements shall include:

Flood requirements in accordance with Section 1612, including proposed lowest floor elevations provided on a FEMA Elevation Certificate, enclosures, flood damage-resistant materials, and dry floodproofing design certification on a FEMA Dry Floodproofing Certificate

* * *

Residential (one- and two-family): ***[partial shown]***

6. Structural requirements shall include:

Flood hazard areas, flood zones, base flood elevations, design flood elevations, proposed lowest floor elevations provided on a FEMA Elevation Certificate, enclosures, equipment, and flood damage-resistant materials.

110.3 Required inspections. The building official upon notification from the permit holder or his or her agent shall make the following inspections, and shall either release that portion of the construction or shall notify the permit holder or his or her agent of any violations which must be corrected in order to comply with the technical codes. The building official shall determine the timing and sequencing of when inspections occur and what elements are inspected at each inspection.

Building *[partial shown]*

1. Foundation inspection. To be made after trenches are excavated and forms erected and shall at a minimum include the following building components:

·Stem-wall

·Monolithic slab-on-grade

·Piling/pile caps

·Footers/grade beams

1.1. In flood hazard areas, upon placement of the lowest floor, including basement, and prior to further vertical construction, the FEMA Elevation Certificate ~~elevation certification~~ shall be submitted to the building official ~~authority having jurisdiction~~.

6. Final inspection. To be made after the building is completed and ready for occupancy.

6.1. In flood hazard areas, as part of the final inspection, a final FEMA Elevation Certificate ~~certification~~ of the lowest floor elevation or an as-built FEMA Dry Floodproofing Certificate for the elevation to which a building is dry floodproofed, as applicable, shall be submitted to the building official ~~authority having jurisdiction~~.

111.2 [Certificate of Occupancy] Certificate issued. After the *building official* inspects the building or structure and does not find violations of the provisions of this code or other laws that are enforced by the department of building safety, the *building official* shall issue a certificate of occupancy that contains the following: ***[partial shown]***

6. For buildings and structures in flood hazard areas, a statement that documentation of the as-built lowest floor elevation has been provided and is retained in the records of the building official ~~authority having jurisdiction.~~

1612.5 Flood hazard documentation. The following documentation shall be prepared and sealed by a licensed professional surveyor and mapper or a registered design professional, as applicable, and submitted to the building official:

1. For construction in flood hazard areas other than coastal high hazard areas or coastal A zones:

    1.1. The elevation of the lowest floor, including the basement, provided on a FEMA Elevation Certificate as required by the lowest floor elevation inspection in Section 110.3, Building, 1.1 and for the final inspection in Section 110.3, Building, 6.1.

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SP11962Text Modification

1.2 For fully enclosed areas below the design flood elevation where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.

1.3. For dry floodproofed nonresidential buildings, construction documents shall include a statement provided on a FEMA Dry Floodproofing Certificate that the dry floodproofing is designed in accordance with ASCE 24 and shall include the flood emergency plan specified in Chapter 6 of ASCE 24.

1.4 For *dry floodproofed* nonresidential buildings, the elevation to which the building is *dry floodproofed* provided on a FEMA Dry Floodproofing Certificate as required for the final inspection in Section 110.3, Building, 6.1.

2. For construction in coastal high hazard areas and coastal A zones:

2.1. The elevation of the bottom of the lowest horizontal structural member provided on a FEMA Elevation Certificate as required by the lowest floor elevation inspection in Section 110.3, Building, 1.1 and for the final inspection in Section 110.3, Building, 5.1.

2.2. Construction documents shall include a statement that the building is designed in accordance with ASCE 24, including that the pile or column foundation and building or structure to be attached thereto is designed to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and flood loads acting simultaneously on all building components, and other load requirements of Chapter 16.

2.3. For breakaway walls designed to have a resistance of more than 20 psf (0.96 kN/m^2) determined using allowable stress design, construction documents shall include a statement that the breakaway wall is designed in accordance with ASCE 24.

2.4 For breakaway walls where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.7.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.7.2.2 of ASCE 24.

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SP11962-G1General Comment

Public Comments to the Florida Division of Emergency Management, MOD #11962, Sec. 107.3.5
From: Arnon Rosen, CEO & President, Garrison Flood, arnon@garrisonflood.com
Date: June 30, 2025

Dear Members of the Florida Building Commission, Building Structural Technical Advisory Committee,

As the CEO of Garrison Flood, a Florida-based manufacturer and installer of emergency flood mitigation panels, I appreciate the Division's ongoing commitment to the safety and resilience of our state's communities. I am writing to highlight a critical issue in the current regulatory framework that affects the ability of homeowners to protect their properties from flood damage, and to respectfully request clarification and action to address this gap.

Rationale for Allowing Retrofit of Flood Mitigation Products Below BFE

We seek clarification on the rationale behind the current prohibition on retrofitting existing residential structures below the Base Flood Elevation (BFE) with flood mitigation products, even when a qualified engineer can demonstrate that the structure is capable of withstanding the necessary hydrostatic and hydrodynamic loads. Notably, the code permits—and in some cases mandates—such retrofits for mixed-use and commercial structures, yet does not extend the same allowance to residential properties. This inconsistency raises questions about the underlying reasoning and creates barriers for homeowners seeking to enhance their flood protection.

Gap in Code Provisions for Temporary Flood Mitigation Solutions

The Florida Building Code (FBC) and ASCE 24-14 provide comprehensive requirements for flood protection in new construction and substantial improvements. However, they do not adequately address the use of temporary or removable flood mitigation products—such as aluminum flood panels—particularly for retrofitting existing residential structures. This omission has led to inconsistent interpretations among local building departments. Some departments prohibit the use of such panels entirely, while others apply requirements intended for new construction, which are often impractical or unnecessarily burdensome for retrofit applications.

Need for a Dedicated "Mitigation" Category

Temporary flood mitigation panels are a proven, cost-effective, and environmentally friendly solution that can be rapidly deployed to protect homes and businesses from floodwaters. These panels are designed for easy installation and removal, safeguarding vulnerable openings without redirecting water to neighboring properties. Their use can significantly reduce property damage, lower recovery costs, and support community resilience in the face of increasing hurricane activity and rising sea levels.

Despite these benefits—including flood protection, job creation, minimized environmental impact, and the potential to reduce insurance costs—these products are not contemplated in the current code framework. The absence of clear standards for temporary flood mitigation products creates

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SP11962-G1General Comment

uncertainty for manufacturers, installers, and homeowners, and may result in the use of inferior products.

Challenges with Current Code Interpretation

The lack of clarity in the FBC has resulted in a patchwork of local requirements. In many cases, building departments apply the same requirements to existing homes as to new construction, which are not always feasible or appropriate for retrofitting. This not only discourages the adoption of effective mitigation measures but also places an undue burden on homeowners and manufacturers striving to comply with the intent of the code. Importantly, these mitigation panels are not intended to replace building requirements for substantial improvements where homes have already suffered significant damage and are required to elevate in the rebuild. Our intent is not to recommend anything that would degrade a community's NFIP rating, but rather to make it more straightforward for homeowners to install temporary flood barriers to safeguard their homes and garages.

Request for Guidance and Action

We respectfully request that the Division:

- Provide the rationale for prohibiting retrofit of flood mitigation products on existing residential structures that are below the BFE and not required to elevate, when an engineer can demonstrate structural adequacy for hydrostatic and hydrodynamic loads and the products won't impact adjacent structures.
- Engage with stakeholders—including manufacturers, installers, local governments, and the insurance industry—to develop standards that ensure safety and effectiveness without imposing unnecessary barriers to adoption.
- Facilitate the installation process for temporary flood barriers, enabling homeowners to more readily protect their residences and garages from flood risks.

We are committed to working collaboratively with the Division and other stakeholders to ensure that these innovative products are properly evaluated and approved for use in Florida. We have already engaged with DBPR staff on product approval and are in the process of submitting our product for approval in the coming months. However, we believe that product approval alone will not fully address the issue, and we welcome any suggestions or guidance regarding the most effective approach to achieving this goal.

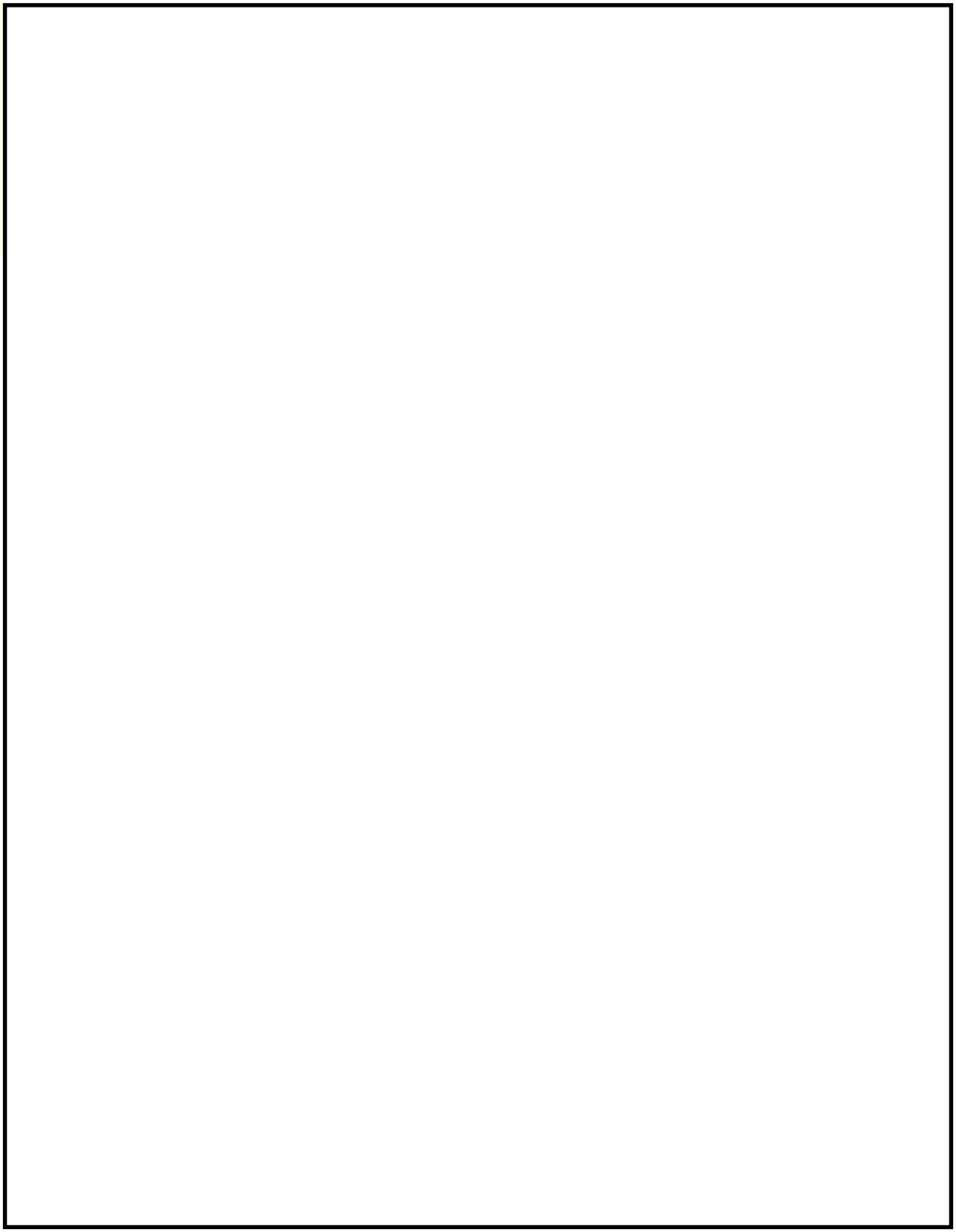
Thank you for your attention to this important matter. We look forward to your response and to supporting the Division's efforts to enhance the resilience of Florida's communities.

Respectfully,
Arnon Rosen
CEO & President
Garrison Flood
arnon@garrisonflood.com

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TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

12

S11892

Date Submitted	02/07/2025	**Section**	202	**Proponent**	Fernando Pages
Chapter	2	**Affects HVHZ**	No	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

1402.1 1404.9.1 1405.14

Summary of Modification

Including definitions for insulated vinyl siding and backed siding in the Florida Building Code is necessary to reflect advancements in siding products and ensure clear guidance for designers, contractors, and inspectors.

Rationale

This modification adds backed vinyl siding, as new siding categories in list of vinyl siding materials. It is importnatn to distiguish the performance characteristics of insulated and backed sidings. Backed Siding, a new category with foam backing, differs by not providing continuous exterior insulation.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Including backed vynil siding in the Florida Building Code aids local building departments by clarifying standards for inspections and approvals.

Impact to building and property owners relative to cost of compliance with code

The materials will 25% to 50% cost if chosen. However, their use in not obligatory.

Impact to industry relative to the cost of compliance with code

The materials will 25% to 50% cost if chosen. However, their use in not obligatory, while they provide valuable benefits for installers and builders to offer their clinets.

Impact to small business relative to the cost of compliance with code

The materials will 25% to 50% cost if chosen. However, their use in not obligatory.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Backed vinyl siding improves impact resistance, durability, and aesthetics.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Adds options to provide energy efficency and hazard resitance.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not descriminate against any other cladding.

Does not degrade the effectiveness of the code

Does not degrade the building code.

Alternate Language

2nd Comment Period

Proponent Fernando Pages **Submitted** 8/20/2025 1:15:00 PM **Attachments** Yes

S11892-A1

Rationale:

Add Backed and Insulated Vinyl Siding to the building code

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Including backed vinyl siding in the Florida Building Code aids local building departments by clarifying standards for inspections and approvals.

Impact to building and property owners relative to cost of compliance with code

The materials will be 25% to 50% if chosen—however, their use in not obligatory.

Impact to industry relative to the cost of compliance with code

The materials will cost 25% to 50% less if chosen. However, their use is not obligatory, although they offer valuable benefits for installers and builders to provide to their clients.

Impact to small business relative to the cost of compliance with code

The materials will 25% to 50% cost if chosen. However, their use in not obligatory.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Adds options to provide impact resistance and energy efficiency.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Adds options to provide impact resistance and energy efficiency.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate against other similar products.

Does not degrade the effectiveness of the code

Does not degrade the building code.

S11892-A1Text Modification

Add new definitions:

Backed Vinyl Siding. A vinyl siding product with a manufacturer-installed foam plastic backing material as an integral part for structural support. Backed Vinyl siding is not used as insulation. When vinyl siding is used as insulation, it is referred to as *insulated vinyl siding*.

Insulated Vinyl Siding. A continuous insulation cladding product, with manufacturer-installed foam plastic insulating material as an integral part of the cladding product, having a thermal resistance not less than R-2.

[Add new subsection]

1403.8.1

1404.9.1 Insulated vinyl siding, backed vinyl siding.

Insulated vinyl siding and *backed vinyl siding* shall be certified and labeled by an approved agency as conforming to ASTM D7793 and D7445 requirements, respectively.

[Modify as follows]

[BS] 1405.14 Vinyl siding.

Vinyl siding, insulated vinyl siding, and backed vinyl siding, conforming to the requirements of this section and complying with ASTM D3679, ASTM D7793, and D7445, shall be permitted on exterior walls where the design wind pressure determined in accordance with Section 1609 does not exceed 30 pounds per square foot (1.44 kN/m2). Where the design wind pressure exceeds 30 pounds per square foot (1.44 kN/m2), tests or calculations indicating compliance with Chapter 16 shall be submitted. Vinyl siding shall be secured to the building so as to provide weather protection for the exterior walls of the building.

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S11892-A1Text Modification

This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.



Designation: D7793 – 24

Standard Specification for Insulated Vinyl Siding[1]

This standard is issued under the fixed designation D7793; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification establishes requirements for insulated vinyl siding, which is vinyl siding with integral foam plastic insulating material, where the vinyl siding is manufactured from rigid PVC compound. Compliance with this standard requires insulated vinyl siding to demonstrate a thermal insulation value of R-2.0 or greater. Other performance requirements and test methods addressed by this standard include materials properties and dimensions, warp, shrinkage, impact strength, expansion, appearance, thermal distortion resistance, flame spread, and windload resistance. Methods of indicating compliance with this specification are also provided.

NOTE 1—Insulated vinyl siding is composed of two major components: the vinyl siding and the insulating material. It is intended that the vinyl siding portion comply with Specification D3679. Applicable portions of Specification D3679 are included in this specification. Additional requirements that pertain only to the insulation as a separate material, or to the combination of vinyl siding and insulation as a whole, are also included. For further explanation, see Appendix X1.

1.2 Insulated vinyl siding shall be tested with the insulation material in place or removed, as specified in the applicable requirement or test method.

1.3 The use of PVC recycled plastic in this product shall be in accordance with the requirements in Section 4.

1.4 Insulated vinyl siding produced to this specification shall be installed in accordance with the manufacturer's installation instructions for the specific product to be installed.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 2—There is no known ISO equivalent to this standard.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C297/C297M Test Method for Flatwise Tensile Strength of Sandwich Constructions
C578 Specification for Rigid, Cellular Polystyrene Thermal Insulation
C591 Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
C1199 Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods
C1289 Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
C1363 Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
D618 Practice for Conditioning Plastics for Testing
D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer
D1042 Test Method for Linear Dimensional Changes of Plastics Caused by Exposure to Heat and Moisture
D1183 Practices for Resistance of Adhesives to Cyclic Laboratory Aging Conditions
D1435 Practice for Outdoor Weathering of Plastics
D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
D2457 Test Method for Specular Gloss of Plastic Films and Solid Plastics

[1] This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.24 on Plastic Building Products.

Current edition approved April 1, 2024. Published April 2024. Originally approved in 2012. Last previous edition approved in 2021 as D7793 – 21. DOI:10.1520/D7793-24.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

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S11892-A1Text Modification

D3679 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding
D3892 Practice for Packaging/Packing of Plastics
D4226 Test Methods for Impact Resistance of Rigid Poly-(Vinyl Chloride) (PVC) Building Products
D5206 Test Method for Windload Resistance of Rigid Plastic Siding
D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens
D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)[3]
D7445 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding with Foam Plastic Backing (Backed Vinyl Siding)
E84 Test Method for Surface Burning Characteristics of Building Materials
E1753 Practice for Use of Qualitative Chemical Spot Test Kits for Detection of Lead in Dry Paint Films
G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

2.2 *American Society of Civil Engineers (ASCE):*[4]
ASCE 7-10 Minimum Design Loads for Buildings and Other Structures

2.3 *International Code Council*
International Building Code
International Residential Code

2.4 *International Code Council–Evaluation Services (ICC-ES):*
AC05 Acceptance Criteria for Sandwich Panel Adhesives

2.5 *International Standards Organization (ISO):*
ISO/IEC Guide 65 General requirements for bodies operating product certification systems

2.6 *Structural Building Components Association:*
ANSI/SBCA FS 100-2012 Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies

2.7 *Vinyl Siding Institute, Inc.*
VSI Vinyl Siding Installation Manual (2015)

2.8 *Federal Standards:*
16 CFR Part 460 Labeling and Advertising of Home Insulation

3. Terminology

3.1 *Definitions:*

3.1.1 *center-pinning*—an installation technique in which the siding panel is fastened tightly through the nail slot at the center length of the panel, in order to cause thermal expansion and contraction to occur equally in both directions from the center.

3.1.2 *cohesive failure*—in the context of tensile testing, internal separation of the adhesive within the adhesive layer, resulting in attachment of adhesive material to the surface of both substrates

3.1.3 *insulation; insulating material*—foam plastic material that is combined at the factory with a vinyl siding profile to form insulated vinyl siding.

3.1.4 *insulated vinyl siding*—a vinyl cladding product sold with manufacturer-installed foam plastic insulating material as an integral part of the cladding product. The vinyl cladding portion of insulated vinyl siding meets the definition of vinyl siding.

3.1.5 *nominal*—the value that a manufacturer consistently uses to represent a specific property or dimension of a vinyl siding product in public claims including, but not limited to, product literature, advertisements, quotations, and certificates of conformance.

3.1.6 *process average thickness*—the rolling, arithmetic mean of average specimen thicknesses measured in accordance with 6.5 for a specific product during all productions runs for the most recent six-month period.

3.1.7 *vertical coverage*—The net vertical distance of the wall covered by a single insulated vinyl siding panel, disregarding any portions of the panel that are overlapped by adjacent panels above or below.

3.1.8 *temperate northern climate*—in weather testing, a North American metropolitan area testing site located within 73 to 100°W longitude and 37 to 45°N latitude.

3.1.9 *vinyl siding*—a shaped material, made principally from rigid poly(vinyl chloride) (PVC), that is used to clad exterior walls of buildings. In this standard, vinyl siding refers to the rigid profile to which the insulation is attached.

3.1.10 *wind load design pressure rating*—the maximum wind pressure that an insulated vinyl siding product is rated to withstand, based on testing under Test Method D5206.

3.1.10.1 *standard wind load design pressure rating*—the wind load design pressure rating for a siding product when installed 1) over a sheathing material designed and attached such that it is capable of resisting 100% of positive and negative wind pressures occurring under design conditions at the building location; and 2) with the standard fastening method specified in building codes, general installation instructions, and the siding manufacturer's instructions.

3.1.10.2 *alternative wind load design pressure rating*—the wind load design pressure rating for a siding product when installed over a sheathing not designed and attached such that it is capable of resisting 100% of positive and negative wind pressures occurring under design conditions at the building location, or when the siding is not fastened in the standard way; as specified by the manufacturer.

3.1.10.3 *Discussion*—The standard test conditions, configuration, and fastening method used in this specification are specified in 6.14, while alternative sheathing and installation conditions are specified by the manufacturer and must be reflected in the product's installation instructions. Alternative ratings apply only when the specified sheathing and fastening conditions are used. See Annex A1 for information on differences between the standard wind load design pressure rating and alternative wind load design pressure ratings, and how to determine standard and alternative design pressure ratings.

[3] The last approved version of this historical standard is referenced on www.astm.org.
[4] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.

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4. Materials and Manufacture

4.1 *Vinyl Siding:*

4.1.1 The vinyl siding, exclusive of foam plastic insulating material, shall be made of one or more layers of poly(vinyl chloride) (PVC) compound. Any layers of materials other than poly (vinyl chloride) (PVC) compound shall be kept to less than 20 % by volume. This limitation does not apply to the insulation material.

4.1.2 Where rigid PVC recycled plastic as defined in Guide D7209 is used, the vinyl siding containing the PVC recycled plastic shall meet all of the requirements of Sections 3, 4, and 5.

4.1.3 The vinyl siding material, exclusive of insulation material, when tested in accordance with Test Method D635, shall not exceed an average extent of burn of 4 in. (100 mm), with an average time of burn not to exceed 10 seconds. A minimum sample thickness of 0.035 in. (0.9 mm) is required. (**Warning—**The flammability testing data, conclusions, and recommendations of Test Method D635 relate solely to the measurement and description of properties for classification of the vinyl siding material in response to flame under controlled laboratory conditions and shall not be used for the description or appraisal of the fire hazard of vinyl siding under actual fire conditions.)

4.2 *Foam Plastic Insulation:*

4.2.1 The foam plastic insulation shall be made of one of the following materials:

4.2.1.1 Expanded polystyrene complying with Specification C578.

4.2.1.2 Extruded polystyrene complying with Specification C578

4.2.1.3 Polyisocyanurate complying with Specification C591 or Specification C1289

4.2.2 The foam plastic insulation shall have a Flame Spread Index not greater than 75 and a Smoke Developed Index not greater than 450 when tested separately under Test Method E84.

4.3 *Adhesives:*

4.3.1 The suitability for outdoor use of an adhesive used to bond the vinyl siding and the insulation, if any, shall be determined by the following procedure.

4.3.1.1 Prepare a minimum of 10 specimens consisting of two Douglas fir-larch blocks or other appropriate substrates, bonded by the adhesive, in accordance with Test Method C297/C297M. Each block is to be 2.0 inches square. The adhesive shall be applied and cured in accordance with the adhesive manufacturer's instructions.

(1) The material selected for use as the substrate shall be capable of withstanding the accelerated aging described in 4.3.1.2 without damage or deterioration of the substrate.

NOTE 3—Other appropriate substrates, such as metal or plastic, compatible with the adhesive according to the manufacturer's guidelines, can be used in place of the Douglas fir-larch blocks. Because in accordance with 4.3.1.4.1 at least 75 % of samples must fail in a cohesive mode, a substrate should be selected that is expected to be stronger than the adhesive and which will form a tight bond with the adhesive.

4.3.1.2 Subject 50 percent of the specimens to accelerated aging under Test Method D1183, Test Condition C, for three cycles. The low-temperature portion of the cycle is not required to be colder than -40°F (-40°C) and the relative humidity during this portion of the cycle shall not be greater than 10 % RH.

4.3.1.3 Condition and test all of the specimens in accordance with Test Method C297/C297M.

4.3.1.4 *Acceptable Performance*—Acceptable performance of the adhesive is demonstrated by one of the following means:

(1) When tested in accordance with 4.3.1.3, the samples demonstrate performance in accordance with either (*a*), (*b*), or (*c*).

(a) For a valid test, the mode of failure for no fewer than 75 % of the specimens shall be cohesive. Only specimens that failed cohesively are counted in the following. The average ultimate tensile strength of the samples that were subjected to accelerated aging shall not be less than 80 % of the average ultimate tensile strength of the specimens that were subjected to conditioning only.

(b) None of five aged specimens fails cohesively under a tensile load less than or equal to 100 psi at a pull rate (crosshead speed) of 0.02 in./min. Only specimens that fail cohesively or do not fail are counted. Specimens that fail non-cohesively under a load at or below 100 psi are discarded and another specimen is tested until five specimens have either failed cohesively, or have not failed at or below 100 psi. Adhesives qualified under this method are limited to use with foam insulation having a tensile strength not greater than 100 psi.

(c) The following applies when the average elongation at yield of the specimens that were subjected to conditioning only is 200 % or greater: the average stress of the aged specimens is not less than 80 percent of that of the specimens that were subjected to conditioning only, when measured at an elongation 75 % of the elongation at yield for each specimen.

(2) As an alternative, adhesives that are covered by a current report, issued by an agency accredited under ISO Guide 65, as a Type I, Class 2 adhesive in accordance with Acceptance Criteria AC05, will have exhibited acceptable performance under the above procedure.

NOTE 4—Compatibility of the adhesive with the vinyl siding and insulation used in the insulated vinyl siding is evaluated separately, under 5.2.4.

4.4 *Insulated Vinyl Siding:*

4.4.1 Insulated vinyl siding shall not contain elemental lead (Pb) or compounds of that material other than traces incidental to raw materials or the manufacturing process. This limitation applies to both PVC substrate and to any cap or film material, as well as the insulation material. Compliance with this requirement shall be demonstrated by one of the methods in 6.16.

5. Physical Requirements

5.1 *Requirements Applicable to Vinyl Siding*—The provisions of 5.1.1 – 5.1.8 apply only to the vinyl siding, exclusive of any insulation material. Where necessary to perform testing, the insulation material shall be removed.

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5.1.1 *Length and Width*—The actual length shall not be less than ¼ in. (6.4 mm) of the nominal length and the actual width shall be within ±1⁄16 in. (1.6 mm) of the nominal width when measured in accordance with 6.3 and 6.4.

5.1.2 *Thickness*—These requirements pertain only to measurements of the portions of the vinyl siding that are exposed after installation of the panel, measured in accordance with the procedure in 6.5. The average thickness of each specimen shall be no less than 0.035 in. No individual measurement shall be thinner than 0.003 in. below the nominal thickness. The process average thickness as defined in 3.1.6 shall be no thinner than 0.001 in. below the nominal thickness.

5.1.3 *Camber*—A full length of vinyl siding (typically 10 or 12 ft (3.05 or 3.61 m)) shall not have a camber greater than ⅛ in. (3.2 mm) when measured in accordance with 6.6.

5.1.4 *Heat Shrinkage*—The average heat shrinkage shall not exceed 3.0 % when determined by the method described in 6.7.

5.1.5 *Impact Resistance*—The vinyl siding shall have a minimum impact strength of 60 in.•lbf (6.78 J) when tested in accordance with 6.8.

5.1.6 *Gloss*—The gloss of smooth and embossed vinyl siding shall be uniform across the exposed surface. The average of all readings for a panel determined in 6.11.2.5 shall not differ from the manufacturer's specified gloss value more than the permitted variation in Table 1, and each individual reading shall not vary more than 10 points from the average. Gloss of smooth and embossed vinyl siding shall be tested in accordance with 6.11.

5.1.7 *Uniformity of Color*—The color specified shall be uniform on the exposed surface of the vinyl siding panels, except in the case of variegated colors. When tested in accordance with 6.13, the total color change, ΔE, between a production specimen and the appropriate reference specimen or agreed-upon color coordinates shall not vary by more than 1.5, and the chromatic coordinates thereof shall not change by more than $\pm\Delta a_H = 1.0$ and $\pm\Delta b_H = 1.0$.

5.1.8 *Weathering*—The vinyl siding shall maintain a uniform color and be free of any visual surface or structural changes such as peeling, chipping, cracking, flaking, and pitting when tested in accordance with 6.10.

5.1.9 *Coefficient of Linear Expansion*—The vinyl siding shall have a coefficient of linear expansion not greater than 4.5 by 10^{-5} in./in./°F (8.1 by 10^{-5} mm/mm/°C) when tested in accordance with 6.9.

5.2 *Requirements Applicable to Insulated Vinyl Siding*—The provisions of 5.2.1–5.2.5 apply to insulated vinyl siding, including the integral foam insulation material. Testing shall be conducted on both the vinyl siding and the insulating material, or with the insulating material in place, as described in the referenced test method.

TABLE 1 Gloss Values

Manufacturer's Specified Gloss Value	Permitted difference from Manufacturer's Specified Gloss Value
Less than or equal to 35	±8
Greater than 35	±10

5.2.1 *Thermal Distortion*—The insulated vinyl siding shall be free of bulges, waves, and ripples, and an overlap shall not open more than ¼ in. (6 mm) when tested to a minimum temperature of 150°F (66°C) in accordance with the procedure in 6.12.

5.2.2 *Wind Load Resistance*—The siding shall withstand a minimum static test pressure and a standard wind load design pressure rating shall be determined.

5.2.2.1 *Minimum Test Pressure*—Insulated vinyl siding shall be able to withstand a minimum test pressure of 22.5 lbf/ft^2 (1077 Pa) when tested in accordance with 6.14. The average maximum sustained static pressure determined in 6.14 shall be equal to or greater than this value. If the manufacturer of insulated vinyl siding provides documentation to support compensation for pressure equalization, the test pressure shall be determined from Annex A1 using the documented pressure equalization factor.

NOTE 5—The static test pressure of 22.5 lbf/ft^2 (1077 Pa) for insulated siding was established to withstand structural loading conditions that occur in wind exposures of approximately 110 mph (177 km/h) (V_{ASD}) for mean roof heights of 30 ft (9.1 m) and less in exposure category B, and corresponds to 30.0 lbf/ft^2 (1436 Pa) negative design pressure, to match the default wind design conditions of Table R703.3(1) in the 2015 International Residential Code. Provision is made for compensation for pressure equalization specific to the product if supporting documentation is provided, using procedures in Annex A1.

NOTE 6—Refer to Annex A1 for an explanation as to how the negative design pressure was established, and for applications where the effective negative design pressure as specified in ASCE 7-10 is different from 30.0 lbf/ft^2 (1436 Pa) (for example, wind-zone areas greater than about 110 mph (177 km/h) (V_{ASD}) (225 km/h (V_{ULT})) or mean roof height above 30 ft (9.1 m), or exposures other than exposure category B).

(1) The design-pressure values can be negative (suction loads) or positive. The negative values are the largest in magnitude and are the values used in this specification.

NOTE 7—In that the insulated vinyl siding is being tested as a weather-resistant exterior product applied to an existing exterior structural wall, forces (negative) working to pull the insulated vinyl siding off the wall, fasteners, or disengage locks will be the most important criteria for testing. Positive wind forces test the integrity of the total wall sections, and do not provide a measure of the performance of the insulated vinyl siding.

5.2.2.2 *Standard Wind Load Design Pressure Rating*—The standard wind load design pressure rating shall be determined from the results of testing in accordance with 6.14, using the procedures described in A1.3.

NOTE 8—The standard design pressure rating is valid for applications where the siding is installed over sheathing and its fastening that are capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location. For applications over other sheathing, a different design pressure rating is applicable, and is determined in accordance with A1.3. Determination of a rating other than the standard design pressure rating is not required by this section.

5.2.2.3 *Alternative Design Pressure Ratings*—Design pressure ratings other than the standard wind load design pressure rating, for use with different sheathing materials or using different installation or fastening, are permitted to be determined in accordance with testing under 6.14, using the procedures in Annex A1.

5.2.3 *Nail Slot Allowance for Thermal Expansion*—For vinyl siding panels utilizing nail slots to allow for thermal

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expansion and contraction, the nail slot shall be sized to allow for the expected range of expansion and contraction over a range of 100°F. Compliance with this requirement shall be demonstrated either by the test method in 6.15 or by sizing of the nail slots according to the specifications in the following sections. The instrument used shall be capable of measuring to the nearest 0.01 in. The manufacturing tolerance shall not exceed -0.030 inches.

5.2.3.1 For panels shorter than 6 ft (1829 mm) in length, the minimum nail slot width shall be ⅜ in. (11.4 mm).

5.2.3.2 For panels 6 ft (1829 mm) in length or longer the minimum nail slot width shall be determined according to the following formula. The minimum width shall be the width resulting from application of the formula, rounded to the next lower quarter-inch. Regardless of the results of the calculation, the minimum nail slot width for panels 6 feet or longer shall be 1 in. (25.4 mm).

$$WS = P_c \times (\alpha \times 100°F \times L) + T_c \quad (1)$$

where:

WS = Minimum width of nail slot, in.
P_c = Center-pinning coefficient: 1 if manufacturer's instructions require panel to be center-pinned; 1.5 if center-pinning is not required
α = Coefficient of linear thermal expansion, 4.5×10^{-5} in./in./°F or actual known coefficient for vinyl siding used, as determined by 6.9
L = Length of panel, inches
T_c = Centering tolerance: 0.25 in.

5.2.4 *Compatibility of Adhesives*—When subjected to cyclical conditioning and tested in accordance with 6.17, samples composed of the vinyl siding and insulation bonded with the adhesive, if any, used in the insulated vinyl siding shall not exhibit a decrease in average ultimate tensile strength greater than 20 %, compared to samples not subjected to cyclical conditioning. This requirement is not applicable to insulated vinyl siding that does not contain any adhesive.

5.2.5 *Thermal Insulation Value*—The thermal insulation value (R-value) of the insulated vinyl siding shall be not less than R-2.0 when measured in accordance with 6.18.

5.2.6 *Flame Spread*—Insulated vinyl siding shall have a Flame Spread Index not greater than 200 when tested underin accordance with 6.19.

6. Test Methods

6.1 *General*—The inspection and test procedures contained in this section are used to determine the conformance of products to the requirements of this specification.

NOTE 9—Each producer who represents its products as conforming to this specification typically uses statistically based sampling plans that are appropriate for each manufacturing process to verify on-going compliance. Specifications for quality control programs are beyond the scope of this Standard Specification.

6.2 *Conditioning and Test Conditions*—Condition the test specimen in accordance with Procedure A of Practice D618 and test under those conditions, unless otherwise specified herein.

6.3 *Length*—Lay the specimen on a flat surface and measure with a steel tape that has been verified as accurate to within ±1⁄16 in. (1.6 mm) against a calibrated standard. Measure the length of a vinyl siding panel to the nearest 1⁄16 in. (1.6 mm) at the center, the butt edge, and the bottom of the top lock. The average of the three measurements is the actual length.

6.4 *Width*—Interlock two specimens, each at least 26 in. (660 mm) long, in the normal mode for installation. Lay the two specimens on a flat surface. Measure to the nearest 1⁄16 in. (1.6 mm), the distance between the lowest butt edge of the top specimen and the lowest butt edge of the bottom specimen. Commencing approximately one in. (25 mm) from one end of the specimens, make five measurements at 6-in. (152-mm) intervals, making sure that the measurement is made perpendicular to the butt edge. Average the measurements. The average constitutes the exposed width of vinyl siding.

6.5 *Thickness*—Thickness shall be measured in accordance with Test Method A of Test Method D5947. The micrometer shall be calibrated in accordance with Section 8 of Test Method D5947. The thickness of the vinyl siding shall be measured at a minimum of five locations equally spaced across the entire portion of the vinyl siding that will be exposed after installation. All measurements shall be taken to the nearest 0.001 in. Calculate and report the average of these measurements. Also report the thinnest individual measurement.

6.6 *Camber*—Place a full length of vinyl siding (typically 10 or 12 ft (3.05 or 3.61 m)) on a flat surface alongside a straightedge at least as long as the vinyl siding specimen. Measure the maximum space between the edge of the vinyl siding specimen and the straightedge for each edge to the nearest 1⁄16 in. (1.6 mm).

6.7 *Heat Shrinkage:*

6.7.1 *Apparatus:*

6.7.1.1 *Scriber,* similar to that described in Test Method D1042, with the exception that the needle points shall be separated by 10 ± 0.01 in. (254 ± 0.254 mm).

6.7.1.2 *Test Media,* a controlled-temperature water bath of 5 gal (10 L) or more, equipped with an efficient stirrer that will maintain uniform temperature throughout. Heater and temperature-control devices must maintain the water at 160 ± 1°F (71 ± 0.5°C). Use a wire rack to raise and lower specimens into the water bath. As an alternative to the use of a water bath, heat the specimens for 30 min in a uniformly heated forced-air oven maintained at a temperature of 160 ± 1°F (71 ± 0.5°C).

6.7.1.3 Make measurements with any device capable of measuring the distance between two scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2 *Procedure:*

6.7.2.1 Cut three specimens from the vinyl siding panel, each 1 in. (25.4 mm) wide by 12 in. (305 mm) long. Cut one specimen from the center and one from each of the extreme edges of the flat surface. The long axis shall be parallel to the machine direction.

6.7.2.2 Condition specimens at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 10 % relative humidity for at least 24 hours.

6.7.2.3 Make a slight mark with the scribe on each specimen so that a reference point will be clearly visible.

6.7.2.4 Place specimens in the test medium.

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6.7.2.5 Remove specimens after 30 min and place on a flat surface until cool.

6.7.2.6 Repeat conditioning in accordance with 6.7.2.2.

6.7.2.7 Make a second mark with the scribe on each specimen, using the same center.

6.7.2.8 Measure the distance, D, between the scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2.9 Calculate the percent shrinkage as (D/10) × 100.

6.7.2.10 Report the average shrinkage of the three specimens tested.

6.8 *Impact Resistance*—Test impact resistance of vinyl siding in accordance with Test Method D4226, Procedure A, impactor head configuration H.25. 4 in.-lb increments (0.5 in. height increments with 8 lb falling weight) shall be used. Minimum sample dimensions shall be 1.5 by 1.5 in. Samples shall be tested with the normally exposed surface facing up. Insulated vinyl siding shall be tested with any insulation material removed. Conditioning time for quality-control tests shall be at least one hour.

6.8.1 For purposes of evaluating failure of the specimen under subsection 3.2.1 of Test Method D4226, a ductile tear of less than 0.2 in. (5 mm) in length shall not be considered a failure. Any brittle break of any dimensions is considered a failure.

6.9 *Coefficient of Linear Expansion*—Conduct this test in accordance with Test Method D696, separately for samples of the vinyl siding and samples of the insulation.

6.9.1 *Alternative Specimen Preparation for Vinyl Siding Samples*—Specimens prepared from strips cut from extruded vinyl siding are permitted to be used in testing under Test Method D696. Where such specimens are used, they shall be cut with the long dimension parallel to the long axis of the vinyl siding panel. Guides shall be used in accordance with Test Method D696 to prevent bending or twisting of the specimen in the dilatometer.

6.10 *Weatherability:*

6.10.1 A minimum of three samples shall be exposed at each of at least three test sites. Test sites shall be located in a northern temperate climate, represented by Cleveland, Ohio or Louisville, Kentucky; a hot, humid climate represented by Miami, Florida; and a hot, dry climate represented by Phoenix, Arizona. The samples shall be exposed for a minimum of 24 months.

6.10.2 Samples shall consist of a flat section of vinyl siding with minimum dimensions of 2 by 3¾ in. (25 by 95 mm).

6.10.3 Samples shall be representative of the product to be evaluated. Samples shall be taken either from commercial products or from laboratory samples. Laboratory samples shall be produced in the same manner as the commercial products to be evaluated.

NOTE 10—Production of laboratory samples in the same manner includes use of the same method of forming the product. For example, if the commercial product is extruded, the laboratory specimen shall be extruded; if the commercial product is injection molded, the laboratory specimen shall be injection molded, and so forth.

6.10.4 Select a minimum of four specimens per sample per test site to allow for three test specimens and one file specimen for each sample evaluated.

6.10.5 Mark each specimen permanently to ensure retention of identity during and after exposure testing.

NOTE 11—Use of a vibrating engraver leaves a permanent mark that satisfies this criterion.

6.10.6 All exposures shall be conducted at an angle of 45° South, plywood-backed, in accordance with Practice D1435 and G147.

6.10.7 After a minimum of 24 months of exposure, remove the samples and inspect each exposed test specimen for appearance and surface condition. Record observations and inspection date in a permanent record.

6.11 *Gloss:*

6.11.1 *Apparatus*—Measure gloss using a 75° geometry glossmeter that meets the requirements of the Apparatus section of Test Method D2457.

6.11.2 *Procedure:*

6.11.2.1 Gloss measurements shall be made in accordance with the procedure in Section 9 of Test Method D2457, unless otherwise specified herein.

6.11.2.2 Measure gloss on one piece of vinyl siding on at least three widely separated sections across the width of the exposed surface of the panel. At least one reading shall be taken on each face of the panel. Use a new surface area for each reading to avoid scratches caused by instrument contact. The area tested must be flat. If a flat area on the exposed surface cannot be found due to the style or depth of embossing of the panel being tested, then a non-exposed area of the panel shall be chosen in its place. Such locations shall be representative of the gloss of the area that will be exposed after installation.

6.11.2.3 Measure gloss parallel to the direction of embossing. When the embossing pattern is not apparent, measure the gloss in the direction of extrusion.

6.11.2.4 Each reading shall be within the appropriate limit specified in 5.1.6.

6.11.2.5 The average of all readings shall be used to represent the gloss of the sample.

6.12 *Thermal Distortion:*

6.12.1 *Test Specimen/Apparatus:*

6.12.1.1 The test specimen shall consist of three courses of insulated vinyl siding, a minimum of 6 ft (1.83 m) in length, mounted on a flat, rigid frame in accordance with the manufacturer's installation instructions.

(1) Horizontal Siding—The middle course shall consist of two lengths of insulated vinyl siding, both with a factory-fabricated end, one section overlapping the other section. The end of the overlapping section shall be located not less than 3 in. (76 mm) and not more than 6 in. (152 mm) from the center of the course. Unless specified otherwise by the manufacturer's installation instructions, the insulation of the two lengths of insulated vinyl siding shall be butted firmly together.

(2) Vertical Siding—The middle course shall consist of a single, uninterrupted insulated vinyl siding panel, without overlap.

6.12.1.2 A thermocouple or other heat-sensing element shall be located at the horizontal midpoint of the back side of the middle course of insulated vinyl siding. The heat-sensing

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element shall be in contact with the back of the vinyl cladding. Any insulation or backing material removed to facilitate placement of the heat sensing element shall be replaced.

6.12.1.3 Radiant-heat rod, 600 W for each linear foot (0.31 m), mounted parallel to the middle course and approximately 32 in. (810 mm) away from the surface of the insulated vinyl siding.

6.12.1.4 Temperature-control device, used to regulate the temperature of the radiant-heat rod, shall be able to maintain the conditions specified in 6.12.2.1.

6.12.1.5 Gap measurement device. A cylindrical pin gauge, ¼ ± 0.005 in. (6 ± 0.127 mm) in diameter is used to evaluate the size of any gap in the overlapped sections of horizontal insulated vinyl siding during the heating period. The pin gauge is attached to a rod such that the gauge can be inserted into a gap while held parallel to the plane of the insulated vinyl siding. The rod shall be sufficiently long to permit insertion of the gauge from beyond the edge to the test frame, not interfere with the exposure of the sample to radiant heat, and otherwise not interfere with conduct of the test.

6.12.2 *Procedure:*

6.12.2.1 Heat the test panel (middle course of insulated vinyl siding) at a rate of 3.0 to 6.0°F/min (1.7 to 3.3°C/min) until a minimum temperature of 150°F (66°C) is achieved as measured by the heat-sensing element on the midpoint of the backside of the middle course. For temperatures equal to or greater than 130°F (54°C), the rate of heating is permitted to be not less than 2.0°F/min (1.1°C/min), provided that the average heating rate from the ambient temperature to 150°F (66°C) is within 3.0 to 6.0°F/min (1.7 to 3.3°C/min). When a temperature of 150°F (66°C) is attained, shut off the heat source.

6.12.2.2 During this heating period, observe the middle course of the insulated vinyl siding for surface distortion and observe for any opening or gap at the end of the overlapped section. If the overlap appears to have opened to approximately ¼ in. (6 mm), attempt to insert the gap measurement device into the opening. If the device can be inserted into the opening to any depth at any location along the overlap, the opening shall be considered to be at least ¼ in. (6 mm).

6.12.2.3 *Failure is defined as:*

(1) the appearance of bulges, waves, or ripples on any surface of the middle course of the insulated vinyl siding; or

(2) occurrence of a gap or opening ¼ in. (6 mm) or greater at any point along the end of the overlapped section, as determined by use of the gap measurement device, at any time before a temperature of 150°F (66°C) is reached.

6.13 *Color Uniformity*—Calculate the difference between the L_H, a_H, and b_H color coordinates for a production specimen to those of either the appropriate reference specimen or the agreed upon color coordinates for that specific color product in accordance with Test Method D2244. Calculate the total difference ΔE between the production specimen and the reference specimen in accordance with Test Method D2244.

6.14 *Wind Load Resistance*—Conduct the test on wind load resistance of finished insulated vinyl siding in accordance with Test Method D5206. The average maximum sustained static test pressure determined from this testing is used in 5.2.3. For purposes of determining compliance with the minimum test pressure and standard design pressure requirements in 5.2.3, the test structure shall be constructed with vertical studs 16 inches on center. The siding shall be tested with insulation attached to the vinyl siding. The siding in the test installation shall be installed over wood sheathing with a nominal thickness of 7/16 to ½ inch, and fastened as follows:

6.14.1 *Fastener Type*—Roofing nail, smooth shank, 0.120 in. (⅛ in. nominal; 3.2 mm) shank diameter, 5/16 in. (7.9 mm) head diameter, length as necessary to penetrate into sheathing and stud a total of 1 ¼ in. (32 mm). For vertical siding, length as necessary to penetrate the thickness of the sheathing plus ¼ in. (6.4 mm).

6.14.2 *Fastener Spacing*—Every 16 in. (406 mm) into center of stud for horizontal siding. For vertical siding, every 12 inches into sheathing only.

6.14.3 Fasteners shall not be driven tightly against the siding. Allow approximately 1/32 in. (0.8 mm) clearance between the fastener head and siding surface.

NOTE 12—The installation details described 6.14 conform to the minimum requirements of the 2015 International Residential Code and the VSI Vinyl Siding Installation Manual.

6.15 *Nail Slot Allowance for Thermal Expansion*—As an alternative to conformance with the nail slot width specification in 5.2.3.1 or 5.2.3.2, provision for thermal expansion and contraction shall be demonstrated through the following test procedure.

6.15.1 *Samples*—At least three samples of each profile in which the insulated vinyl siding is produced shall be provided. The length of each sample shall be at least 50 % of the longest length in which the profile is produced, and not shorter than 12 ft (3658 mm).

6.15.2 *Test Chamber*—The test chamber shall consist of an environmentally controlled room or compartment capable of providing an air temperature range of at least 0 to 100°F (-18 to 38°C) without exposure of the panel to radiant energy from heating or cooling elements. Air temperature shall be controlled such that a rate of temperature change of 2°F (1.11°C) per minute can be achieved over the full temperature range, and the minimum and maximum temperatures can be maintained for at least 15 minutes. Means for circulating air to provide a uniform air temperature throughout the chamber shall be provided. A vertical wall shall be provided for mounting of samples. The wall shall be insulated such that, with no panels mounted, the inner surface of the wall does not deviate more than 10°F (5.5°C) from the air temperature at the high and low temperature extremes after a holding period of five minutes. The test chamber shall be of sufficient size to accommodate the longest panel to be tested, including expected thermal expansion of the panel. Means shall be provided to measure the actual temperature of the surface of each panel at a minimum of three evenly-spaced locations along the length of the panel.

6.15.3 *Length Measurement*—A means for measuring the length of each sample throughout the temperature range shall be provided. The method utilized for length measurement shall not be influenced by the temperature of the chamber and shall have a minimum resolution of no greater than 0.0625 in. (1.59 mm).

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6.15.4 *Procedure*—Install the sample panels on the wall inside the test chamber, following the manufacturer's instructions for fastener type, spacing, location and tightness. At ambient temperature measure and record the length of each panel and the temperature of the panel, averaged from a minimum of three locations along the length of the panel.

6.15.4.1 *Test Cycle*—Test cycles shall be performed by raising the air temperature to 100 ± 5°F (38 ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding the air temperature at 100°F (38 ± 2.75°C) for 15 minutes, lowering the air temperature to 0 ± 5°F (-18 ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding at 0°F (-18 ± 2.75°C) for 15 minutes, and returning to ambient temperature at an average rate of 2°F per minute.

6.15.4.2 *Conditioning*—Close the test chamber and perform at least two conditioning cycles using the procedure in 6.15.4.1. No interruption is required between conditioning cycles.

6.15.4.3 *Test*—Following completion of the conditioning cycles, conduct three test cycles using the procedure in 6.15.4.1. It is acceptable for the test cycles to follow immediately upon completion of the final conditioning cycle, and no interruption is required between test cycles. After a minimum holding period of 15 minutes at the high and low extremes of each test cycle, measure and record the length of each panel and the temperature of the panel, averaged from a minimum of three locations along the length of the panel.

6.15.5 *Normalization*—From among the length measurements recorded for all three cycles, identify the shortest and longest length of each panel, and the average panel temperature at the time that length was recorded. Determine the maximum difference in length, ΔL, and the maximum difference in temperature, ΔT, by subtracting the smaller from the larger. Normalize the change in length to the full length of the panel over a 100°F (38°C) temperature range using the following formula:

$$E_t = \Delta L \times (100/\Delta T) \times (L_f/L_t) \quad (2)$$

where:

E_t = Total thermal expansion and contraction of a full length panel over a range of 100°F (38°C)
ΔL = maximum change in length of the tested panel,
ΔT = maximum change in temperature of the tested panel,
L_f = longest length in which the panel is produced, and
L_t = actual length of the panel as tested.

6.15.6 *Acceptable Performance*—When tested according to this procedure, the result of ($E_t \times 2$) + 0.25 in. for each of the three samples for each profile shall not be greater than the width of the nail slot. If the manufacturer's installation instructions require the panel to be center-pinned, the result of E_t + 0.25 in. for each of the three samples for each profile shall not be greater than the width of the nail slot.

6.16 *Lead Content:*

6.16.1 Testing for lead content shall be conducted on insulated vinyl siding using a rhodizinate-type lead swab test kit conforming to Practice E1753. Testing shall be performed in accordance with the test kit manufacturer's instructions. The insulated vinyl siding shall be deemed to comply with 4.4.1 if the test shows a negative or not-detected result; that is, the test does not indicate the presence of lead. The test shall be conducted separately on the substrate and on any cap or film material, and on the insulation material.

6.16.2 As an alternative to the method in 6.16.1, and as a means of resolving any ambiguous results from that method, an analytical method capable of detecting lead at least as low as 0.02 percent by sample weight shall be employed. Under this alternative, neither the substrate nor any cap or film shall contain a concentration of lead in excess of 0.02 percent by weight.

6.17 *Compatibility of Adhesives:*

6.17.1 *Sample Preparation*—Combine a flat, 2 by 2 in. section of vinyl siding with a 2 by 2 by 0.75 in. sample of insulation, using the adhesive used in the insulated vinyl siding. The top and bottom surfaces of the insulation are to be parallel. The application rate, thickness, and distribution of the adhesive are to be consistent with its application in the insulated vinyl siding. Prepare a total of at least ten such samples.

6.17.2 *Cyclical Conditioning*—Subject half of the samples to the following conditioning. In an appropriate environmental conditioning chamber, starting at room temperature, increase the temperature of air surrounding the sample to 150°F (66°C) and hold for 15 minutes. Over a period of time not greater than 15 minutes, decrease the surrounding air temperature to -10°F (-23°C), and hold for 15 minutes. Return the surrounding air temperature to 150°F (66°C) over a period of time not greater than 15 minutes. This cycle is repeated for a total of 30 cycles.

6.17.2.1 *Tensile Testing*—Condition and test all of the samples in accordance with Test Method C297/C297M Any of the failure modes listed in Test Method C297/C297M (other than failure at the bond to the loading blocks) shall be counted in calculating the average ultimate tensile strength. Separately determine the average ultimate tensile strength for the samples subjected to cyclical conditioning, and for those not subjected to such conditioning.

6.18 *Thermal Insulation Value*—The thermal insulation value for the insulated vinyl siding shall be determined in accordance with Test Method C1363. Test conditions, test sample selection, configuration and installation, and procedure shall be as specified in the following sections.

6.18.1 *Wind Direction and Velocity*—Testing of the base wall and insulated vinyl siding samples shall be with the exterior wind direction perpendicular to the plane of the test wall. The calibration procedure in Section 6 of Test Method C1199 shall be used to establish standard room and weather side surface heat transfer coefficients.

6.18.2 *Test Temperatures*—Testing shall be performed at an exterior temperature of 50°F and an interior temperature of 100°F.

6.18.3 *Base Wall*—The base wall for attachment of the insulated vinyl siding shall provide for overall test sample dimensions of 96 ± 6 in. (2438 ± 152 mm) in both the vertical and horizontal axis. The construction of the wall shall be sufficient to hold the test installation without flexing under the imposed wind. The weather side surface of the base wall shall include a solid surface composed of uniform sheet material

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capable of securely holding standard roofing nails or the fasteners specified by the manufacturer for installation of the insulated vinyl siding under test. The wall shall be fully sealed to prevent movement of air between the chambers.

NOTE 13—The precise materials and construction of the base wall are not specified because its thermal characteristics will be directly measured to establish baseline conditions from which the performance of the insulated vinyl siding alone can be distinguished. A standard framed wall composed of nominal 2 by 4 in. studs on 16 in. (406 mm) centers, covered by nominal ½ in. plywood or oriented strand board (OSB) has been found to be suitable for most test applications.

6.18.4 *Sample Selection*—reserved for any requirements needed for specifying the sample to be used, how many replicates, etc. (if needed).

6.18.5 *Test Installation*—The area covered by the insulated vinyl siding shall be 96 ± 6 in. (2438 ± 152 mm) in both the vertical and horizontal axis. The test installation shall be composed of the number of insulated vinyl siding panels needed to cover the test installation area, and any siding accessories normally used for installation of that insulated vinyl siding.

6.18.5.1 *Overlaps*—The test installation shall include both courses that cover the full width of the test wall with a single panel, and courses composed of two or more adjacent, overlapping panels. The number of courses containing overlapped panels shall be as specified below.

(1) Panels shorter than full width of the test wall—Where the insulated vinyl siding is commercially available in panels shorter in length than the full width of the testing installation, each course shall contain adjacent, overlapped panels. For panels equal to or longer than one-half the test installation width, each course shall contain two panels, with one joint between them. For shorter panels, the number of panels and joints per course is determined by the length of the panels and the overlapping of panels specified in the manufacturer's installation instructions.

(2) Vertical Siding—The test installation for vertical insulated vinyl siding shall contain no overlap joints.

(3) Horizontal Siding—The number of courses with overlap joints for horizontal insulated vinyl siding shall be based on the vertical coverage of the profile, in accordance with Table 1 or the following formula. For test walls with a insulated vinyl siding installation height other than 96 in (2438 mm), or for insulated vinyl siding profiles not listed in Table 2, the number of courses with overlap joints shall be determined according to the following formula:

$$L = 0.375\left(\frac{H}{V}\right) \quad (3)$$

where:

L = Number of courses with overlap joints in test installation; rounded to the nearest integer
H = Height of test installation, inches
V = Vertical coverage of one panel, inches

(4) The specified number of courses with overlaps joints shall be evenly distributed vertically across the test installation. Adjacent courses shall not contain overlap joints.

TABLE 2 Courses with Overlaps Joints

Siding Type	Vertical Coverage (in.)	Number of Courses Including Overlaps
Single 6.5	6.5	6
Single 7	7	5
Double 4	8	5
Single 8	8	5
Double 4.5	9	4
Triple 3	9	4
Double 5	10	4
Quad 2.5	10	4
Double 6	12	3
Triple 4	12	3
Double 6.5	13	3
Double 7	14	3
Quad 4.5	18	2
Triple 6	18	2

6.18.5.2 The bottom edge of the insulated vinyl siding shall be secured with a starter strip or equivalent trim specified by the manufacturer. The sides and top edge of the insulated vinyl siding shall be bound by J-channels or equivalent trim specified by the manufacturer.

6.18.5.3 The insulated vinyl siding and trim shall be installed in the order in which they are installed in the field, in accordance with the manufacturer's installation instructions. Fastening of the insulated vinyl siding and trim to the wall shall be as specified in the manufacturer's installation instructions.

6.18.5.4 *Sealing of Test Installation*—No part of the test installation, including insulated vinyl siding panels, joints, overlaps and perimeter, shall be sealed other than by the means integral to manufacturer-supplied siding panels or trim. Any actions specified in the manufacturer's installation instructions to secure or enable an integral sealing means shall be carried out.

6.18.6 *Procedure*—Conduct a test of the base wall alone, with no insulated vinyl siding installed, in accordance with Test Method C1363. Determine the R-value of the base wall. Install the insulated vinyl siding and conduct a test under the same conditions, and determine the R-value of the base wall-insulated vinyl siding assembly. Determine the R-value of the insulated vinyl siding by subtracting the R-value of the base wall alone from that of the base wall-insulated vinyl siding assembly. Report the R-value of the insulated vinyl siding, rounded to the nearest tenth.

6.18.6.1 Reuse of the R-value determined for the base wall is permitted for subsequent tests of insulated vinyl siding. The R-value of the base wall shall be reestablished by testing if the test configuration is changed, the base wall has been removed and reinstalled, ambient temperature or humidity has changed or fluctuated significantly, or any other event has occurred that is likely to affect the R-value of the base wall.

6.19 *Flame Spread*—Conduct the test on flame spread of finished insulated vinyl siding in accordance with Test Method E84. The test specimen shall either be self-supporting by its own structural characteristics or held in place by added supports along the test specimen surface, or secured from the back side.

7. Packaging and Package Marking

7.1 The insulated vinyl siding shall be packed in such a manner as to provide reasonable protection against damage in ordinary handling, transportation, and storage.

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7.2 Provisions of Practice D3892 shall apply to this specification.

7.3 To aid identification of insulated vinyl siding conforming to all requirements of this specification, producers and distributors shall include a statement of compliance in conjunction with their name and address on product labels, invoices, sales literature, and the like. The following statement is suggested when sufficient space is available: "This insulated vinyl siding conforms to all the requirements established in ASTM Specification D7793 developed cooperatively with the industry and published by ASTM. Full responsibility for the conformance of this product to the specification is assumed by (name and address of producer or distributor)."

7.4 The following abbreviated statement is suggested when available space on labels is insufficient for the full statement: "Conforms to ASTM Specification D7793 (name and address of producer or distributor)."

7.5 The package shall be marked or labeled with the R-value determined in 6.18.

NOTE 14—Marking or labeling done in compliance with 16 CFR Part 460 will normally satisfy this requirement. That and other government regulations may require additional information and statements which are not required by this standard.

7.6 The standard wind load design pressure rating determined in accordance with 5.2.3.2 shall be stated on the product or on the product package by one of the means in 7.6.1 or 7.6.2.

7.6.1 The package shall be marked or labeled with the standard wind load design pressure rating. The marking shall be in the format "Standard Wind Load Design Pressure Rating: ##.# psf (ASD)".

7.6.2 The standard design pressure rating shall be included on a line imprint or other marking on the front (outward-facing) surface of all siding panels. It is not required that the marking be visible after installation, provided that the marking can be revealed and read by detaching the lower edge lock of an adjacent course, without removal of any fasteners. The standard design pressure marking shall be stated at least once per panel. The marking shall be in the format "Std Design Pressure Rating: ##.# psf (ASD)".

7.6.3 At the option of the manufacturer, additional marking or labeling of the package or product with alternative wind load design pressure ratings determined in accordance with 5.2.2.3 for use with alternative sheathings, wall configurations or fastening methods is permitted. The marking shall use the format specified in 7.6, shall indicate the type of sheathing or wall configuration for which it is applicable, and shall refer to the manufacturer's instructions for more information and any installation requirements.

8. Keywords

8.1 insulated siding; insulated vinyl siding; plastic building products; plastic weatherability; recycled plastic; rigid PVC siding; specification; vinyl siding

ANNEX

(Mandatory Information)

A1. WIND LOAD RESISTANCE TEST DESIGN FACTORS

A1.1 Wind Load Criteria

A1.1.1 ASCE 7-10 is the basis for determining the design pressures used in this specification. Design wind loads are determined on an ASD basis in this specification.

NOTE A1.1—In previous editions of ASCE 7, wind loads were determined using wind speed maps based on a 50-year return period. In ASCE 7-10, maps based on a 700-year return period are used which, for any given location, produce a wind speed approximately 30 % greater than that of the previous maps. This larger magnitude (higher return period) wind speed, referred to as the ultimate wind speed, (V_{ULT}), is used directly (with a load factor of 1.0) to determine nominal wind loads on a Strength Design (LRFD) or "ultimate" wind load basis. When Allowable Stress Design (ASD) is used, ASCE 7-10 provides for these ultimate wind loads, determined from the ultimate wind speed map velocities, to be multiplied by a load factor of 0.6. Alternatively, the adjustment can be made directly to the wind velocity, which is the approach taken in this method (see A1.1.2). This procedure produces results consistent with past ASD wind loads.

A1.1.2 It is necessary to determine whether the wind velocity to be used is based on the maps in ASCE 7-10 or on older maps designed for direct application of ASD. Wind velocity, V, based on ASD is used in this method. Wind speeds determined using the maps in ASCE 7-10, referred to as V_{ULT}, are converted to ASD wind speeds, V_{ASD}, by multiplying by the square root of 0.6. Wind speeds based on maps using an ASD basis do not require conversion (see A1.3) Thus:

$$V = V_{ASD} = V_{ULT} \times \sqrt{0.6} \quad \text{(A1.1)}$$

The V determined in this section is used in the following calculations.

A1.1.3 The velocity pressures, q, used in this specification have been computed using the following equation:

$$q = 0.00256\, K_z K_d V^2 I (lb/sq.\,ft) = 0.613\, K_z K_d V^2 I (N/m^2) \quad \text{(A1.2)}$$

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where:

V = wind velocity, mph (km/h). The basic wind speed corresponds to a 3-s gust speed at 33 ft (10.1 m) above ground in exposure category C, as described in ASCE 7-10. A velocity of $V = V_{ASD}$ = 110 mph (177 km/h) was used in this specification. (See Note A1.2 and Note A1.3.)

I = "importance factor" as described in editions of ASCE 7 prior to ASCE 7-10. A value of 1.0 is used. This factor is not used where the wind speed has been determined from a map in ASCE 7-10. (See Note A1.4.)

K_z = "velocity pressure coefficient" as described in ASCE 7-10. A "K_z" of 0.70 is used in the wind pressure calculations, which is the value from ASCE 7-10 for a mean roof height of 30 ft (9.1 m) above ground level and Exposure Category B.

K_d = "wind directionality factor" as described in ASCE 7-10. A "K_d" of 0.85 is used.

A1.1.4 Thus for the given velocity and factors, the velocity pressure, q = 18.43 lbf/ft^2 (882 Pa).

NOTE A1.2—As explained in Note A1.1, the wind velocity used in this method is converted from the V_{ULT} given by wind speed maps in ASCE 7-10 to V_{ASD} using the equation in A1.1.2. A V_{ULT} wind speed of approximately 140 mph from the maps is equivalent to a V_{ASD} of 110 mph, which is the velocity V used in this specification.

NOTE A1.3—In ASCE 7-10 the default wind speeds are given for exposure category C, and a table is provided to adjust this wind speed for other exposure categories. Since most insulated vinyl siding is installed on buildings located in exposure category B, the velocity pressure coefficient, K_z is included in the equation to make this adjustment.

NOTE A1.4—Editions of ASCE 7 prior to ASCE 7-10 included an importance factor to represent the relative significance of the building and the consequences of its loss. Because most insulated vinyl siding is installed on residential and light commercial buildings, the importance factor was set at 1.0 by default. ASCE 7-10 has removed the importance factor from the velocity pressure equation, and instead provides a different wind speed map for each of the building importance categories (referred to as risk categories in ASCE 7-10). Thus the importance factor will already have been incorporated into the wind speed determined from the appropriate map, and the importance factor is not used for determining velocity pressure using wind speeds from ASCE 7-10 maps.

A1.1.5 ASCE 7-10 recommends various internal and external pressure coefficients, which include gust response factors. These coefficients vary with the effective area of the cladding component, the location of the cladding component relative to building corners, and the configuration of the building (open versus enclosed). The internal and external pressure coefficients are taken from Table 26.11-1 and Figure 30.4-1 of ASCE 7-10. The effective area is taken as 10 square feet (the area of one piece of siding), an enclosed building is assumed, and factors for the building corners are used. The pressure coefficients are as follows:

$$\textit{Internal Pressure Coefficient} = \pm 0.18 \qquad \text{(A1.3)}$$

$$\textit{External Pressure Coefficient} = +1.00 \textit{ and } -1.40$$

A1.1.6 The design pressure is calculated by multiplying the velocity pressures by the algebraic sum of the internal and external pressure coefficients.

A1.2 Design Pressure

NOTE A1.5—Because the wind velocity has already been adjusted from an ultimate basis to an ASD basis at the beginning of these calculations, the design pressure determined in this step is an ASD load. This correlates to the design pressure requirements stated in tables in the 2015 International Residential Code and other codes which have also been adjusted to an ASD basis. However, the required design pressures in some other codes and design standards have not been adjusted to an ASD basis. Where required design pressures are based on ultimate wind loads determined from ASCE 7-10 wind speeds, those loads must be multiplied by 0.60 to match the design pressure determined from this equation. A1.2

$$\textit{Positive Design Pressure} = (18.43)\,(1.00+0.18) = 21.74\ \textit{psf} \qquad \text{(A1.4)}$$

$$\textit{Negative Design Pressure} = (18.43)(-1.40-0.18) = -29.12\ \textit{psf}$$

A1.2.1 The negative values (suction loads) are the largest in magnitude and are the design values used in this specification. Research conducted by various organizations[5,6] has shown that a certain amount of pressure equalization occurs through residential siding products installed with sheathing under high dynamic pressures. In light of this pressure equalization, the design pressure in the ASCE 7-10 wind load standards is reduced by a factor of 0.5 for insulated vinyl siding.

A1.2.2 Therefore, the required test pressures are calculated as follows:

$$P_t = D_P \times PEF \times 1.5 \qquad \text{(A1.5)}$$

where:

P_t = test pressure, lbf/ft^2 (Pa),

D_P = design pressure, lbf/ft^2 (Pa),

PEF = pressure equalization factor, insulated vinyl siding, 0.5, and

1.5 = safety factor.

A1.2.2.1 If documentation in support of the use of compensation for pressure equalization other than 0.5 is provided, use the calculation in A1.2.2, substituting the appropriate pressure equalization factor.

A1.2.3 Using the above equations, in a 110 mph (177 km/h) (V_{ASD}) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, the required minimum uniform load test pressure for insulated vinyl siding is 21.84 lbf/ft^2 (1046 Pa).

A1.2.3.1 For compliance with 5.2.2, the referenced design pressure has been rounded to -30.0 lbf/ft^2 (1436 Pa) to match the standard design conditions specified by the 2015 International Residential Code. When tested under Test Method D5206, the siding must attain an average maximum sustained static test pressure equal to or greater than the corresponding minimum test pressure of 22.5 lb/ft^2 (1077 Pa).

A1.2.4 For applications where the effective design pressure is greater than -30.0 lbf/ft^2 (1436 Pa) (for example, wind zone areas greater than 110 mph (177 km/h) (V_{ASD}), mean roof height over 30 ft (9.1 m), or exposure conditions other than Exposure B), refer to ASCE 7-10 for the effective design pressure. To be shown to be suitable for the application, when

[5] Vinyl Siding Pressure Equalization Factor, Architectural Testing, Inc. Report No. 01-40776.01, September 2002.

[6] Morrison, M.J., Cope A.D. "Wind Performance and Evaluation Methods of Multi-Layered Wall Assemblies." *Structures Congress*, 2735-2748, Portland, OR, 2015.

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tested under Test Method D5206 the siding must attain an average maximum sustained static test pressure equal to or greater than the minimum test pressure determined by the formula in A1.2.2, using the design pressure, D_P, determined for the application using the procedure in A1.1.2 through A1.2.

A1.2.5 These loading conditions apply only to siding installed without an air space directly over sheathing of a type and fastening method that is capable of independently resisting both positive and negative wind design pressures at the building location. Examples of such sheathing include oriented strand board (OSB) and plywood fastened to resist the design wind pressures. For applications where the siding is installed over open studding, without sheathing, rapid pressure equalization does not occur and pressure equalization factor (PEF) is set to 1.0. In these applications, the load the siding will see is equal to the total design pressure. The static test pressure required for products used under these conditions is as follows:

$$P_t = D_P \times PEF \times 1.5 \quad \text{(A1.6)}$$

where:

P_t = static test pressure, lbf/ft^2 (Pa),
D_P = design pressure, lbf/ft^2 (Pa), and
PEF = pressure equalization factor, 1.0, and
1.5 = safety factor.

A1.2.5.1 Therefore in a 110 mph (177 km/h) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, siding installed without sheathing would require a uniform load test pressure of 43.72 lbf/ft^2 (2093 Pa).

NOTE A1.6—Building codes and insulated vinyl siding installation instructions require insulated vinyl siding to be installed over sheathing, so calculation of minimum test pressure for siding installed without sheathing is essentially moot. However, the calculation has been retained for completeness and comparison with other installation conditions.

A1.2.6 When siding is installed over sheathing that is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, a greater percentage of the total wind pressure is transferred to the siding and its fasteners. This has the effect of partially or completely countering the effect of the pressure equalization factor. In these cases a value between 0.5 and 1.0 is used for the pressure equalization factor (PEF).

A1.2.6.1 In addition, in cases where failure of the siding would result in failure of the exterior wall covering assembly (that is, siding and sheathing) a safety factor of greater than 1.5 is indicated.

A1.2.6.2 If the adjusted PEF for a given combination of siding and sheathing is known, and an appropriate safety factor is used, a minimum test pressure can be determined using the equation in A1.2.1. However, it is normally more appropriate to make an adjustment for alternative sheathings when determining the design pressure rating, as discussed in A1.3.

NOTE A1.7—Where the sheathing is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, the layer of siding over the sheathing, and its fastening through the sheathing, act to reinforce the sheathing such that the whole wall covering (siding-sheathing) assembly is capable of resisting such wind pressures. Because the siding is tested by itself (not as part of a siding-sheathing assembly) in Test Method D5206, the adjustment of test pressure (before the test) or of the design pressure (after the test) ensures that the wind load resistance of the assembly as a whole is reflected in the rating of the siding.

NOTE A1.8—In some high wind hazard regions, such as south Florida, the exterior wall covering assembly may also be required to meet wind-borne debris impact resistance criteria which would affect the choice of sheathing material to be used together with siding. Such considerations are beyond the scope of this standard.

A1.3 Wind Design Pressure Rating (Maximum Allowable Pressure)

A1.3.1 A design pressure rating is the maximum wind pressure that a particular siding product is rated to be able to withstand. It is used in building design and building codes to determine the acceptability of a siding product for use under the design wind conditions for a specific application. To be acceptable, a siding's design pressure rating must be equal to or greater than the design pressure for the specific building at the specific location. The design pressure rating is determined from the average maximum sustained static test pressure for a siding product produced by testing under Test Method D5206, the pressure equalization factor, and a safety factor.

A1.3.2 *Standard Design Pressure Rating*—The standard design pressure rating is used for applications where the siding is installed over a sheathing type and fastening method that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location.

A1.3.2.1 The standard design pressure rating assumes that the siding is fastened to the building in the standard manner, with the minimum fastener type, size, spacing, and penetration depth prescribed in Chapter 7 of the International Residential Code and the VSI Vinyl Siding Installation Manual. The installation of the siding for testing under Test Method D5206 must be consistent with these minimum fastening requirements. However, this does not prevent additional testing, using different fastening, to support design pressure ratings for other applications, such as special high wind installations.

A1.3.2.2 The pressure equalization factor and safety factor are the same as those used to determine the test pressure in A1.2.1, using the following equation:

$$D_{Rstd} = \frac{P_m}{(PEF \times SF)} \quad \text{(A1.7)}$$

where:

D_{Rstd} = standard design pressure rating, lbf/ft^2 (Pa),
P_m = average maximum sustained static test pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, 0.5, and
SF = safety factor, 1.5.

A1.3.3 *Alternative Design Pressure Ratings*—Design pressure ratings for applications other than the standard conditions described above can be developed. Common circumstances where this is done include the use of alternative fastening methods in order to achieve a higher design pressure rating, and cases where the sheathing is not capable of independently resisting wind pressures under design conditions, which necessitates a reduction in the siding's design pressure rating.

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A1.3.3.1 *Alternative Fastening*—Where an alternative fastening method is specified by the manufacturer, the siding is permitted to be tested under Test Method D5206 using the specified fastening. The resulting average maximum sustained static test pressure is used in the above equation to determine the alternative design pressure rating. In order for this alternative rating to be realized, the siding must be installed using the alternative method, and the rating must be clearly tied to installation requirements in manufacturer's literature and instructions.

A1.3.3.2 *Alternative Sheathing*—An adjusted design pressure rating for use of the siding over sheathings not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, as discussed in A1.2.6, can be calculated using the above equation if the appropriate PEF and safety factor are specified.

A1.3.3.3 Alternative PEF and safety factor values have been documented (see 2009 and 2012 International Residential Code, section R703.11.2) for one type of sheathing, foam plastic insulating sheathing complying with ANSI/SBCA FS 100. Two wall assembly cases are considered: 1) where the interior surface of the wall is covered with gypsum wall board or equivalent; and 2) where the interior surface of the wall is not covered with gypsum wall board or equivalent. In both cases the siding is installed directly over foam sheathing, which is then attached directly to framing, without intervening sheathing. The PEF and safety factor for each case are as follows:

Case	PEF	Safety Factor
Case 1	0.7	2.0
Case 2	1.0	2.0

A1.3.3.4 Adjustment of the standard design pressure rating is not necessary when foam plastic insulating sheathing is installed directly over sheathing that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, or where the sheathing is fastened in a way that allows it to independently resist the design wind pressure. For such cases the standard design pressure rating is applied.

A1.4 Design Wind Speeds

A1.4.1 The wind velocity maps in ASCE 7-10 provide one source of design wind speeds for particular geographic regions. The velocities on these maps are stated in terms of "ultimate," 700-year return interval speeds. To be used in the procedure in this Annex, those velocities need to be converted to the ASD equivalent in accordance with A1.1.2, and the resulting velocity V used in the equation in A1.1.3. The 2012 and 2015 International Building Code and 2015 International Residential Code also contain maps based on ultimate wind speeds.

A1.4.2 Other maps are available that do not require conversion of wind velocities. Examples include the wind map in the 2012 International Residential Code, on which the velocities have already been converted from those on the ASCE 7-10 maps. Maps from previous editions of ASCE 7 used ASD velocities and do not require conversion. However, only editions since 1995 used the 3-second gust basis that is used in this Annex. The 1998, 2002, and 2005 editions of ASCE 7 continued the use of 3-second gust wind basis, but with improved hazard modeling of hurricane wind speeds first made in the 1998 edition. These previous editions also do not have the benefit of further improved hurricane hazard modeling that was incorporated into the maps used in ASCE 7-10.

APPENDIX

(Nonmandatory Information)

X1. VINYL SIDING, BACKED SIDING, AND INSULATED VINYL SIDING

X1.1 Relationships among types of vinyl siding

X1.1.1 Conventional vinyl siding is covered by ASTM D3679, Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding. D3679 includes provisions for the materials and performance of vinyl siding, including minimum PVC composition and percentage of recycled material, dimensional requirements, impact resistance, resistance to surface distortion and deterioration, thermal expansion, windload resistance, etc.

X1.1.2 Backed vinyl siding is vinyl siding that includes an integral foam plastic backing material, and is covered by Specification D7445. That specification includes many of the same requirements as are found in D3679, which are applied to the vinyl siding "skin" of the product. Additional requirements, which apply to the foam backing itself, or to the full product including both siding and foam, are also included in Specification D7445

X1.1.3 Insulated vinyl siding, which is the subject of this standard specification, may be thought of as backed vinyl siding that is able to meet enhanced requirements. Chief among those is the requirement that insulated vinyl siding demonstrate a minimum thermal resistance, or R-value. While the foam backing of backed vinyl siding may, or may not, impart some R-value, it is not required to demonstrate that. To be considered "insulated vinyl siding" the product must demonstrate that it delivers the minimum R-value.

X1.1.4 As with backed vinyl siding, insulated vinyl siding is composed of a vinyl siding "skin" and foam plastic insulation. The vinyl siding portion must meet specific requirements for vinyl siding, which parallel with those in D3679. As with backed vinyl siding, insulated vinyl siding is subjected to additional requirements that apply to the foam or to the full product including siding and foam. In some cases the minimum

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specification or performance level is higher for insulated vinyl siding compared to backed vinyl siding. This is consistent with the intent that insulated vinyl siding be understood as offering enhanced performance and tangible benefits over the more basic backed vinyl siding.

REFERENCES

(1) ASHRAE Handbook of Fundamentals, American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. Chapter 26, 1977.

(2) "Wind Forces on Structures," Transactions of the American Society of Civil Engineers, Vol 126, Part II, 1961, pp. 1124–1198.

(3) AAMA, CW 11-85, American Architectural Manufacturers Assn., Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing, American Architectural Manufacturers Assn., 1827 Walden Office Square - Suite 550, Schaumburg, IL.

(4) Thom, H. C. S., New Distribution of Extreme Winds in the United States , American Society of Civil Engineers, Environmental Engineering Conference Preprint 431, Dallas, TX, Feb. 6, 1967.

(5) Sachs, Peter, Wind Forces in Engineering, Pergamon Press, Elmsford, NY 1972.

(6) MacDonald, A. J., Wind Loading on Buildings, Applied Sciences Publishers, Ltd., Essex, England, 1975.

(7) Houghton, E., and Carruthers, N., Wind Forces on Buildings and Structures , John Wiley & Sons, New York, NY, 1976.

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D7793 - 21) that may impact the use of this standard. (April 1, 2024)

(1) Revised 1.4.
(2) Removed withdrawn Practice D4756 from Referenced Documents section.

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This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.



Designation: D7445 – 24

An American National Standard

Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding with Foam Plastic Backing (Backed Vinyl Siding)[1]

This standard is issued under the fixed designation D7445; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification establishes requirements for vinyl siding with integral foam plastic backing, where the siding is manufactured from rigid PVC compound. Performance requirements and test methods addressed by this standard include materials properties and dimensions, warp, shrinkage, impact strength, expansion, appearance, flame spread, and wind load resistance. Methods of indicating compliance with this specification are also provided.

NOTE 1—Backed vinyl siding is composed of two major components: the siding and the backing. It is intended that the siding portion comply with Specification D3679. Applicable portions of Specification D3679 are included in this specification. Additional requirements that pertain only to the backing as a separate material, or to the combination of siding and backing as a whole, are also included.

1.2 Backed vinyl siding shall be tested with the backing material in place or removed, as specified in the applicable requirement or test method.

1.3 The use of PVC recycled plastic in this product shall be in accordance with the requirements in Section 4.

1.4 Siding produced to this specification shall be installed in accordance with Practice D4756. Reference shall also be made to the manufacturer's installation instructions for the specific product to be installed.

NOTE 2—Information with regard to siding maintenance shall be obtained from the manufacturer.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 3—There is no known ISO equivalent to this standard.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing
D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer
D883 Terminology Relating to Plastics
D1042 Test Method for Linear Dimensional Changes of Plastics Caused by Exposure to Heat and Moisture
D1435 Practice for Outdoor Weathering of Plastics
D1600 Terminology for Abbreviated Terms Relating to Plastics (Withdrawn 2024)[3]
D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
D2457 Test Method for Specular Gloss of Plastic Films and Solid Plastics
D3679 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding
D3892 Practice for Packaging/Packing of Plastics
D4226 Test Methods for Impact Resistance of Rigid Poly-(Vinyl Chloride) (PVC) Building Products
D4756 Practice for Installation of Rigid Poly(Vinyl Chloride) (PVC) Siding and Soffit (Withdrawn 2023)[3]
D5206 Test Method for Windload Resistance of Rigid Plastic Siding

[1] This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.24 on Plastic Building Products.

Current edition approved X 1, 2024. Published X 2024. Originally approved in 1979. Last previous edition approved in 2018 as D7445 – 18. DOI: 10.1520/D7445-24.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

***A Summary of Changes section appears at the end of this standard**

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D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens
D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)[3]
D7793 Specification for Insulated Vinyl Siding
E84 Test Method for Surface Burning Characteristics of Building Materials
E631 Terminology of Building Constructions
E1753 Practice for Use of Qualitative Chemical Spot Test Kits for Detection of Lead in Dry Paint Films
G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

2.2 *ASCE Standard:*[4]
ASCE 7-10 Minimum Design loads for Buildings and Other Structures

2.3 *International Code Council:*[5]
International Building Code
International Residential Code

2.4 *Vinyl Siding Institute, Inc.:*[6]
VSI Vinyl Siding Installation Manual (2015)

2.5 *Structural Building Components Association:*[7]
ANSI/SBCA FS 100-2012 Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies

3. Terminology

3.1 Definitions are in accordance with Terminologies D883, E631, and D1600, unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *backed vinyl siding*—a vinyl cladding product sold with manufacturer-installed foam plastic backing material as an integral part of the cladding product. The vinyl cladding portion of backed vinyl siding meets the definition of vinyl siding. Backed vinyl siding is intended to be installed only with the integral backing.

3.2.2 *backing material; foam plastic backing*—a layer or layers of plastic that has been intentionally expanded to produce a reduced-density plastic containing voids consisting of open or closed cells distributed throughout the plastic.

3.2.3 *nominal*—the value that a manufacturer consistently uses to represent a specific property or dimension of a vinyl siding product in public claims including, but not limited to, product literature, advertisements, quotations, and certificates of conformance.

3.2.4 *process average thickness*—the rolling, arithmetic mean of average specimen thicknesses measured according to 6.5 for a specific product during all productions runs for the most recent six month period.

3.2.5 *wind load design pressure rating*—the maximum wind pressure that a backed vinyl siding product is rated to withstand, based on testing under Test Method D5206.

3.2.5.1 *standard wind load design pressure rating*—the wind load design pressure rating for a siding product when installed 1) over a sheathing material designed and attached such that it is capable of resisting 100 % of positive and negative wind pressures occurring under design conditions at the building location; and 2) with the standard fastening method specified in building codes, general installation instructions, and the siding manufacturer's instructions.

3.2.5.2 *alternative wind load design pressure rating*—the wind load design pressure rating for a siding product when installed over a sheathing not designed and attached such that it is capable of resisting 100 % of positive and negative wind pressures occurring under design conditions at the building location, or when the siding is not fastened in the standard way; as specified by the manufacturer.

3.2.5.3 *Discussion*—The standard test conditions, configuration, and fastening method used in this specification are specified in 6.14, while alternative sheathing and installation conditions are specified by the manufacturer and must be reflected in the product's installation instructions. Alternative ratings apply only when the specified sheathing and fastening conditions are used. See Annex A1 for information on differences between the standard wind load design pressure rating and alternative wind load design pressure ratings, and how to determine standard and alternative design pressure ratings.

3.2.6 *temperate northern climate*—in weather testing, a North American metropolitan area testing site located within 73 to 100°W longitude and 37 to 45°N latitude.

3.2.7 *vinyl siding*—a shaped material, made principally from rigid poly(vinyl chloride) (PVC), that is used to clad exterior walls of buildings; in this standard, vinyl siding refers to the rigid profile to which the backing material is attached.

3.2.7.1 *Discussion*—Any exception to a homogeneous rigid PVC compound is present in a coextruded or laminated capstock.

4. Materials and Manufacture

4.1 The vinyl siding, exclusive of backing material, shall be made of one or more layers of poly(vinyl chloride) (PVC) compound. Any layers of materials other than poly (vinyl chloride) (PVC) compound shall be kept to less than 20 % by volume. This limitation does not apply to the backing material.

4.2 Where rigid PVC recycled plastic as defined in Guide D7209 is used, the siding containing the PVC recycled plastic shall meet all of the requirements of 3,Terminology; 4, Materials and Manufacture; and 5, Physical Requirements.

4.3 The poly(vinyl chloride) siding material, exclusive of backing material, when tested in accordance with Test Method D635, shall not exceed an average extent of burn of 4 in. (100 mm), with an average time of burn not to exceed 10 s. A minimum sample thickness of 0.035 in. (0.9 mm) is required. **Warning—**The flammability testing data, conclusions, and recommendations of Test Method D635 relate solely to the

[4] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.
[5] Available from International Code Council (ICC), 500 New Jersey Ave., NW, 6th Floor, Washington, DC 20001, http://www.iccsafe.org.
[6] National Housing Center, 1201 15th Street NW, Suite 220, Washington, DC 20005, http://www.vinylsiding.org
[7] 6300 Enterprise Lane, Madison, WI 53719, http://www.sbcindustry.com

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measurement and description of properties for classification of the poly(vinyl chloride) siding material in response to flame under controlled laboratory conditions and shall not be used for the description or appraisal of the fire hazard of vinyl siding under actual fire conditions.

4.4 The foam plastic backing shall have a Flame Spread Index not greater than 75 and a Smoke Developed Index not greater than 450 when tested separately under method E84.

4.5 The PVC compound when extruded into siding shall maintain uniform color and be free of any visual surface or structural changes, such as peeling, chipping, cracking, flaking, or pitting.

4.6 The PVC compound shall be compounded so as to provide the heat stability and weather exposure stability required for the siding market application.

4.7 Backed vinyl siding shall not contain elemental lead (Pb) or compounds of that material other than traces incidental to raw materials or the manufacturing process. This limitation applies to both PVC substrate and to any cap or film material, as well as the backing material. Compliance with this requirement shall be demonstrated by one of the methods in 6.16.

5. Physical Requirements

5.1 *Requirements Applicable to Vinyl Siding*—The provisions of 5.1.1 – 5.1.8 apply only to the vinyl siding, exclusive of any backing material. Where necessary to perform testing, the backing material shall be removed.

5.1.1 *Length and Width*—The nominal length and width of the siding shall be as agreed upon between the purchaser and the seller. The actual length shall not be less than ¼ in. (6.4 mm) of the nominal length and the actual width shall be within ± 1⁄16 in. (1.6 mm) of the nominal width when measured in accordance with 6.3 and 6.4.

5.1.2 *Thickness*—These requirements pertain only to measurements of the portions of the siding that are exposed after installation of the panel, measured in accordance with the procedure in 6.5. The average thickness of each specimen shall be no less than 0.035 in. No individual measurement shall be thinner than 0.003 in. below the nominal thickness. The process average thickness as defined in 3.2.4 shall be no thinner than 0.001 in. below the nominal thickness.

5.1.3 *Camber*—A full length of siding (typically 10 or 12 ft (3.05 or 3.61 m)) shall not have a camber greater than ⅛ in. (3.2 mm) when measured in accordance with 6.6.

5.1.4 *Heat Shrinkage*—The average heat shrinkage shall not exceed 3.0 % when determined by the method described in 6.7.

5.1.5 *Impact Resistance*—Siding shall have a minimum impact strength of 60 in.·lbf (6.78 J) when tested in accordance with 6.8.

5.1.6 *Coefficient of Linear Expansion*—The siding shall have a coefficient of linear expansion not greater than 4.5 by 10^{-5}in./in./°F (8.1 by 10^{-5} mm/mm/°C) when tested in accordance with 6.9.

5.1.7 *Gloss*—The gloss of smooth and embossed vinyl siding shall be uniform across the exposed surface. The average of all readings for a panel determined in 6.11.2.5 shall not differ from the manufacturer's specified gloss value more than the permitted variation in Table 1, and each individual reading shall not vary more than 10 points from the average. Gloss of smooth and embossed vinyl siding shall be tested in accordance with 6.11.

5.1.8 *Uniformity of Color*—The color specified shall be uniform on the exposed surface of the vinyl siding panels, except on the case of variegated colors. When tested in accordance with 6.13, the total color change, ΔE, between a production specimen and the appropriate reference specimen or agreed-upon color coordinates shall not vary by more than 1.5, and the chromatic coordinates thereof shall not change by more than $\pm\Delta a_H = 1.0$ and $\pm\Delta b_H = 1.0$.

5.1.9 *Weathering:*

5.1.9.1 The vinyl siding shall maintain a uniform color and be free of any visual surface or structural changes such as peeling, chipping, cracking, flaking, and pitting when tested in accordance with 6.10.

NOTE 4—Weathering-conformance-testing requirements are to reflect performance of a "typical" extrusion siding profile representing a specific color of PVC compound and a specific extrusion technology. In no case is there an implied requirement for testing all the various shaped and sized siding profiles produced in this color. The lengthy outdoor weatherability testing for new products may be performed concurrently with market development and sales of siding to existing markets. Completion of weatherability testing prior to marketing of the product is not required.

5.2 *Requirements Applicable to Backed Vinyl Siding*—The provisions of 5.2.1 – 5.2.3 apply to backed vinyl siding, including the integral foam backing material. Testing shall be conducted with the backing material in place, as described in the referenced test method.

5.2.1 *Surface Distortion*—The *backed vinyl* siding shall be free of bulges, waves, and ripples when tested to a minimum temperature of 150°F (66°C) in accordance with the procedure in 6.12. This distortion is called "oil-canning."

5.2.2 *Wind Load Resistance*—The siding shall withstand a minimum static test pressure and a standard wind load design pressure rating shall be determined.

5.2.2.1 *Minimum Test Pressure*—Backed siding shall be able to withstand a minimum test pressure of 22.5 lbf/ft^2 (1077 Pa) when tested in accordance with 6.14. The average maximum sustained static test pressure determined in 6.14 shall be equal to or greater than this value. If the manufacturer of backed siding provides documentation to support compensation for pressure equalization, the test pressure shall be determined from Annex A1 using the documented pressure equalization factor.

NOTE 5—The static test pressure of 22.5 lbf/ft^2 (1077 Pa) for backed siding was established to withstand structural loading conditions that occur in wind exposures of approximately 110 mph (177 km/h) (V_{ASD}) for mean roof heights of 30 ft (9.1 m) and less in exposure category B, and corresponds to 30.0 lbf/ft^2 (1436 Pa) negative design pressure, to match the default wind design conditions of Table R703.3(1) in the 2015 International Residential Code. Provision is made for compensation for pressure equalization specific to the product if supporting documentation

TABLE 1 Gloss Values

Manufacturer's Specified Gloss Value	Permitted Difference from Manufacturer's Specified Gloss Value
Less than or equal to 35	±8
Greater than 35	±10

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is provided, using procedures in Annex A1.

NOTE 6—Refer to Annex A1 for an explanation as to how the negative design pressure was established, and for applications where the effective negative design pressure as specified in ASCE 7-10 is different from 30.0 lbf/ft^2 (1436 Pa) (for example, wind-zone areas greater than about 110 mph (177 km/h) (V_{ASD}) (225 km/h (V_{ULT})) or mean roof height above 30 ft (9.1 m), or exposures other than exposure category B).

(1) The design-pressure values can be negative (suction loads) or positive. The negative values are the largest in magnitude and are the values used in this specification.

NOTE 7—In that the siding is being tested as a weather-resistant exterior product applied to an existing exterior structural wall, forces (negative) working to pull the siding off the wall, fasteners, or disengage locks will be the most important criteria for testing. Positive wind forces test the integrity of the total wall sections, and do not provide a measure of the performance of the siding.

5.2.2.2 *Standard Wind Load Design Pressure Rating*—The standard wind load design pressure rating shall be determined from the results of testing in accordance with 6.14, using the procedures described in A1.3.

NOTE 8—The standard design pressure rating is valid for applications where the siding is installed over sheathing and its fastening that are capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location. For applications over other sheathing, a different design pressure rating is applicable, and is determined in accordance with A1.3. Determination of a rating other than the standard design pressure rating is not required by this section.

5.2.2.3 *Alternative Design Pressure Ratings*—Design pressure ratings other than the standard wind load design pressure rating, for use with different sheathing materials or using different installation or fastening, are permitted to be determined in accordance with testing under 6.14, using the procedures in Annex A1.

5.2.3 *Nail Slot Allowance for Thermal Expansion*—For siding panels utilizing nail slots to allow for thermal expansion and contraction, the nail slot shall be sized to allow for the expected range of expansion and contraction over a range of 100°F. Compliance with this requirement shall be demonstrated either by the test method in 6.15 or by sizing of the nail slots according to the specifications in the following sections. The instrument used shall be capable of measuring to the nearest 0.01 in. The manufacturing tolerance shall not exceed -0.030 in.

5.2.3.1 For panels shorter than 6 ft (1829 mm) in length, the minimum nail slot width shall be ⅜ in. (11.4 mm).

5.2.3.2 For panels 6 ft (1829 mm) in length or longer the minimum nail slot width shall be determined according to the following formula. The minimum width shall be the width resulting from application of the formula, rounded to the next lower quarter-inch. Regardless of the results of the calculation, the minimum nail slot width for panels 6 feet or longer shall be 1 in (25.4 mm).

$$WS = P_c \times (\alpha \times 100\,°F \times L) + T_c \quad (1)$$

WS = minimum width of nail slot, in.,
P_c = center-pinning coefficient: 1 if manufacturer's instructions require panel to be center-pinned; 1.5 if center-pinning is not required,
α = coefficient of linear thermal expansion, 4.5×10^{-5} in./in./°F or actual known coefficient for material used, as determined by 6.9,
L = length of panel, inches, and
T_c = centering tolerance: 0.25 in.

5.2.4 *Flame Spread*—Backed vinyl siding shall have a Flame Spread Index not greater than 200 when tested in accordance with 6.17.

6. Test Methods

6.1 *General*—The inspection and test procedures contained in this section are used to determine the conformance of products to the requirements of this specification. Each producer who represents its products as conforming to this specification shall be permitted to use statistically based sampling plans that are appropriate for each manufacturing process, but shall keep the essential records necessary to document, with a high degree of assurance, his claim that all of the requirements of this specification have been met. Additional sampling and testing of the product, as agreed upon between the purchaser and the manufacturer, are not precluded by this section.

6.2 *Conditioning and Test Conditions*—Condition the test specimen in accordance with Procedure A of Practice D618 and test under those conditions, unless otherwise specified herein.

6.3 *Length*—Lay the specimen on a flat surface and measure with a steel tape. Measure the length of a siding panel to the nearest 1/16 in. (1.6 mm) at the center, the butt edge, and the bottom of the top lock. The average of the three measurements is the actual length.

6.4 *Width*—Interlock two long specimens, each at least 26 in. (600 mm) long, in the normal mode for installation. Lay the two specimens on a flat surface. Measure to the nearest 1/16 in. (1.6 mm), the distance between the lowest butt edge of the top specimen and the lowest butt edge of the bottom specimen. Commencing approximately 1 in. (25 mm) from one end of the specimens, make five measurements at 6 in. (152 mm) intervals, making sure that the measurement is made perpendicular to the butt edge. Average the measurements. The average constitutes the exposed width of siding.

6.5 Thickness shall be measured in accordance with Test Method A of Test Method D5947. The micrometer shall be calibrated in accordance with Section 8 of Test Method D5947. The thickness of the siding shall be measured at a minimum of 5 locations equally spaced across the entire portion of the siding that will be exposed after installation. All measurements shall be taken to the nearest 0.001 in. Calculate and report the average of these measurements. Also report the thinnest individual measurement.

6.6 *Camber*—Place a full length of siding (typically 10 or 12 ft (3.05 or 3.61 m)) on a flat surface alongside a straightedge at least as long as the siding specimen. Measure the maximum space between edge of the siding specimen and the straightedge for each edge to the nearest 1/16 in. (1.6 mm).

6.7 *Heat Shrinkage:*
6.7.1 *Apparatus:*

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6.7.1.1 *Scriber,* similar to that described in Test Method D1042, with the exception that the needle points shall be separated by 10 ± 0.01 in. (254 ± 0.254 mm).

6.7.1.2 *Test Media,* a controlled-temperature water bath of 5 gal (10 L) or more, equipped with an efficient stirrer that will maintain uniform temperature throughout. Heater and temperature-control devices must maintain the water at 160 ± 1°F (71 ± 0.5°C). Use a wire rack to raise and lower specimens into the water bath. As an alternative to the use of a water bath, the specimens may be heated for 30 min in a uniformly heated forced-air oven maintained at a temperature of 160 ± 1°F (71 ± 0.5°C).

6.7.1.3 Make measurements with any device capable of measuring the distance between two scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2 *Procedure:*

6.7.2.1 Cut three specimens from the siding panel, each 1 in. (25.4 mm) wide by 12 in. (305 mm) long. Cut one specimen from the center and one from each of the extreme edges of the flat surface. The long axis shall be parallel to the machine direction.

6.7.2.2 Condition specimens at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity for at least 24 h.

6.7.2.3 Make a slight mark with the scribe on each specimen so that a reference point will be clearly visible.

6.7.2.4 Place specimens in the test medium.

6.7.2.5 Remove specimens after 30 min and place on a flat surface until cool.

6.7.2.6 Repeat conditioning in accordance with 6.7.2.2.

6.7.2.7 Make a second mark with the scribe on each specimen, using the same center.

6.7.2.8 Measure the distance, *D*, between the scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2.9 Calculate the percent shrinkage as (*D*/10) × 100.

6.7.2.10 Report the average shrinkage of the three specimens tested.

6.8 *Impact Resistance*—Test impact resistance of siding in accordance with Test Method D4226, Procedure A, impactor head configuration H.25. 4 in.-lb increments (0.5 in. height increments with 8 lb falling weight) shall be used. Minimum sample dimensions shall be 1.5 by 1.5 in. Samples shall be tested with the normally exposed surface facing up. Backed siding shall be tested with any backing material removed. Conditioning time for quality-control tests shall be at least 1 h.

6.8.1 For purposes of evaluating failure of the specimen under section 3.2.1 of Test Method D4226, a ductile tear of less than 0.2 in. (5 mm) in length shall not be considered a failure. Any brittle break of any dimensions is considered a failure.

6.9 *Coefficient of Linear Expansion*—Conduct this test in accordance with Test Method D696.

6.10 *Weatherability:*

6.10.1 A minimum of three samples shall be exposed at each of at least three test sites. Test sites shall be located in a northern temperate climate, represented by Cleveland, Ohio or Louisville, Kentucky; a hot, humid climate represented by Miami, Florida; and a hot, dry climate represented by Phoenix, Arizona. The samples shall be exposed for a minimum of 24 months.

6.10.2 Samples shall consist of a flat section of siding with minimum dimensions of 2 in. by 3 ¾ in. (25 mm by 95 mm).

6.10.3 Samples shall be representative of the product to be evaluated.

NOTE 9—Samples prepared in the laboratory in the same manner as commercial samples are permitted to be used as an alternative to a commercial part. If the commercial product is extruded, the laboratory specimen must be extruded; if the commercial product is injection molded, the laboratory specimen must be injection molded, and so forth.

6.10.4 Select a minimum of 4 specimens per sample per test site to allow for 3 test specimens and 1 file specimen for each sample evaluated.

6.10.5 Mark each specimen permanently to ensure retention of identity during and after exposure testing.

NOTE 10—Use of a vibratool leaves a permanent mark that satisfies this criterion.

6.10.6 All exposures shall be conducted at an angle of 45° South, plywood backed, in accordance with Practice D1435 and G147.

6.10.7 After a minimum of 24 months of exposure, remove the samples and inspect each exposed test specimen for appearance and surface condition. Record observations and inspection date in a permanent record.

6.11 *Gloss:*

6.11.1 *Apparatus*—Measure gloss using a 75° geometry glossmeter that meets the requirements of the Apparatus section of Test Method D2457.

6.11.2 *Procedure:*

6.11.2.1 Gloss measurements shall be made in accordance with the procedure in Section 9 of Test Method D2457, unless otherwise specified herein.

6.11.2.2 Measure gloss on one piece of siding on at least three widely separated sections across the width of the exposed surface of the panel. At least one reading shall be taken on each face of the panel. Use new surface area for each reading to avoid scratches caused by instrument contact. The area tested must be flat. If a flat area on the exposed surface cannot be found due to the style or depth of embossing of the panel being tested, then a non-exposed area of the panel shall be chosen in its place. Such locations shall be representative of the gloss of the area that will be exposed after installation.

6.11.2.3 Measure gloss parallel to the direction of embossing. When the embossing pattern is not apparent, measure the gloss in the direction of extrusion.

6.11.2.4 Each reading shall be within the appropriate limit specified in 5.1.7.

6.11.2.5 The average reading of all readings shall be used to represent the gloss of the sample.

6.12 *Surface Distortion:*

6.12.1 *Test Specimen/Apparatus:*

6.12.1.1 The test specimen shall consist of three courses of backed vinyl siding, a minimum of 6 ft (1.83 m) in length, mounted on a flat rigid frame in accordance with the manufacturer's recommended installation instructions.

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(1) Horizontal Siding—The middle course shall consist of two lengths of backed vinyl siding, both with a factory-fabricated end, one section overlapping the other section. The end of the overlapping section shall be located not less than 3 in. (76 mm) and not more than 6 in. (152 mm) from the center of the course. Unless specified otherwise by the manufacturer's installation instructions, the insulation of the two lengths of backed vinyl siding shall be butted firmly together.

(2) Vertical Siding—The middle course shall consist of a single, uninterrupted backed vinyl siding panel, without overlap.

6.12.1.2 A thermocouple or other heat-sensing element shall be located at the horizontal midpoint of the backside of the middle course of backed vinyl siding. The heat-sensing element shall be in contact with the back of the vinyl cladding. Any backing material removed to facilitate placement of the heat sensing element shall be replaced.

6.12.1.3 *Radiant-Heat Rod,* 600 W for each linear foot (0.31 m), mounted parallel to the middle course and approximately 32 in. (810 mm) away from the surface of the backed vinyl siding.

6.12.1.4 *Temperature-Control Device,* used to regulate the temperature of the radiant-heat rod, shall be able to maintain the conditions specified in 6.12.2.1.

6.12.1.5 *Gap Measurement Device*—A cylindrical pin gauge, ¼ ± 0.005 in. (6 ± 0.127 mm) in diameter is used to evaluate the size of any gap in the overlapped sections of horizontal backed vinyl siding during the heating period. The pin gauge is attached to a rod such that the gauge can be inserted into a gap while held parallel to the plane of the backed vinyl siding. The rod shall be sufficiently long to permit insertion of the gauge from beyond the edge to the test frame, not interfere with the exposure of the sample to radiant heat, and otherwise not interfere with conduct of the test.

6.12.2 *Procedure:*

6.12.2.1 Heat the test panel (middle course of backed vinyl siding) at a rate of 3.0 to 6.0°F/min (1.7 to 3.3°C/min) until a minimum temperature of 150°F (66°C) is achieved as measured by the heat-sensing element on the midpoint of the backside of the middle course. For temperatures equal to or greater than 130°F (54°C), the rate of heating is permitted to be not less than 2.0°F/min (1.1°C/min), provided that the average heating rate from the ambient temperature to 150°F (66°C) is within 3.0 to 6.0°F/min (1.7 to 3.3°C/min). When a temperature of 150°F (66°C) is attained, shut off the heat source.

6.12.2.2 During this heating period, observe the middle course of the backed vinyl siding for surface distortion and observe for any opening or gap at the end of the overlapped section. If the overlap appears to have opened to approximately ¼ in. (6 mm), attempt to insert the gap measurement device into the opening. If the device can be inserted in to the opening to any depth at any location along the overlap, the opening shall be considered to be at least ¼ in. (6 mm).

6.12.2.3 Failure is defined as:

(1) the appearance of bulges, waves, or ripples on any surface of the middle course of the backed vinyl siding;

(2) occurrence of a gap or opening ¼ in. (6 mm) or greater at any point along the end of the overlapped section, as determined by use of the gap measurement device, at any time or before a temperature of 150°F (66°C) is reached.

6.13 *Color Uniformity*—Calculate the difference between the L_H, a_H, and b_H color coordinates for a production specimen to those of either the appropriate reference specimen or the agreed upon color coordinates for that specific color product in accordance with Test Method D2244. Calculate the total difference ΔE between the production specimen and the reference specimen in accordance with Test Method D2244.

6.14 *Wind Load Resistance*—Conduct the test on wind load resistance of finished siding in accordance with Test Method D5206. The average maximum sustained static test pressure determined from this testing is used in 5.2.2. For purposes of determining compliance with the minimum test pressure and standard design pressure requirements in 5.2.2, the test structure shall be constructed with vertical studs 16 in. on center. The siding shall be tested with the foam plastic backing attached to the vinyl siding. The siding in the test installation shall be installed over wood sheathing with a nominal thickness of 7/16 to ½ in., and fastened as follows:

6.14.1 *Fastener type*—Roofing nail, smooth shank, 0.120 in. (⅛ in. nominal; 3.2 mm) shank diameter, 5/16 in. (7.9 mm) head diameter, length as necessary to penetrate into sheathing and stud a total of 1 ¼ in. (32 mm). For vertical siding, length as necessary to penetrate the thickness of the sheathing plus ¼ in. (6.4 mm).

6.14.2 *Fastener Spacing*—Every 16 in. (406 mm) into center of stud for horizontal siding. For vertical siding, every 12 in. into sheathing only.

6.14.3 Fasteners shall not be driven tightly against the siding. Allow approximately 1/32 in. (0.8 mm) clearance between the fastener head and siding surface.

NOTE 11—The installation details described 6.14 conform to the minimum requirements of the 2015 International Residential Code and the VSI Vinyl Siding Installation Manual.

6.15 *Nail Slot Allowance for Thermal Expansion*—As an alternative to conformance with the nail slot width specification in 5.2.3.1 or 5.2.3.2, provision for thermal expansion and contraction shall be demonstrated through the following test procedure.

6.15.1 *Samples*—At least 3 samples of each profile in which the siding is produced shall be provided. The length of each sample shall be at least 50 % of the longest length in which the profile is produced, and not shorter than 12 ft (3658 mm).

6.15.2 *Test Chamber*—The test chamber shall consist of an environmentally controlled room or compartment capable of providing an air temperature range of at least 0°F to 100°F (-18°C to 38°C) without exposure of the panel to radiant energy from heating or cooling elements. Air temperature shall be controlled such that a rate of temperature change of 2°F (1.11°C) per minute can be achieved over the full temperature range, and the minimum and maximum temperatures can be maintained for at least 15 minutes. Means for circulating air to provide a uniform air temperature throughout the chamber shall be provided. A vertical wall shall be provided for mounting of samples. The wall shall be insulated such that, with no panels mounted, the inner surface of the wall does not

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deviate more than 10°F (5.5°C) from the air temperature at the high and low temperature extremes after a holding period of 5 minutes. The test chamber shall be of sufficient size to accommodate the longest panel to be tested, including expected thermal expansion of the panel. Means shall be provided to measure the actual temperature of the surface of each panel at a minimum of 3 evenly-spaced locations along the length of the panel.

6.15.3 *Length Measurement*—A means for measuring the length of each sample throughout the temperature range shall be provided. The method utilized for length measurement shall not be influenced by the temperature of the chamber and shall have a minimum resolution of no greater than 0.0625 in. (1.59 mm).

6.15.4 *Procedure*—Install the sample panels on the wall inside the test chamber, following the manufacturer's instructions for fastener type, spacing, location and tightness. At ambient temperature measure and record the length of each panel and the temperature of the panel, averaged from a minimum of 3 locations along the length of the panel.

6.15.4.1 *Test Cycle*—Test cycles shall be performed by raising the air temperature to 100°F ± 5°F (38°C ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding the air temperature at 100°F (38°C ± 2.75°C) for 15 minutes, lowering the air temperature to 0°F ± 5°F (-18°C ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding at 0 °F (-18°C ± 2.75°C) for 15 minutes, and returning to ambient temperature at an average rate of 2 °F per minute.

6.15.4.2 *Conditioning*—Close the test chamber and perform at least 2 conditioning cycles using the procedure in 6.15.1. No interruption is required between conditioning cycles.

6.15.4.3 *Test*—Following completion of the conditioning cycles, conduct 3 test cycles using the procedure in 6.15.4.1. It is acceptable for the test cycles to follow immediately upon completion of the final conditioning cycle, and no interruption is required between test cycles. After a minimum holding period of 15 minutes at the high and low extremes of each test cycle, measure and record the length of each panel and the temperature of the panel, averaged from a minimum of 3 locations along the length of the panel.

6.15.5 *Normalization*—From among the length measurements recorded for all three cycles, identify the shortest and longest length of each panel, and the average panel temperature at the time that length was recorded. Determine the maximum difference in length, ΔL, and the maximum difference in temperature, ΔT, by subtracting the smaller from the larger. Normalize the change in length to the full length of the panel over a 100 °F (38 °C) temperature range using the following formula:

$$E_t = \Delta L \times (100/\Delta T) \times (L_f/L_t) \quad (2)$$

E_t = total thermal expansion and contraction of a full length panel over a range of 100°F (38°C),
ΔL = maximum change in length of the tested panel,
ΔT = maximum change in temperature of the tested panel,
L_f = longest length in which the panel is produced, and
L_t = actual length of the panel as tested.

6.15.6 *Acceptable Performance*—When tested according to this procedure, the result of $(E_t \times 2) + 0.25$ in. for each of the 3 samples for each profile shall not be greater than the width of the nail slot. If the manufacturer's installation instructions require the panel to be center-pinned, the result of $E_t + 0.25$ in. for each of the 3 samples for each profile shall not be greater than the width of the nail slot.

6.16 *Lead Content:*

6.16.1 Testing for lead content shall be conducted on backed vinyl siding using a rhodizinate-type lead swab test kit conforming to Practice E1753. Testing shall be performed in accordance with the test kit manufacturer's instructions. The backed vinyl siding shall be deemed to comply with 4.7 if the test shows a negative or not-detected result; that is, the test does not indicate the presence of lead. The test shall be conducted separately on the substrate and on any cap or film material.

6.16.2 As an alternative to the method in 6.16.1, and as a means of resolving any ambiguous results from that method, an analytical method capable of detecting lead at least as low as 0.02 percent by sample weight shall be employed. Under this alternative, neither the substrate nor any cap or film shall contain a concentration of lead in excess of 0.02 percent by weight.

6.17 *Flame Spread*—Conduct the test on flame spread of finished backed vinyl siding in accordance with Test Method E84. The test specimen shall either be self-supporting by its own structural characteristics or held in place by added supports along the test specimen surface, or secured from the back side.

7. Packaging and Package Marking

7.1 The siding shall be packed in such a manner as to provide reasonable protection against damage in ordinary handling, transportation, and storage.

7.2 Provisions of Practice D3892 shall apply to this specification.

7.3 To aid identification of siding conforming to all requirements of this specification, producers and distributors shall include a statement of compliance in conjunction with their name and address on product labels, invoices, sales literature, and the like. The following statement is suggested when sufficient space is available:

This PVC siding conforms to all the requirements established in ASTM Specification D7445, developed cooperatively with the industry and published by ASTM.

Full responsibility for the conformance of this product to the specification is assumed by (name and address of producer or distributor).

7.4 The following abbreviated statement is suggested when available space on labels is insufficient for the full statement: Conforms to ASTM Specification D7445 (name and address of producer or distributor).

7.5 The standard wind load design pressure rating determined in accordance with 5.2.2.2 shall be stated on the product or on the product package by one of the means in 7.5.1 or 7.5.2.

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7.5.1 The package shall be marked or labeled with the standard wind load design pressure rating. The marking shall be in the format "Standard Wind Load Design Pressure Rating: ##.# psf (ASD)".

7.5.2 The standard design pressure rating shall be included on a line imprint or other marking on the front (outward-facing) surface of all siding panels. It is not required that the marking be visible after installation, provided that the marking can be revealed and read by detaching the lower edge lock of an adjacent course, without removal of any fasteners. The standard design pressure marking shall be stated at least once per panel. The marking shall be in the format "Std Design Pressure Rating: ##.# psf (ASD)".

7.5.3 At the option of the manufacturer, additional marking or labeling of the package or product with alternative wind load design pressure ratings determined in accordance with 5.2.2.3 for use with alternative sheathings, wall configurations or fastening methods is permitted. The marking shall use the format specified in 7.5, shall indicate the type of sheathing or wall configuration for which it is applicable, and shall refer to the manufacturer's instructions for more information and any installation requirements.

8. Keywords

8.1 plastic building products; plastic weatherability; recycled plastic; rigid PVC siding; specification

ANNEX

(Mandatory Information)

A1. WIND LOAD RESISTANCE TEST DESIGN FACTORS

A1.1 *Wind Load Criteria:*

A1.1.1 ASCE 7-10 is the basis for determining the design pressures used in this specification. Design wind loads are determined on an ASD basis in this specification.

NOTE A1.1—In previous editions of ASCE 7, wind loads were determined using wind speed maps based on a 50-year return period. In ASCE 7-10, maps based on a 700-year return period are used which, for any given location, produce a wind speed approximately 30 % greater than that of the previous maps. This larger magnitude (higher return period) wind speed, referred to as the ultimate wind speed, (V_{ULT}), is used directly (with a load factor of 1.0) to determine nominal wind loads on a Strength Design (LRFD) or "ultimate" wind load basis. When Allowable Stress Design (ASD) is used, ASCE 7-10 provides for these ultimate wind loads, determined from the ultimate wind speed map velocities, to be multiplied by a load factor of 0.6. Alternatively, the adjustment can be made directly to the wind velocity, which is the approach taken in this method (see A1.1.2). This procedure produces results consistent with past ASD wind loads.

A1.1.2 It is necessary to determine whether the wind velocity to be used is based on the maps in ASCE 7-10 or on older maps designed for direct application of ASD. Wind velocity, V, based on ASD is used in this method. Wind speeds determined using the maps in ASCE7-10, referred to as V_{ULT}, are converted to ASD wind speeds, V_{ASD}, by multiplying by the square root of 0.6. Wind speeds based on maps using an ASD basis do not require conversion (see A1.3). Thus:

$$V = V_{ASD} = V_{ULT} \times \sqrt{0.6} \quad \text{(A1.1)}$$

The V determined in this section is used in the following calculations.

A1.1.3 The velocity pressures, q, used in this specification have been computed using the following equation:

$$q = 0.00256\, K_z K_d V^2 I\,(\,lb/sq\,ft\,) = 0.613\, K_z\, K_d\, V^2 I\,(N/m^2) \quad \text{(A1.2)}$$

V = wind velocity, mph (km/h). The basic wind speed corresponds to a 3-s gust speed at 33 ft (10.1 m) above ground in exposure category C, as described in ASCE 7-10. A velocity of $V = V_{ASD}$ = 110 mph (177 km/h) was used in this specification. (See Note A1.2and Note A1.3.)

I = "importance factor" as described in editions of ASCE 7 prior to ASCE 7-10. A value of 1.0 is used. This factor is not used where the wind speed has been determined from a map in ASCE 7-10. (See Note A1.4.)

K_z = "velocity pressure coefficient" as described in ASCE 7-10. A "K_z" of 0.70 was used in the wind pressure calculations, which is the value from ASCE 7-10 for a mean roof height of 30 ft (9.1 m) above ground level and Exposure Category B.

K_d = "wind directionality factor" as described in ASCE 7-10. A "K_d" of 0.85 is used.

A1.1.4 Thus, for the given velocity and factors, the velocity pressure = 18.43 lbf/ft^2 (882 Pa).

NOTE A1.2—As explained in Note A1.1, the wind velocity used in this method is converted from the V_{ULT} given by wind speed maps in ASCE 7-10 to V_{ASD} using the equation in A1.1.2. A V_{ULT} wind speed of approximately 140 mph from the maps is equivalent to a V_{ASD} of 110 mph, which is the velocity V used in this specification.

NOTE A1.3—In ASCE 7-10 the default wind speeds are given for exposure category C, and a table is provided to adjust this wind speed for other exposure categories. Since most backed vinyl siding is installed on buildings located in exposure category B, the velocity pressure coefficient, K_z is included in the equation to make this adjustment.

NOTE A1.4—Editions of ASCE 7 prior to ASCE 7-10 included an importance factor to represent the relative significance of the building and the consequences of its loss. Because most backed vinyl siding is installed on residential and light commercial buildings, the importance factor was set at 1.0 by default. ASCE 7-10 has removed the importance factor from the velocity pressure equation, and instead provides a different wind speed map for each of the building importance categories (referred to as risk categories in ASCE 7-10). Thus the importance factor will already have been incorporated into the wind speed determined from the appropriate

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map, and the importance factor is not used for determining velocity pressure using wind speeds from ASCE 7-10 maps.

A1.1.5 ASCE 7-10 recommends various internal and external pressure coefficients, which include gust response factors. These coefficients vary with the effective area of the cladding component, the location of the cladding component relative to building corners, and the configuration of the building (open versus enclosed). The internal and external pressure coefficients are taken from Table 26.11-1 and Figure 30.4-1 of ASCE 7-10. The effective area is taken as 10 square ft (the area of one piece of siding), an enclosed building is assumed, and factors for the building corners are used. The pressure coefficients are as follows:

$$\textit{Internal Pressure Coefficient} = \pm 0.18 \quad \text{(A1.3)}$$

$$\textit{External Pressure Coefficient} = +1.00 \textit{ and } -1.40$$

The design pressure is calculated by multiplying the velocity pressures by the algebraic sum of the internal and external pressure coefficients.

A1.2 *Design Pressure:*

NOTE A1.5—Because the wind velocity has already been adjusted from an ultimate basis to an ASD basis at the beginning of these calculations, the design pressure determined in this step is an ASD load. This correlates to the design pressure requirements stated in tables in the 2015 International Residential Code and other codes which have also been adjusted to an ASD basis. However, the required design pressures in some other codes and design standards have not been adjusted to an ASD basis. Where required design pressures are based on ultimate wind loads determined from ASCE 7-10 wind speeds, those loads must be multiplied by 0.60 to match the design pressure determined from this equation.

$$\textit{Positive Design Pressure} = (18.43)(1.00+0.18) = 21.74\ \textit{psf} \quad \text{(A1.4)}$$

$$\textit{Negative Design Pressure} = (18.43)(-1.40-0.18) = -29.12\ \textit{psf}$$

A1.2.1 The negative values (suction loads) are the largest in magnitude and are the design values used in this specification. Research conducted by various organizations[8,9] has shown that a certain amount of pressure equalization occurs through residential siding products installed with sheathing under high dynamic pressures. In light of this pressure equalization, the design pressure in the ASCE 7-10 wind load standards is reduced by a factor of 0.5 for backed siding.

A1.2.2 Therefore, the required test pressures are calculated as follows:

$$P_t = D_P \times PEF \times 1.5 \quad \text{(A1.5)}$$

where:

P_t = test pressure, lbf/ft^2 (Pa),
D_P = design pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, backed siding, 0.5, and
1.5 = safety factor.

A1.2.2.1 If documentation in support of the use of compensation for pressure equalization other than 0.5 is provided, use the calculation in A1.2.2, substituting the appropriate pressure equalization factor.

A1.2.3 Using the above equations, in a 110 mph (177 km/h) (V_{ASD}) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, the required minimum uniform load test pressure for backed siding is 21.84 lbf/ft^2 (1046 Pa).

A1.2.3.1 For compliance with 5.2.2, the referenced design pressure has been rounded to -30.0 lbf/ft^2 (1436 Pa) to match the standard design conditions specified by the 2015 International Residential Code. When tested under Test Method D5206, the siding must attain an average maximum sustained static test pressure equal to or greater than the corresponding minimum test pressure of 22.5 lb/ft^2 (1077 Pa).

A1.2.4 For applications where the effective design pressure is greater than -30.0 lbf/ft^2 (1436 Pa) (for example, wind zone areas greater than 110 mph (177 km/h) (V_{ASD}), mean roof height over 30 ft (9.1 m), or exposure conditions other than Exposure B), refer to ASCE 7-10 for the effective design pressure. To be shown to be suitable for the application, when tested under Test Method D5206 the siding must attain an average maximum sustained static test pressure equal to or greater than the minimum test pressure determined by the formula in A1.2.2, using the design pressure, D_P, determined for the application using the procedure in A1.1.2 through A1.2.

A1.2.5 These loading conditions apply only to siding installed without an air space directly over sheathing of a type and fastening method that is capable of independently resisting both positive and negative wind design pressures at the building location. Examples of such sheathing include oriented strand board (OSB) and plywood fastened to resist the design wind pressures. For applications where the siding is installed over open studding, without sheathing, rapid pressure equalization does not occur. In these applications, the load the siding will see is equal to the total design pressure and the pressure equalization factor (PEF) is set to 1.0. The static test pressure required for products used under these conditions is as follows:

$$P_t = D_P \times PEF \times 1.5 \quad \text{(A1.6)}$$

where:

P_t = static test pressure, lbf/ft^2 (Pa),
D_P = design pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, 1.0, and
1.5 = safety factor.

A1.2.5.1 Therefore in a 110 mph (177 km/h) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, siding installed without sheathing would require a uniform load test pressure of 43.72 lbf/ft^2 (2093 Pa).

NOTE A1.6—Building codes and backed vinyl siding installation instructions require backed vinyl siding to be installed over sheathing, so calculation of minimum test pressure for siding installed without sheathing is essentially moot. However, the calculation has been retained for completeness and comparison with other installation conditions.

A1.2.6 When siding is installed over sheathing that is not capable of independently resisting both positive and negative

[8] Vinyl Siding Pressure Equalization Factor, Architectural Testing, Inc. Report No. 01–40776.01, September 2002.

[9] Morrison M.J., Cope A.D. "Wind Performance and Evaluation Methods of Multi-Layered Wall Assemblies." Structures Congress, 2735-2748, Portland, OR, 2015.

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wind pressures occurring under design conditions at the building location, a greater percentage of the total wind pressure is transferred to the siding and its fasteners. This has the effect of partially or completely countering the effect of the pressure equalization factor. In these cases a value between 0.5 and 1.0 is used for the pressure equalization factor (PEF).

A1.2.6.1 In addition, in cases where failure of the siding would result in failure of the exterior wall covering assembly (that is, siding and sheathing) a safety factor of greater than 1.5 is indicated.

A1.2.6.2 If the adjusted PEF for a given combination of siding and sheathing is known, and an appropriate safety factor is used, a minimum test pressure can be determined using the equation in A1.2.1. However, it is normally more appropriate to make an adjustment for alternative sheathings when determining the design pressure rating, as discussed in A1.3.

NOTE A1.7—Where the sheathing is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, the layer of siding over the sheathing, and its fastening through the sheathing, act to reinforce the sheathing such that the whole wall covering (siding-sheathing) assembly is capable of resisting such wind pressures. Because siding is tested by itself (not as part of a siding-sheathing assembly) in Test Method D5206, the adjustment of test pressure (before the test) or of the design pressure (after the test) ensures that the wind load resistance of the assembly as a whole is reflected in the rating of the siding.

NOTE A1.8—In some high wind hazard regions, such as south Florida, the exterior wall covering assembly may also be required to meet wind-borne debris impact resistance criteria which would affect the choice of sheathing material to be used together with siding. Such considerations are beyond the scope of this standard.

A1.3 *Wind Design Pressure Rating (Maximum Allowable Pressure):*

A1.3.1 A design pressure rating is the maximum wind pressure that a particular backed vinyl siding product is rated to be able to withstand. It is used in building design and building codes to determine the acceptability of a siding product for use under the design wind conditions for a specific application. To be acceptable, a siding's design pressure rating must be equal to or greater than the design pressure for the specific building at the specific location. The design pressure rating is determined from the average maximum sustained static test pressure for a siding product produced by testing under Test Method D5206, the pressure equalization factor, and a safety factor.

A1.3.2 *Standard Design Pressure Rating*—The standard design pressure rating is used for applications where the siding is installed over a sheathing type and fastening method that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location.

A1.3.2.1 The standard design pressure rating assumes that the siding is fastened to the building in the standard manner, with the minimum fastener type, size, spacing, and penetration depth prescribed in Chapter 7 of the International Residential Code and the VSI Vinyl Siding Installation Manual. The installation of the siding for testing under Test Method D5206 must be consistent with these minimum fastening requirements. However, this does not prevent additional testing, using different fastening, to support design pressure ratings for other applications, such as special high wind installations.

A1.3.2.2 The pressure equalization factor and safety factor are the same as those used to determine the test pressure in A1.2.1, using the following equation:

$$D_{Rstd} = \frac{P_m}{(PEF \times SF)} \quad (0)$$

where:

D_{Rstd} = standard design pressure rating, lbf/ft^2 (Pa),
P_m = average maximum sustained static test pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, 0.5, and
SF = safety factor, 1.5.

A1.3.3 *Alternative Design Pressure Ratings*—Design pressure ratings for applications other than the standard conditions described above can be developed. Common circumstances where this is done include the use of alternative fastening methods in order to achieve a higher design pressure rating, and cases where the sheathing is not capable of independently resisting wind pressures under design conditions, which necessitates a reduction in the siding's design pressure rating.

A1.3.3.1 *Alternative Fastening*—Where an alternative fastening method is specified by the manufacturer, the siding is permitted to be tested under Test Method D5206 using the specified fastening. The resulting average maximum sustained static test pressure is used in the above equation to determine the alternative design pressure rating. In order for this alternative rating to be realized, the siding must be installed using the alternative method, and the rating must be clearly tied to installation requirements in manufacturer's literature and instructions.

A1.3.3.2 *Alternative Sheathing*—An adjusted design pressure rating for use of the siding over sheathings not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, as discussed in A1.2.6, can be calculated using the above equation if the appropriate PEF and safety factor are specified.

A1.3.3.3 Alternative PEF and safety factor values have been documented (see 2009 and 2012 International Residential Code, section R703.11.2) for one type of sheathing, foam plastic insulating sheathing complying with ANSI/SBCA FS 100. Two wall assembly cases are considered: 1) where the interior surface of the wall is covered with gypsum wall board or equivalent; and 2) where the interior surface of the wall is not covered with gypsum wall board or equivalent. In both cases the siding is installed directly over foam sheathing, which is then attached directly to framing, without intervening sheathing. The PEF and safety factor for each case are as follows:

Case	PEF	Safety Factor
Case 1	0.7	2.0
Case 2	1.0	2.0

A1.3.3.4 Adjustment of the standard design pressure rating is not necessary when foam plastic insulating sheathing is installed directly over sheathing that is capable of independently resisting both positive and negative wind pressures

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occurring under design conditions at the building location, or where the sheathing is fastened in a way that allows it to independently resist the design wind pressure. For such cases the standard design pressure rating is applied.

A1.4 *Design Wind Speeds:*

A1.4.1 The wind velocity maps in ASCE 7-10 provide one source of design wind pressures for particular geographic regions. The velocities on these maps are stated in terms of "ultimate", 700-year return interval speeds. To be used in the procedure in this Annex, those velocities need to be converted to the ASD equivalent in accordance with A1.1.2, and the resulting velocity *V* used in the equation in A1.1.3. The 2012 and 2015 International Building Code and 2015 International Residential Code also contain maps based on ultimate wind speeds.

A1.4.2 Other maps are available that do not require conversion of wind velocities. Examples include the wind map in the 2012 International Residential Code, on which the velocities have already been converted from those on the ASCE 7-10 maps. Maps from previous editions of ASCE 7 used ASD velocities and do not require conversion. However, only editions since 1995 used the 3-second gust basis that is used in this annex. The 1998, 2002, and 2005 editions of ASCE 7 continued the use of 3-second gust wind basis, but with improved hazard modeling of hurricane wind speeds first made in the 1998 edition. These previous editions also do not have the benefit of further improved hurricane hazard modeling that was incorporated into the maps used in ASCE 7-10.

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SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D7445–18) that may impact the use of this standard. (X 1, 2024)

(1) Revised 1.1.

(2) Added 5.2.4 and 6.17.

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Add new definition:

Backed Vinyl Siding. A cladding product with a manufacturer-installed foam plastic backing material as an integral part. Where used as insulation, refer to *insulated vinyl siding*.

[Add new subsection]

1404.9.1 Insulated vinyl siding, backed vinyl siding.

Insulated vinyl siding and *backed vinyl siding* shall be certified and labeled by an approved agency as conforming to ASTM D7793 and D7445 requirements, respectively.

[Modify as follows]

[BS] 1405.14 Vinyl siding, insulated vinyl siding**, and backed vinyl siding.**

Vinyl siding, insulated vinyl siding, and *backed vinyl siding* conforming to the requirements of this section and complying with ASTM D3679, ASTM D3793, and D7445, respectively, shall be permitted on exterior walls where the design wind pressure determined in accordance with Section 1609 does not exceed 30 pounds per square foot (1.44 kN/m^2). Where the design wind pressure exceeds 30 pounds per square foot (1.44 kN/m^2), tests or calculations indicating compliance with Chapter 16 shall be submitted. Vinyl siding shall be secured to the building so as to provide weather protection for the exterior walls of the building.

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This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: D7793 – 20

Standard Specification for Insulated Vinyl Siding[1]

This standard is issued under the fixed designation D7793; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification establishes requirements for insulated vinyl siding, which is vinyl siding with integral foam plastic insulating material, where the vinyl siding is manufactured from rigid PVC compound. Compliance with this standard requires insulated vinyl siding to demonstrate a thermal insulation value of R-2.0 or greater. Other performance requirements and test methods addressed by this standard include materials properties and dimensions, warp, shrinkage, impact strength, expansion, appearance, thermal distortion resistance, flame spread, and windload resistance. Methods of indicating compliance with this specification are also provided.

NOTE 1—Insulated vinyl siding is composed of two major components: the vinyl siding and the insulating material. It is intended that the vinyl siding portion comply with Specification D3679. Applicable portions of Specification D3679 are included in this specification. Additional requirements that pertain only to the insulation as a separate material, or to the combination of vinyl siding and insulation as a whole, are also included. For further explanation, see Appendix X1.

1.2 Insulated vinyl siding shall be tested with the insulation material in place or removed, as specified in the applicable requirement or test method.

1.3 The use of PVC recycled plastic in this product shall be in accordance with the requirements in Section 4.

1.4 Insulated vinyl siding produced to this specification shall be installed in accordance with Practice D4756. Reference shall also be made to the manufacturer's installation instructions for the specific product to be installed.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 2—There is no known ISO equivalent to this standard.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C297/C297M Test Method for Flatwise Tensile Strength of Sandwich Constructions

C578 Specification for Rigid, Cellular Polystyrene Thermal Insulation

C591 Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

C1199 Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods

C1289 Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

C1363 Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus

D618 Practice for Conditioning Plastics for Testing

D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer

D1042 Test Method for Linear Dimensional Changes of Plastics Caused by Exposure to Heat and Moisture

D1183 Practices for Resistance of Adhesives to Cyclic Laboratory Aging Conditions

D1435 Practice for Outdoor Weathering of Plastics

D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

D2457 Test Method for Specular Gloss of Plastic Films and Solid Plastics

[1] This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.24 on Plastic Building Products.

Current edition approved . Published December 2020. Originally approved in 2012. Last previous edition approved in 2017 as D7793 – 17. DOI:10.1520/D7793-20.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

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D3679 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding
D3892 Practice for Packaging/Packing of Plastics
D4226 Test Methods for Impact Resistance of Rigid Poly-(Vinyl Chloride) (PVC) Building Products
D4756 Practice for Installation of Rigid Poly(Vinyl Chloride) (PVC) Siding and Soffit
D5206 Test Method for Windload Resistance of Rigid Plastic Siding
D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens
D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)[3]
D7445 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding with Foam Plastic Backing (Backed Vinyl Siding)
E84 Test Method for Surface Burning Characteristics of Building Materials
E1753 Practice for Use of Qualitative Chemical Spot Test Kits for Detection of Lead in Dry Paint Films
G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

2.2 *American Society of Civil Engineers (ASCE):*[4]
ASCE 7-10 Minimum Design Loads for Buildings and Other Structures

2.3 *International Code Council*
International Building Code
International Residential Code

2.4 *International Code Council–Evaluation Services (ICC-ES):*
AC05 Acceptance Criteria for Sandwich Panel Adhesives

2.5 *International Standards Organization (ISO):*
ISO/IEC Guide 65 General requirements for bodies operating product certification systems

2.6 *Structural Building Components Association:*
ANSI/SBCA FS 100-2012 Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies

2.7 *Vinyl Siding Institute, Inc.*
VSI Vinyl Siding Installation Manual (2015)

2.8 *Federal Standards:*
16 CFR Part 460 Labeling and Advertising of Home Insulation

3. Terminology

3.1 *Definitions:*

3.1.1 *center-pinning*—an installation technique in which the siding panel is fastened tightly through the nail slot at the center length of the panel, in order to cause thermal expansion and contraction to occur equally in both directions from the center.

3.1.2 *cohesive failure*—in the context of tensile testing, internal separation of the adhesive within the adhesive layer, resulting in attachment of adhesive material to the surface of both substrates

3.1.3 *insulation; insulating material*—foam plastic material that is combined at the factory with a vinyl siding profile to form insulated vinyl siding.

3.1.4 *insulated vinyl siding*—a vinyl cladding product sold with manufacturer-installed foam plastic insulating material as an integral part of the cladding product. The vinyl cladding portion of insulated vinyl siding meets the definition of vinyl siding.

3.1.5 *nominal*—the value that a manufacturer consistently uses to represent a specific property or dimension of a vinyl siding product in public claims including, but not limited to, product literature, advertisements, quotations, and certificates of conformance.

3.1.6 *process average thickness*—the rolling, arithmetic mean of average specimen thicknesses measured in accordance with 6.5 for a specific product during all productions runs for the most recent six-month period.

3.1.7 *vertical coverage*—The net vertical distance of the wall covered by a single insulated vinyl siding panel, disregarding any portions of the panel that are overlapped by adjacent panels above or below.

3.1.8 *temperate northern climate*—in weather testing, a North American metropolitan area testing site located within 73 to 100°W longitude and 37 to 45°N latitude.

3.1.9 *vinyl siding*—a shaped material, made principally from rigid poly(vinyl chloride) (PVC), that is used to clad exterior walls of buildings. In this standard, vinyl siding refers to the rigid profile to which the insulation is attached.

3.1.10 *wind load design pressure rating*—the maximum wind pressure that an insulated vinyl siding product is rated to withstand, based on testing under Test Method D5206.

3.1.10.1 *standard wind load design pressure rating*—the wind load design pressure rating for a siding product when installed 1) over a sheathing material designed and attached such that it is capable of resisting 100% of positive and negative wind pressures occurring under design conditions at the building location; and 2) with the standard fastening method specified in building codes, general installation instructions, and the siding manufacturer's instructions.

3.1.10.2 *alternative wind load design pressure rating*—the wind load design pressure rating for a siding product when installed over a sheathing not designed and attached such that it is capable of resisting 100% of positive and negative wind pressures occurring under design conditions at the building location, or when the siding is not fastened in the standard way; as specified by the manufacturer.

3.1.10.3 *Discussion*—The standard test conditions, configuration, and fastening method used in this specification are specified in 6.14, while alternative sheathing and installation conditions are specified by the manufacturer and must be reflected in the product's installation instructions. Alternative

[3] The last approved version of this historical standard is referenced on www.astm.org.
[4] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.

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ratings apply only when the specified sheathing and fastening conditions are used. See Annex A1 for information on differences between the standard wind load design pressure rating and alternative wind load design pressure ratings, and how to determine standard and alternative design pressure ratings.

4. Materials and Manufacture

4.1 *Vinyl Siding:*

4.1.1 The vinyl siding, exclusive of foam plastic insulating material, shall be made of one or more layers of poly(vinyl chloride) (PVC) compound. Any layers of materials other than poly (vinyl chloride) (PVC) compound shall be kept to less than 20 % by volume. This limitation does not apply to the insulation material.

4.1.2 Where rigid PVC recycled plastic as defined in Guide D7209 is used, the vinyl siding containing the PVC recycled plastic shall meet all of the requirements of Sections 3, 4, and 5.

4.1.3 The vinyl siding material, exclusive of insulation material, when tested in accordance with Test Method D635, shall not exceed an average extent of burn of 4 in. (100 mm), with an average time of burn not to exceed 10 seconds. A minimum sample thickness of 0.035 in. (0.9 mm) is required. (**Warning—**The flammability testing data, conclusions, and recommendations of Test Method D635 relate solely to the measurement and description of properties for classification of the vinyl siding material in response to flame under controlled laboratory conditions and shall not be used for the description or appraisal of the fire hazard of vinyl siding under actual fire conditions.)

4.2 *Foam Plastic Insulation:*

4.2.1 The foam plastic insulation shall be made of one of the following materials:

4.2.1.1 Expanded polystyrene complying with Specification C578.

4.2.1.2 Extruded polystyrene complying with Specification C578

4.2.1.3 Polyisocyanurate complying with Specification C591 or Specification C1289

4.2.2 The foam plastic insulation shall have a Flame Spread Index not greater than 75 and a Smoke Developed Index not greater than 450 when tested separately under Test Method E84.

4.3 *Adhesives:*

4.3.1 The suitability for outdoor use of an adhesive used to bond the vinyl siding and the insulation, if any, shall be determined by the following procedure.

4.3.1.1 Prepare a minimum of 10 specimens consisting of two Douglas fir-larch blocks or other appropriate substrates, bonded by the adhesive, in accordance with Test Method C297/C297M. Each block is to be 2.0 inches square. The adhesive shall be applied and cured in accordance with the adhesive manufacturer's instructions.

(1) The material selected for use as the substrate shall be capable of withstanding the accelerated aging described in 4.3.1.2 without damage or deterioration of the substrate.

NOTE 3—Other appropriate substrates, such as metal or plastic, compatible with the adhesive according to the manufacturer's guidelines, can be used in place of the Douglas fir-larch blocks. Because in accordance with 4.3.1.4.1 at least 75 % of samples must fail in a cohesive mode, a substrate should be selected that is expected to be stronger than the adhesive and which will form a tight bond with the adhesive.

4.3.1.2 Subject 50 percent of the specimens to accelerated aging under Test Method D1183, Test Condition C, for three cycles. The low-temperature portion of the cycle is not required to be colder than -40°F (-40°C) and the relative humidity during this portion of the cycle shall not be greater than 10 % RH.

4.3.1.3 Condition and test all of the specimens in accordance with Test Method C297/C297M.

4.3.1.4 *Acceptable Performance*—Acceptable performance of the adhesive is demonstrated by one of the following means:

(1) When tested in accordance with 4.3.1.3, the samples demonstrate performance in accordance with either (*a*), (*b*), or (*c*).

(a) For a valid test, the mode of failure for no fewer than 75 % of the specimens shall be cohesive. Only specimens that failed cohesively are counted in the following. The average ultimate tensile strength of the samples that were subjected to accelerated aging shall not be less than 80 % of the average ultimate tensile strength of the specimens that were subjected to conditioning only.

(b) None of five aged specimens fails cohesively under a tensile load less than or equal to 100 psi at a pull rate (crosshead speed) of 0.02 in./min. Only specimens that fail cohesively or do not fail are counted. Specimens that fail non-cohesively under a load at or below 100 psi are discarded and another specimen is tested until five specimens have either failed cohesively, or have not failed at or below 100 psi. Adhesives qualified under this method are limited to use with foam insulation having a tensile strength not greater than 100 psi.

(c) The following applies when the average elongation at yield of the specimens that were subjected to conditioning only is 200 % or greater: the average stress of the aged specimens is not less than 80 percent of that of the specimens that were subjected to conditioning only, when measured at an elongation 75 % of the elongation at yield for each specimen.

(2) As an alternative, adhesives that are covered by a current report, issued by an agency accredited under ISO Guide 65, as a Type I, Class 2 adhesive in accordance with Acceptance Criteria AC05, will have exhibited acceptable performance under the above procedure.

NOTE 4—Compatibility of the adhesive with the vinyl siding and insulation used in the insulated vinyl siding is evaluated separately, under 5.2.4.

4.4 *Insulated Vinyl Siding:*

4.4.1 Insulated vinyl siding shall not contain elemental lead (Pb) or compounds of that material other than traces incidental to raw materials or the manufacturing process. This limitation applies to both PVC substrate and to any cap or film material, as well as the insulation material. Compliance with this requirement shall be demonstrated by one of the methods in 6.16.

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5. Physical Requirements

5.1 *Requirements Applicable to Vinyl Siding*—The provisions of 5.1.1 – 5.1.8 apply only to the vinyl siding, exclusive of any insulation material. Where necessary to perform testing, the insulation material shall be removed.

5.1.1 *Length and Width*—The nominal length and width of the vinyl siding shall be as agreed upon between the purchaser and the seller. The actual length shall not be less than ¼ in. (6.4 mm) of the nominal length and the actual width shall be within ±1/16 in. (1.6 mm) of the nominal width when measured in accordance with 6.3 and 6.4.

5.1.2 *Thickness*—These requirements pertain only to measurements of the portions of the vinyl siding that are exposed after installation of the panel, measured in accordance with the procedure in 6.5. The average thickness of each specimen shall be no less than 0.035 in. No individual measurement shall be thinner than 0.003 in. below the nominal thickness. The process average thickness as defined in 3.1.6 shall be no thinner than 0.001 in. below the nominal thickness.

5.1.3 *Camber*—A full length of vinyl siding (typically 10 or 12 ft (3.05 or 3.61 m)) shall not have a camber greater than ⅛ in. (3.2 mm) when measured in accordance with 6.6.

5.1.4 *Heat Shrinkage*—The average heat shrinkage shall not exceed 3.0 % when determined by the method described in 6.7.

5.1.5 *Impact Resistance*—The vinyl siding shall have a minimum impact strength of 60 in.•lbf (6.78 J) when tested in accordance with 6.8.

5.1.6 *Gloss*—The gloss of smooth and embossed vinyl siding shall be uniform across the exposed surface. The average of all readings for a panel determined in 6.11.2.5 shall not differ from the manufacturer's specified gloss value more than the permitted variation in Table 1, and each individual reading shall not vary more than 10 points from the average. Gloss of smooth and embossed vinyl siding shall be tested in accordance with 6.11.

5.1.7 *Uniformity of Color*—The color specified shall be uniform on the exposed surface of the vinyl siding panels, except in the case of variegated colors. When tested in accordance with 6.13, the total color change, ΔE, between a production specimen and the appropriate reference specimen or agreed-upon color coordinates shall not vary by more than 1.5, and the chromatic coordinates thereof shall not change by more than $\pm\Delta a_H = 1.0$ and $\pm\Delta b_H = 1.0$.

5.1.8 *Weathering*—The vinyl siding shall maintain a uniform color and be free of any visual surface or structural changes such as peeling, chipping, cracking, flaking, and pitting when tested in accordance with 6.10.

5.1.9 *Coefficient of Linear Expansion*—The vinyl siding shall have a coefficient of linear expansion not greater than 4.5 by 10^{-5} in./in./°F (8.1 by 10^{-5} mm/mm/°C) when tested in accordance with 6.9.

TABLE 1 Gloss Values

Manufacturer's Specified Gloss Value	Permitted difference from Manufacturer's Specified Gloss Value
Less than or equal to 35	±8
Greater than 35	±10

5.2 *Requirements Applicable to Insulated Vinyl Siding*—The provisions of 5.2.1–5.2.5 apply to insulated vinyl siding, including the integral foam insulation material. Testing shall be conducted on both the vinyl siding and the insulating material, or with the insulating material in place, as described in the referenced test method.

5.2.1 *Thermal Distortion*—The insulated vinyl siding shall be free of bulges, waves, and ripples, and an overlap shall not open more than ¼ in. (6 mm) when tested to a minimum temperature of 150°F (66°C) in accordance with the procedure in 6.12.

5.2.2 *Wind Load Resistance*—The siding shall withstand a minimum static test pressure and a standard wind load design pressure rating shall be determined.

5.2.2.1 *Minimum Test Pressure*—Insulated vinyl siding shall be able to withstand a minimum test pressure of 22.5 lbf/ft^2 (1077 Pa) when tested in accordance with 6.14. The average maximum sustained static pressure determined in 6.14 shall be equal to or greater than this value. If the manufacturer of insulated vinyl siding provides documentation to support compensation for pressure equalization, the test pressure shall be determined from Annex A1 using the documented pressure equalization factor.

NOTE 5—The static test pressure of 22.5 lbf/ft^2 (1077 Pa) for insulated siding was established to withstand structural loading conditions that occur in wind exposures of approximately 110 mph (177 km/h) (V_{ASD}) for mean roof heights of 30 ft (9.1 m) and less in exposure category B, and corresponds to 30.0 lbf/ft^2 (1436 Pa) negative design pressure, to match the default wind design conditions of Table R703.3(1) in the 2015 International Residential Code. Provision is made for compensation for pressure equalization specific to the product if supporting documentation is provided, using procedures in Annex A1.

NOTE 6—Refer to Annex A1 for an explanation as to how the negative design pressure was established, and for applications where the effective negative design pressure as specified in ASCE 7-10 is different from 30.0 lbf/ft^2 (1436 Pa) (for example, wind-zone areas greater than about 110 mph (177 km/h) (V_{ASD}) (225 km/h (V_{ULT})) or mean roof height above 30 ft (9.1 m), or exposures other than exposure category B).

(1) The design-pressure values can be negative (suction loads) or positive. The negative values are the largest in magnitude and are the values used in this specification.

NOTE 7—In that the insulated vinyl siding is being tested as a weather-resistant exterior product applied to an existing exterior structural wall, forces (negative) working to pull the insulated vinyl siding off the wall, fasteners, or disengage locks will be the most important criteria for testing. Positive wind forces test the integrity of the total wall sections, and do not provide a measure of the performance of the insulated vinyl siding.

5.2.2.2 *Standard Wind Load Design Pressure Rating*—The standard wind load design pressure rating shall be determined from the results of testing in accordance with 6.14, using the procedures described in A1.3.

NOTE 8—The standard design pressure rating is valid for applications where the siding is installed over sheathing and its fastening that are capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location. For applications over other sheathing, a different design pressure rating is applicable, and is determined in accordance with A1.3. Determination of a rating other than the standard design pressure rating is not required by this section.

5.2.2.3 *Alternative Design Pressure Ratings*—Design pressure ratings other than the standard wind load design pressure

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rating, for use with different sheathing materials or using different installation or fastening, are permitted to be determined in accordance with testing under 6.14, using the procedures in Annex A1.

5.2.3 *Nail Slot Allowance for Thermal Expansion*—For vinyl siding panels utilizing nail slots to allow for thermal expansion and contraction, the nail slot shall be sized to allow for the expected range of expansion and contraction over a range of 100°F. Compliance with this requirement shall be demonstrated either by the test method in 6.15 or by sizing of the nail slots according to the specifications in the following sections. The instrument used shall be capable of measuring to the nearest 0.01 in. The manufacturing tolerance shall not exceed -0.030 inches.

5.2.3.1 For panels shorter than 6 ft (1829 mm) in length, the minimum nail slot width shall be ⅜ in. (11.4 mm).

5.2.3.2 For panels 6 ft (1829 mm) in length or longer the minimum nail slot width shall be determined according to the following formula. The minimum width shall be the width resulting from application of the formula, rounded to the next lower quarter-inch. Regardless of the results of the calculation, the minimum nail slot width for panels 6 feet or longer shall be 1 in. (25.4 mm).

$$WS = P_c \times (\alpha \times 100°F \times L) + T_c \quad (1)$$

where:

WS = Minimum width of nail slot, in.
P_c = Center-pinning coefficient: 1 if manufacturer's instructions require panel to be center-pinned; 1.5 if center-pinning is not required
α = Coefficient of linear thermal expansion, 4.5×10^{-5} in./in./°F or actual known coefficient for vinyl siding used, as determined by 6.9
L = Length of panel, inches
T_c = Centering tolerance: 0.25 in.

5.2.4 *Compatibility of Adhesives*—When subjected to cyclical conditioning and tested in accordance with 6.17, samples composed of the vinyl siding and insulation bonded with the adhesive, if any, used in the insulated vinyl siding shall not exhibit a decrease in average ultimate tensile strength greater than 20 %, compared to samples not subjected to cyclical conditioning. This requirement is not applicable to insulated vinyl siding that does not contain any adhesive.

5.2.5 *Thermal Insulation Value*—The thermal insulation value (R-value) of the insulated vinyl siding shall be not less than R-2.0 when measured in accordance with 6.18.

5.2.6 *Flame Spread*—Insulated vinyl siding shall have a Flame Spread Index not greater than 200 when tested underin accordance with 6.19.

6. Test Methods

6.1 *General*—The inspection and test procedures contained in this section are used to determine the conformance of products to the requirements of this specification.

NOTE 9—Each producer who represents its products as conforming to this specification typically uses statistically based sampling plans that are appropriate for each manufacturing process to verify on-going compliance. Specifications for quality control programs are beyond the scope of this Standard Specification. Additional sampling and testing of the product, as agreed upon between the purchaser and the manufacturer, are not precluded by this section.

6.2 *Conditioning and Test Conditions*—Condition the test specimen in accordance with Procedure A of Practice D618 and test under those conditions, unless otherwise specified herein.

6.3 *Length*—Lay the specimen on a flat surface and measure with a steel tape that has been verified as accurate to within ±1⁄16 in. (1.6 mm) against a calibrated standard. Measure the length of a vinyl siding panel to the nearest 1⁄16 in. (1.6 mm) at the center, the butt edge, and the bottom of the top lock. The average of the three measurements is the actual length.

6.4 *Width*—Interlock two specimens, each at least 26 in. (660 mm) long, in the normal mode for installation. Lay the two specimens on a flat surface. Measure to the nearest 1⁄16 in. (1.6 mm), the distance between the lowest butt edge of the top specimen and the lowest butt edge of the bottom specimen. Commencing approximately one in. (25 mm) from one end of the specimens, make five measurements at 6-in. (152-mm) intervals, making sure that the measurement is made perpendicular to the butt edge. Average the measurements. The average constitutes the exposed width of vinyl siding.

6.5 *Thickness*—Thickness shall be measured in accordance with Test Method A of Test Method D5947. The micrometer shall be calibrated in accordance with Section 8 of Test Method D5947. The thickness of the vinyl siding shall be measured at a minimum of five locations equally spaced across the entire portion of the vinyl siding that will be exposed after installation. All measurements shall be taken to the nearest 0.001 in. Calculate and report the average of these measurements. Also report the thinnest individual measurement.

6.6 *Camber*—Place a full length of vinyl siding (typically 10 or 12 ft (3.05 or 3.61 m)) on a flat surface alongside a straightedge at least as long as the vinyl siding specimen. Measure the maximum space between the edge of the vinyl siding specimen and the straightedge for each edge to the nearest 1⁄16 in. (1.6 mm).

6.7 *Heat Shrinkage:*

6.7.1 *Apparatus:*

6.7.1.1 *Scriber,* similar to that described in Test Method D1042, with the exception that the needle points shall be separated by 10 ± 0.01 in. (254 ± 0.254 mm).

6.7.1.2 *Test Media,* a controlled-temperature water bath of 5 gal (10 L) or more, equipped with an efficient stirrer that will maintain uniform temperature throughout. Heater and temperature-control devices must maintain the water at 160 ± 1°F (71 ± 0.5°C). Use a wire rack to raise and lower specimens into the water bath. As an alternative to the use of a water bath, heat the specimens for 30 min in a uniformly heated forced-air oven maintained at a temperature of 160 ± 1°F (71 ± 0.5°C).

6.7.1.3 Make measurements with any device capable of measuring the distance between two scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2 *Procedure:*

6.7.2.1 Cut three specimens from the vinyl siding panel, each 1 in. (25.4 mm) wide by 12 in. (305 mm) long. Cut one

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specimen from the center and one from each of the extreme edges of the flat surface. The long axis shall be parallel to the machine direction.

6.7.2.2 Condition specimens at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 10 % relative humidity for at least 24 hours.

6.7.2.3 Make a slight mark with the scribe on each specimen so that a reference point will be clearly visible.

6.7.2.4 Place specimens in the test medium.

6.7.2.5 Remove specimens after 30 min and place on a flat surface until cool.

6.7.2.6 Repeat conditioning in accordance with 6.7.2.2.

6.7.2.7 Make a second mark with the scribe on each specimen, using the same center.

6.7.2.8 Measure the distance, D, between the scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2.9 Calculate the percent shrinkage as (D/10) × 100.

6.7.2.10 Report the average shrinkage of the three specimens tested.

6.8 *Impact Resistance*—Test impact resistance of vinyl siding in accordance with Test Method D4226, Procedure A, impactor head configuration H.25. 4 in.-lb increments (0.5 in. height increments with 8 lb falling weight) shall be used. Minimum sample dimensions shall be 1.5 by 1.5 in. Samples shall be tested with the normally exposed surface facing up. Insulated vinyl siding shall be tested with any insulation material removed. Conditioning time for quality-control tests shall be at least one hour.

6.8.1 For purposes of evaluating failure of the specimen under subsection 3.2.1 of Test Method D4226, a ductile tear of less than 0.2 in. (5 mm) in length shall not be considered a failure. Any brittle break of any dimensions is considered a failure.

6.9 *Coefficient of Linear Expansion*—Conduct this test in accordance with Test Method D696, separately for samples of the vinyl siding and samples of the insulation.

6.9.1 *Alternative Specimen Preparation for Vinyl Siding Samples*—Specimens prepared from strips cut from extruded vinyl siding are permitted to be used in testing under Test Method D696. Where such specimens are used, they shall be cut with the long dimension parallel to the long axis of the vinyl siding panel. Guides shall be used in accordance with Test Method D696 to prevent bending or twisting of the specimen in the dilatometer.

6.10 *Weatherability:*

6.10.1 A minimum of three samples shall be exposed at each of at least three test sites. Test sites shall be located in a northern temperate climate, represented by Cleveland, Ohio or Louisville, Kentucky; a hot, humid climate represented by Miami, Florida; and a hot, dry climate represented by Phoenix, Arizona. The samples shall be exposed for a minimum of 24 months.

6.10.2 Samples shall consist of a flat section of vinyl siding with minimum dimensions of 2 by 3¾ in. (25 by 95 mm).

6.10.3 Samples shall be representative of the product to be evaluated. Samples shall be taken either from commercial products or from laboratory samples. Laboratory samples shall be produced in the same manner as the commercial products to be evaluated.

NOTE 10—Production of laboratory samples in the same manner includes use of the same method of forming the product. For example, if the commercial product is extruded, the laboratory specimen shall be extruded; if the commercial product is injection molded, the laboratory specimen shall be injection molded, and so forth.

6.10.4 Select a minimum of four specimens per sample per test site to allow for three test specimens and one file specimen for each sample evaluated.

6.10.5 Mark each specimen permanently to ensure retention of identity during and after exposure testing.

NOTE 11—Use of a vibrating engraver leaves a permanent mark that satisfies this criterion.

6.10.6 All exposures shall be conducted at an angle of 45° South, plywood-backed, in accordance with Practice D1435 and G147.

6.10.7 After a minimum of 24 months of exposure, remove the samples and inspect each exposed test specimen for appearance and surface condition. Record observations and inspection date in a permanent record.

6.11 *Gloss:*

6.11.1 *Apparatus*—Measure gloss using a 75° geometry glossmeter that meets the requirements of the Apparatus section of Test Method D2457.

6.11.2 *Procedure:*

6.11.2.1 Gloss measurements shall be made in accordance with the procedure in Section 9 of Test Method D2457, unless otherwise specified herein.

6.11.2.2 Measure gloss on one piece of vinyl siding on at least three widely separated sections across the width of the exposed surface of the panel. At least one reading shall be taken on each face of the panel. Use a new surface area for each reading to avoid scratches caused by instrument contact. The area tested must be flat. If a flat area on the exposed surface cannot be found due to the style or depth of embossing of the panel being tested, then a non-exposed area of the panel shall be chosen in its place. Such locations shall be representative of the gloss of the area that will be exposed after installation.

6.11.2.3 Measure gloss parallel to the direction of embossing. When the embossing pattern is not apparent, measure the gloss in the direction of extrusion.

6.11.2.4 Each reading shall be within the appropriate limit specified in 5.1.6.

6.11.2.5 The average of all readings shall be used to represent the gloss of the sample.

6.12 *Thermal Distortion:*

6.12.1 *Test Specimen/Apparatus:*

6.12.1.1 The test specimen shall consist of three courses of insulated vinyl siding, a minimum of 6 ft (1.83 m) in length, mounted on a flat, rigid frame in accordance with the manufacturer's installation instructions.

(1) Horizontal Siding—The middle course shall consist of two lengths of insulated vinyl siding, both with a factory-fabricated end, one section overlapping the other section. The

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end of the overlapping section shall be located not less than 3 in. (76 mm) and not more than 6 in. (152 mm) from the center of the course. Unless specified otherwise by the manufacturer's installation instructions, the insulation of the two lengths of insulated vinyl siding shall be butted firmly together.

(2) Vertical Siding—The middle course shall consist of a single, uninterrupted insulated vinyl siding panel, without overlap.

6.12.1.2 A thermocouple or other heat-sensing element shall be located at the horizontal midpoint of the back side of the middle course of insulated vinyl siding. The heat-sensing element shall be in contact with the back of the vinyl cladding. Any insulation or backing material removed to facilitate placement of the heat sensing element shall be replaced.

6.12.1.3 Radiant-heat rod, 600 W for each linear foot (0.31 m), mounted parallel to the middle course and approximately 32 in. (810 mm) away from the surface of the insulated vinyl siding.

6.12.1.4 Temperature-control device, used to regulate the temperature of the radiant-heat rod, shall be able to maintain the conditions specified in 6.12.2.1.

6.12.1.5 Gap measurement device. A cylindrical pin gauge, ¼ ± 0.005 in. (6 ± 0.127 mm) in diameter is used to evaluate the size of any gap in the overlapped sections of horizontal insulated vinyl siding during the heating period. The pin gauge is attached to a rod such that the gauge can be inserted into a gap while held parallel to the plane of the insulated vinyl siding. The rod shall be sufficiently long to permit insertion of the gauge from beyond the edge to the test frame, not interfere with the exposure of the sample to radiant heat, and otherwise not interfere with conduct of the test.

6.12.2 *Procedure:*

6.12.2.1 Heat the test panel (middle course of insulated vinyl siding) at a rate of 3.0 to 6.0°F/min (1.7 to 3.3°C/min) until a minimum temperature of 150°F (66°C) is achieved as measured by the heat-sensing element on the midpoint of the backside of the middle course. For temperatures equal to or greater than 130°F (54°C), the rate of heating is permitted to be not less than 2.0°F/min (1.1°C/min), provided that the average heating rate from the ambient temperature to 150°F (66°C) is within 3.0 to 6.0°F/min (1.7 to 3.3°C/min). When a temperature of 150°F (66°C) is attained, shut off the heat source.

6.12.2.2 During this heating period, observe the middle course of the insulated vinyl siding for surface distortion and observe for any opening or gap at the end of the overlapped section. If the overlap appears to have opened to approximately ¼ in. (6 mm), attempt to insert the gap measurement device into the opening. If the device can be inserted into the opening to any depth at any location along the overlap, the opening shall be considered to be at least ¼ in. (6 mm).

6.12.2.3 *Failure is defined as:*

(1) the appearance of bulges, waves, or ripples on any surface of the middle course of the insulated vinyl siding; or

(2) occurrence of a gap or opening ¼ in. (6 mm) or greater at any point along the end of the overlapped section, as determined by use of the gap measurement device, at any time before a temperature of 150°F (66°C) is reached.

6.13 *Color Uniformity*—Calculate the difference between the L_H, a_H, and b_H color coordinates for a production specimen to those of either the appropriate reference specimen or the agreed upon color coordinates for that specific color product in accordance with Test Method D2244. Calculate the total difference ΔE between the production specimen and the reference specimen in accordance with Test Method D2244.

6.14 *Wind Load Resistance*—Conduct the test on wind load resistance of finished insulated vinyl siding in accordance with Test Method D5206. The average maximum sustained static test pressure determined from this testing is used in 5.2.3. For purposes of determining compliance with the minimum test pressure and standard design pressure requirements in 5.2.3, the test structure shall be constructed with vertical studs 16 inches on center. The siding shall be tested with insulation attached to the vinyl siding. The siding in the test installation shall be installed over wood sheathing with a nominal thickness of 7/16 to ½ inch, and fastened as follows:

6.14.1 *Fastener Type*—Roofing nail, smooth shank, 0.120 in. (⅛ in. nominal; 3.2 mm) shank diameter, 5/16 in. (7.9 mm) head diameter, length as necessary to penetrate into sheathing and stud a total of 1 ¼ in. (32 mm). For vertical siding, length as necessary to penetrate the thickness of the sheathing plus ¼ in. (6.4 mm).

6.14.2 *Fastener Spacing*—Every 16 in. (406 mm) into center of stud for horizontal siding. For vertical siding, every 12 inches into sheathing only.

6.14.3 Fasteners shall not be driven tightly against the siding. Allow approximately 1/32 in. (0.8 mm) clearance between the fastener head and siding surface.

NOTE 12—The installation details described 6.14 conform to the minimum requirements of the 2015 International Residential Code and the VSI Vinyl Siding Installation Manual.

6.15 *Nail Slot Allowance for Thermal Expansion*—As an alternative to conformance with the nail slot width specification in 5.2.3.1 or 5.2.3.2, provision for thermal expansion and contraction shall be demonstrated through the following test procedure.

6.15.1 *Samples*—At least three samples of each profile in which the insulated vinyl siding is produced shall be provided. The length of each sample shall be at least 50 % of the longest length in which the profile is produced, and not shorter than 12 ft (3658 mm).

6.15.2 *Test Chamber*—The test chamber shall consist of an environmentally controlled room or compartment capable of providing an air temperature range of at least 0 to 100°F (-18 to 38°C) without exposure of the panel to radiant energy from heating or cooling elements. Air temperature shall be controlled such that a rate of temperature change of 2°F (1.11°C) per minute can be achieved over the full temperature range, and the minimum and maximum temperatures can be maintained for at least 15 minutes. Means for circulating air to provide a uniform air temperature throughout the chamber shall be provided. A vertical wall shall be provided for mounting of samples. The wall shall be insulated such that, with no panels mounted, the inner surface of the wall does not deviate more than 10°F (5.5°C) from the air temperature at the high and low temperature extremes after a holding period of

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five minutes. The test chamber shall be of sufficient size to accommodate the longest panel to be tested, including expected thermal expansion of the panel. Means shall be provided to measure the actual temperature of the surface of each panel at a minimum of three evenly-spaced locations along the length of the panel.

6.15.3 *Length Measurement*—A means for measuring the length of each sample throughout the temperature range shall be provided. The method utilized for length measurement shall not be influenced by the temperature of the chamber and shall have a minimum resolution of no greater than 0.0625 in. (1.59 mm).

6.15.4 *Procedure*—Install the sample panels on the wall inside the test chamber, following the manufacturer's instructions for fastener type, spacing, location and tightness. At ambient temperature measure and record the length of each panel and the temperature of the panel, averaged from a minimum of three locations along the length of the panel.

6.15.4.1 *Test Cycle*—Test cycles shall be performed by raising the air temperature to 100 ± 5°F (38 ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding the air temperature at 100°F (38 ± 2.75°C) for 15 minutes, lowering the air temperature to 0 ± 5°F (-18 ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding at 0°F (-18 ± 2.75°C) for 15 minutes, and returning to ambient temperature at an average rate of 2°F per minute.

6.15.4.2 *Conditioning*—Close the test chamber and perform at least two conditioning cycles using the procedure in 6.15.4.1. No interruption is required between conditioning cycles.

6.15.4.3 *Test*—Following completion of the conditioning cycles, conduct three test cycles using the procedure in 6.15.4.1. It is acceptable for the test cycles to follow immediately upon completion of the final conditioning cycle, and no interruption is required between test cycles. After a minimum holding period of 15 minutes at the high and low extremes of each test cycle, measure and record the length of each panel and the temperature of the panel, averaged from a minimum of three locations along the length of the panel.

6.15.5 *Normalization*—From among the length measurements recorded for all three cycles, identify the shortest and longest length of each panel, and the average panel temperature at the time that length was recorded. Determine the maximum difference in length, ΔL, and the maximum difference in temperature, ΔT, by subtracting the smaller from the larger. Normalize the change in length to the full length of the panel over a 100°F (38°C) temperature range using the following formula:

$$E_t = \Delta L \times (100/\Delta T) \times (L_f/L_t) \quad (2)$$

where:

E_t = Total thermal expansion and contraction of a full length panel over a range of 100°F (38°C)
ΔL = maximum change in length of the tested panel,
ΔT = maximum change in temperature of the tested panel,
L_f = longest length in which the panel is produced, and
L_t = actual length of the panel as tested.

6.15.6 *Acceptable Performance*—When tested according to this procedure, the result of $(E_t \times 2) + 0.25$ in. for each of the three samples for each profile shall not be greater than the width of the nail slot. If the manufacturer's installation instructions require the panel to be center-pinned, the result of $E_t + 0.25$ in. for each of the three samples for each profile shall not be greater than the width of the nail slot.

6.16 *Lead Content:*

6.16.1 Testing for lead content shall be conducted on insulated vinyl siding using a rhodizinate-type lead swab test kit conforming to Practice E1753. Testing shall be performed in accordance with the test kit manufacturer's instructions. The insulated vinyl siding shall be deemed to comply with 4.4.1 if the test shows a negative or not-detected result; that is, the test does not indicate the presence of lead. The test shall be conducted separately on the substrate and on any cap or film material, and on the insulation material.

6.16.2 As an alternative to the method in 6.16.1, and as a means of resolving any ambiguous results from that method, an analytical method capable of detecting lead at least as low as 0.02 percent by sample weight shall be employed. Under this alternative, neither the substrate nor any cap or film shall contain a concentration of lead in excess of 0.02 percent by weight.

6.17 *Compatibility of Adhesives:*

6.17.1 *Sample Preparation*—Combine a flat, 2 by 2 in. section of vinyl siding with a 2 by 2 by 0.75 in. sample of insulation, using the adhesive used in the insulated vinyl siding. The top and bottom surfaces of the insulation are to be parallel. The application rate, thickness, and distribution of the adhesive are to be consistent with its application in the insulated vinyl siding. Prepare a total of at least ten such samples.

6.17.2 *Cyclical Conditioning*—Subject half of the samples to the following conditioning. In an appropriate environmental conditioning chamber, starting at room temperature, increase the temperature of air surrounding the sample to 150°F (66°C) and hold for 15 minutes. Over a period of time not greater than 15 minutes, decrease the surrounding air temperature to -10°F (-23°C), and hold for 15 minutes. Return the surrounding air temperature to 150°F (66°C) over a period of time not greater than 15 minutes. This cycle is repeated for a total of 30 cycles.

6.17.2.1 *Tensile Testing*—Condition and test all of the samples in accordance with Test Method C297/C297M Any of the failure modes listed in Test Method C297/C297M (other than failure at the bond to the loading blocks) shall be counted in calculating the average ultimate tensile strength. Separately determine the average ultimate tensile strength for the samples subjected to cyclical conditioning, and for those not subjected to such conditioning.

6.18 *Thermal Insulation Value*—The thermal insulation value for the insulated vinyl siding shall be determined in accordance with Test Method C1363. Test conditions, test sample selection, configuration and installation, and procedure shall be as specified in the following sections.

6.18.1 *Wind Direction and Velocity*—Testing of the base wall and insulated vinyl siding samples shall be with the

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exterior wind direction perpendicular to the plane of the test wall. The calibration procedure in Section 6 of Test Method C1199 shall be used to establish standard room and weather side surface heat transfer coefficients.

6.18.2 *Test Temperatures*—Testing shall be performed at an exterior temperature of 50°F and an interior temperature of 100°F.

6.18.3 *Base Wall*—The base wall for attachment of the insulated vinyl siding shall provide for overall test sample dimensions of 96 ± 6 in. (2438 ± 152 mm) in both the vertical and horizontal axis. The construction of the wall shall be sufficient to hold the test installation without flexing under the imposed wind. The weather side surface of the base wall shall include a solid surface composed of uniform sheet material capable of securely holding standard roofing nails or the fasteners specified by the manufacturer for installation of the insulated vinyl siding under test. The wall shall be fully sealed to prevent movement of air between the chambers.

NOTE 13—The precise materials and construction of the base wall are not specified because its thermal characteristics will be directly measured to establish baseline conditions from which the performance of the insulated vinyl siding alone can be distinguished. A standard framed wall composed of nominal 2 by 4 in. studs on 16 in. (406 mm) centers, covered by nominal ½ in. plywood or oriented strand board (OSB) has been found to be suitable for most test applications.

6.18.4 *Sample Selection*—reserved for any requirements needed for specifying the sample to be used, how many replicates, etc. (if needed).

6.18.5 *Test Installation*—The area covered by the insulated vinyl siding shall be 96 ± 6 in. (2438 ± 152 mm) in both the vertical and horizontal axis. The test installation shall be composed of the number of insulated vinyl siding panels needed to cover the test installation area, and any siding accessories normally used for installation of that insulated vinyl siding.

6.18.5.1 *Overlaps*—The test installation shall include both courses that cover the full width of the test wall with a single panel, and courses composed of two or more adjacent, overlapping panels. The number of courses containing overlapped panels shall be as specified below.

(1) Panels shorter than full width of the test wall—Where the insulated vinyl siding is commercially available in panels shorter in length than the full width of the testing installation, each course shall contain adjacent, overlapped panels. For panels equal to or longer than one-half the test installation width, each course shall contain two panels, with one joint between them. For shorter panels, the number of panels and joints per course is determined by the length of the panels and the overlapping of panels specified in the manufacturer's installation instructions.

(2) Vertical Siding—The test installation for vertical insulated vinyl siding shall contain no overlap joints.

(3) Horizontal Siding—The number of courses with overlap joints for horizontal insulated vinyl siding shall be based on the vertical coverage of the profile, in accordance with Table 1 or the following formula. For test walls with a insulated vinyl siding installation height other than 96 in (2438 mm), or for insulated vinyl siding profiles not listed in Table 2, the number of courses with overlap joints shall be determined according to the following formula:

$$L = 0.375\left(\frac{H}{V}\right) \quad (3)$$

where:

L = Number of courses with overlap joints in test installation; rounded to the nearest integer
H = Height of test installation, inches
V = Vertical coverage of one panel, inches

(4) The specified number of courses with overlaps joints shall be evenly distributed vertically across the test installation. Adjacent courses shall not contain overlap joints.

6.18.5.2 The bottom edge of the insulated vinyl siding shall be secured with a starter strip or equivalent trim specified by the manufacturer. The sides and top edge of the insulated vinyl siding shall be bound by J-channels or equivalent trim specified by the manufacturer.

6.18.5.3 The insulated vinyl siding and trim shall be installed in the order in which they are installed in the field, in accordance with the manufacturer's installation instructions. Fastening of the insulated vinyl siding and trim to the wall shall be as specified in the manufacturer's installation instructions.

6.18.5.4 *Sealing of Test Installation*—No part of the test installation, including insulated vinyl siding panels, joints, overlaps and perimeter, shall be sealed other than by the means integral to manufacturer-supplied siding panels or trim. Any actions specified in the manufacturer's installation instructions to secure or enable an integral sealing means shall be carried out.

6.18.6 *Procedure*—Conduct a test of the base wall alone, with no insulated vinyl siding installed, in accordance with Test Method C1363. Determine the R-value of the base wall. Install the insulated vinyl siding and conduct a test under the same conditions, and determine the R-value of the base wall-insulated vinyl siding assembly. Determine the R-value of the insulated vinyl siding by subtracting the R-value of the base wall alone from that of the base wall-insulated vinyl siding assembly. Report the R-value of the insulated vinyl siding, rounded to the nearest tenth.

6.18.6.1 Reuse of the R-value determined for the base wall is permitted for subsequent tests of insulated vinyl siding. The

TABLE 2 Courses with Overlaps Joints

Siding Type	Vertical Coverage (in.)	Number of Courses Including Overlaps
Single 6.5	6.5	6
Single 7	7	5
Double 4	8	5
Single 8	8	5
Double 4.5	9	4
Triple 3	9	4
Double 5	10	4
Quad 2.5	10	4
Double 6	12	3
Triple 4	12	3
Double 6.5	13	3
Double 7	14	3
Quad 4.5	18	2
Triple 6	18	2

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R-value of the base wall shall be reestablished by testing if the test configuration is changed, the base wall has been removed and reinstalled, ambient temperature or humidity has changed or fluctuated significantly, or any other event has occurred that is likely to affect the R-value of the base wall.

6.19 *Flame Spread*—Conduct the test on flame spread of finished insulated vinyl siding in accordance with Test Method E84. The test specimen shall either be self-supporting by its own structural characteristics or held in place by added supports along the test specimen surface, or secured from the back side.

7. Packaging and Package Marking

7.1 The insulated vinyl siding shall be packed in such a manner as to provide reasonable protection against damage in ordinary handling, transportation, and storage.

7.2 Provisions of Practice D3892 shall apply to this specification.

7.3 To aid identification of insulated vinyl siding conforming to all requirements of this specification, producers and distributors shall include a statement of compliance in conjunction with their name and address on product labels, invoices, sales literature, and the like. The following statement is suggested when sufficient space is available: "This insulated vinyl siding conforms to all the requirements established in ASTM Specification D7793 developed cooperatively with the industry and published by ASTM. Full responsibility for the conformance of this product to the specification is assumed by (name and address of producer or distributor)."

7.4 The following abbreviated statement is suggested when available space on labels is insufficient for the full statement: "Conforms to ASTM Specification D7793 (name and address of producer or distributor)."

7.5 The package shall be marked or labeled with the R-value determined in 6.18.

NOTE 14—Marking or labeling done in compliance with 16 CFR Part 460 will normally satisfy this requirement. That and other government regulations may require additional information and statements which are not required by this standard.

7.6 The standard wind load design pressure rating determined in accordance with 5.2.3.2 shall be stated on the product or on the product package by one of the means in 7.6.1 or 7.6.2.

7.6.1 The package shall be marked or labeled with the standard wind load design pressure rating. The marking shall be in the format "Standard Wind Load Design Pressure Rating: ##.# psf (ASD)".

7.6.2 The standard design pressure rating shall be included on a line imprint or other marking on the front (outward-facing) surface of all siding panels. It is not required that the marking be visible after installation, provided that the marking can be revealed and read by detaching the lower edge lock of an adjacent course, without removal of any fasteners. The standard design pressure marking shall be stated at least once per panel. The marking shall be in the format "Std Design Pressure Rating: ##.# psf (ASD)".

7.6.3 At the option of the manufacturer, additional marking or labeling of the package or product with alternative wind load design pressure ratings determined in accordance with 5.2.2.3 for use with alternative sheathings, wall configurations or fastening methods is permitted. The marking shall use the format specified in 7.6, shall indicate the type of sheathing or wall configuration for which it is applicable, and shall refer to the manufacturer's instructions for more information and any installation requirements.

8. Keywords

8.1 insulated siding; insulated vinyl siding; plastic building products; plastic weatherability; recycled plastic; rigid PVC siding; specification; vinyl siding

ANNEX

(Mandatory Information)

A1. WIND LOAD RESISTANCE TEST DESIGN FACTORS

A1.1 Wind Load Criteria

A1.1.1 ASCE 7-10 is the basis for determining the design pressures used in this specification. Design wind loads are determined on an ASD basis in this specification.

NOTE A1.1—In previous editions of ASCE 7, wind loads were determined using wind speed maps based on a 50-year return period. In ASCE 7-10, maps based on a 700-year return period are used which, for any given location, produce a wind speed approximately 30 % greater than that of the previous maps. This larger magnitude (higher return period) wind speed, referred to as the ultimate wind speed, (V_{ULT}), is used directly (with a load factor of 1.0) to determine nominal wind loads on a Strength Design (LRFD) or "ultimate" wind load basis. When Allowable Stress Design (ASD) is used, ASCE 7-10 provides for these ultimate wind loads, determined from the ultimate wind speed map velocities, to be multiplied by a load factor of 0.6. Alternatively, the adjustment can be made directly to the wind velocity, which is the approach taken in this method (see A1.1.2). This procedure produces results consistent with past ASD wind loads.

A1.1.2 It is necessary to determine whether the wind velocity to be used is based on the maps in ASCE 7-10 or on older maps designed for direct application of ASD. Wind velocity, V, based on ASD is used in this method. Wind speeds determined using the maps in ASCE 7-10, referred to as V_{ULT}, are converted to ASD wind speeds, V_{ASD}, by multiplying by the square root of 0.6. Wind speeds based on maps using an ASD basis do not require conversion (see A1.3) Thus:

$$V = V_{ASD} = V_{ULT} \times \sqrt{0.6} \qquad \text{(A1.1)}$$

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The V determined in this section is used in the following calculations.

A1.1.3 The velocity pressures, q, used in this specification have been computed using the following equation:

$$q = 0.00256\,K_z K_d V^2 I(lb/sq.\,ft) = 0.613\,K_z K_d V^2 I(N/m^2) \quad (A1.2)$$

where:

V = wind velocity, mph (km/h). The basic wind speed corresponds to a 3-s gust speed at 33 ft (10.1 m) above ground in exposure category C, as described in ASCE 7-10. A velocity of $V = V_{ASD}$ = 110 mph (177 km/h) was used in this specification. (See Note A1.2 and Note A1.3.)

I = "importance factor" as described in editions of ASCE 7 prior to ASCE 7-10. A value of 1.0 is used. This factor is not used where the wind speed has been determined from a map in ASCE 7-10. (See Note A1.4.)

K_z = "velocity pressure coefficient" as described in ASCE 7-10. A "K_z" of 0.70 is used in the wind pressure calculations, which is the value from ASCE 7-10 for a mean roof height of 30 ft (9.1 m) above ground level and Exposure Category B.

K_d = "wind directionality factor" as described in ASCE 7-10. A "K_d" of 0.85 is used.

A1.1.4 Thus for the given velocity and factors, the velocity pressure, q = 18.43 lbf/ft^2 (882 Pa).

NOTE A1.2—As explained in Note A1.1, the wind velocity used in this method is converted from the V_{ULT} given by wind speed maps in ASCE 7-10 to V_{ASD} using the equation in A1.1.2. A V_{ULT} wind speed of approximately 140 mph from the maps is equivalent to a V_{ASD} of 110 mph, which is the velocity V used in this specification.

NOTE A1.3—In ASCE 7-10 the default wind speeds are given for exposure category C, and a table is provided to adjust this wind speed for other exposure categories. Since most insulated vinyl siding is installed on buildings located in exposure category B, the velocity pressure coefficient, K_z is included in the equation to make this adjustment.

NOTE A1.4—Editions of ASCE 7 prior to ASCE 7-10 included an importance factor to represent the relative significance of the building and the consequences of its loss. Because most insulated vinyl siding is installed on residential and light commercial buildings, the importance factor was set at 1.0 by default. ASCE 7-10 has removed the importance factor from the velocity pressure equation, and instead provides a different wind speed map for each of the building importance categories (referred to as risk categories in ASCE 7-10). Thus the importance factor will already have been incorporated into the wind speed determined from the appropriate map, and the importance factor is not used for determining velocity pressure using wind speeds from ASCE 7-10 maps.

A1.1.5 ASCE 7-10 recommends various internal and external pressure coefficients, which include gust response factors. These coefficients vary with the effective area of the cladding component, the location of the cladding component relative to building corners, and the configuration of the building (open versus enclosed). The internal and external pressure coefficients are taken from Table 26.11-1 and Figure 30.4-1 of ASCE 7-10. The effective area is taken as 10 square feet (the area of one piece of siding), an enclosed building is assumed, and factors for the building corners are used. The pressure coefficients are as follows:

$$Internal\ Pressure\ Coefficient = \pm 0.18 \quad (A1.3)$$

$$External\ Pressure\ Coefficient = +1.00\ and\ -1.40$$

A1.1.6 The design pressure is calculated by multiplying the velocity pressures by the algebraic sum of the internal and external pressure coefficients.

A1.2 Design Pressure

NOTE A1.5—Because the wind velocity has already been adjusted from an ultimate basis to an ASD basis at the beginning of these calculations, the design pressure determined in this step is an ASD load. This correlates to the design pressure requirements stated in tables in the 2015 International Residential Code and other codes which have also been adjusted to an ASD basis. However, the required design pressures in some other codes and design standards have not been adjusted to an ASD basis. Where required design pressures are based on ultimate wind loads determined from ASCE 7-10 wind speeds, those loads must be multiplied by 0.60 to match the design pressure determined from this equation. A1.2

$$Positive\ Design\ Pressure = (18.43)\,(1.00+0.18) = 21.74\ psf \quad (A1.4)$$

$$Negative\ Design\ Pressure = (18.43)(-1.40-0.18) = -29.12\ psf$$

A1.2.1 The negative values (suction loads) are the largest in magnitude and are the design values used in this specification. Research conducted by various organizations[5,6] has shown that a certain amount of pressure equalization occurs through residential siding products installed with sheathing under high dynamic pressures. In light of this pressure equalization, the design pressure in the ASCE 7-10 wind load standards is reduced by a factor of 0.5 for insulated vinyl siding.

A1.2.2 Therefore, the required test pressures are calculated as follows:

$$P_t = D_P \times PEF \times 1.5 \quad (A1.5)$$

where:

P_t = test pressure, lbf/ft^2 (Pa),

D_P = design pressure, lbf/ft^2 (Pa),

PEF = pressure equalization factor, insulated vinyl siding, 0.5, and

1.5 = safety factor.

A1.2.2.1 If documentation in support of the use of compensation for pressure equalization other than 0.5 is provided, use the calculation in A1.2.2, substituting the appropriate pressure equalization factor.

A1.2.3 Using the above equations, in a 110 mph (177 km/h) (V_{ASD}) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, the required minimum uniform load test pressure for insulated vinyl siding is 21.84 lbf/ft^2 (1046 Pa).

A1.2.3.1 For compliance with 5.2.2, the referenced design pressure has been rounded to -30.0 lbf/ft^2 (1436 Pa) to match the standard design conditions specified by the 2015 International Residential Code. When tested under Test Method D5206, the siding must attain an average maximum sustained static test pressure equal to or greater than the corresponding minimum test pressure of 22.5 lb/ft^2 (1077 Pa).

[5] Vinyl Siding Pressure Equalization Factor, Architectural Testing, Inc. Report No. 01-40776.01, September 2002.

[6] Morrison, M.J., Cope A.D. "Wind Performance and Evaluation Methods of Multi-Layered Wall Assemblies." *Structures Congress*, 2735-2748, Portland, OR, 2015.

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A1.2.4 For applications where the effective design pressure is greater than -30.0 lbf/ft^2 (1436 Pa) (for example, wind zone areas greater than 110 mph (177 km/h) (V_{ASD}), mean roof height over 30 ft (9.1 m), or exposure conditions other than Exposure B), refer to ASCE 7-10 for the effective design pressure. To be shown to be suitable for the application, when tested under Test Method D5206 the siding must attain an average maximum sustained static test pressure equal to or greater than the minimum test pressure determined by the formula in A1.2.2, using the design pressure, D_P, determined for the application using the procedure in A1.1.2 through A1.2.

A1.2.5 These loading conditions apply only to siding installed without an air space directly over sheathing of a type and fastening method that is capable of independently resisting both positive and negative wind design pressures at the building location. Examples of such sheathing include oriented strand board (OSB) and plywood fastened to resist the design wind pressures. For applications where the siding is installed over open studding, without sheathing, rapid pressure equalization does not occur and pressure equalization factor (PEF) is set to 1.0. In these applications, the load the siding will see is equal to the total design pressure. The static test pressure required for products used under these conditions is as follows:

$$P_t = D_P \times PEF \times 1.5 \quad \text{(A1.6)}$$

where:

P_t = static test pressure, lbf/ft^2 (Pa),
D_P = design pressure, lbf/ft^2 (Pa), and
PEF = pressure equalization factor, 1.0, and
1.5 = safety factor.

A1.2.5.1 Therefore in a 110 mph (177 km/h) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, siding installed without sheathing would require a uniform load test pressure of 43.72 lbf/ft^2 (2093 Pa).

NOTE A1.6—Building codes and insulated vinyl siding installation instructions require insulated vinyl siding to be installed over sheathing, so calculation of minimum test pressure for siding installed without sheathing is essentially moot. However, the calculation has been retained for completeness and comparison with other installation conditions.

A1.2.6 When siding is installed over sheathing that is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, a greater percentage of the total wind pressure is transferred to the siding and its fasteners. This has the effect of partially or completely countering the effect of the pressure equalization factor. In these cases a value between 0.5 and 1.0 is used for the pressure equalization factor (PEF).

A1.2.6.1 In addition, in cases where failure of the siding would result in failure of the exterior wall covering assembly (that is, siding and sheathing) a safety factor of greater than 1.5 is indicated.

A1.2.6.2 If the adjusted PEF for a given combination of siding and sheathing is known, and an appropriate safety factor is used, a minimum test pressure can be determined using the equation in A1.2.1. However, it is normally more appropriate to make an adjustment for alternative sheathings when determining the design pressure rating, as discussed in A1.3.

NOTE A1.7—Where the sheathing is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, the layer of siding over the sheathing, and its fastening through the sheathing, act to reinforce the sheathing such that the whole wall covering (siding-sheathing) assembly is capable of resisting such wind pressures. Because the siding is tested by itself (not as part of a siding-sheathing assembly) in Test Method D5206, the adjustment of test pressure (before the test) or of the design pressure (after the test) ensures that the wind load resistance of the assembly as a whole is reflected in the rating of the siding.

NOTE A1.8—In some high wind hazard regions, such as south Florida, the exterior wall covering assembly may also be required to meet wind-borne debris impact resistance criteria which would affect the choice of sheathing material to be used together with siding. Such considerations are beyond the scope of this standard.

A1.3 Wind Design Pressure Rating (Maximum Allowable Pressure)

A1.3.1 A design pressure rating is the maximum wind pressure that a particular siding product is rated to be able to withstand. It is used in building design and building codes to determine the acceptability of a siding product for use under the design wind conditions for a specific application. To be acceptable, a siding's design pressure rating must be equal to or greater than the design pressure for the specific building at the specific location. The design pressure rating is determined from the average maximum sustained static test pressure for a siding product produced by testing under Test Method D5206, the pressure equalization factor, and a safety factor.

A1.3.2 *Standard Design Pressure Rating*—The standard design pressure rating is used for applications where the siding is installed over a sheathing type and fastening method that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location.

A1.3.2.1 The standard design pressure rating assumes that the siding is fastened to the building in the standard manner, with the minimum fastener type, size, spacing, and penetration depth prescribed in Chapter 7 of the International Residential Code and the VSI Vinyl Siding Installation Manual. The installation of the siding for testing under Test Method D5206 must be consistent with these minimum fastening requirements. However, this does not prevent additional testing, using different fastening, to support design pressure ratings for other applications, such as special high wind installations.

A1.3.2.2 The pressure equalization factor and safety factor are the same as those used to determine the test pressure in A1.2.1, using the following equation:

$$D_{Rstd} = \frac{P_m}{(PEF \times SF)} \quad \text{(A1.7)}$$

where:

D_{Rstd} = standard design pressure rating, lbf/ft^2 (Pa),
P_m = average maximum sustained static test pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, 0.5, and
SF = safety factor, 1.5.

A1.3.3 *Alternative Design Pressure Ratings*—Design pressure ratings for applications other than the standard conditions described above can be developed. Common circumstances

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where this is done include the use of alternative fastening methods in order to achieve a higher design pressure rating, and cases where the sheathing is not capable of independently resisting wind pressures under design conditions, which necessitates a reduction in the siding's design pressure rating.

A1.3.3.1 *Alternative Fastening*—Where an alternative fastening method is specified by the manufacturer, the siding is permitted to be tested under Test Method D5206 using the specified fastening. The resulting average maximum sustained static test pressure is used in the above equation to determine the alternative design pressure rating. In order for this alternative rating to be realized, the siding must be installed using the alternative method, and the rating must be clearly tied to installation requirements in manufacturer's literature and instructions.

A1.3.3.2 *Alternative Sheathing*—An adjusted design pressure rating for use of the siding over sheathings not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, as discussed in A1.2.6, can be calculated using the above equation if the appropriate PEF and safety factor are specified.

A1.3.3.3 Alternative PEF and safety factor values have been documented (see 2009 and 2012 International Residential Code, section R703.11.2) for one type of sheathing, foam plastic insulating sheathing complying with ANSI/SBCA FS 100. Two wall assembly cases are considered: 1) where the interior surface of the wall is covered with gypsum wall board or equivalent; and 2) where the interior surface of the wall is not covered with gypsum wall board or equivalent. In both cases the siding is installed directly over foam sheathing, which is then attached directly to framing, without intervening sheathing. The PEF and safety factor for each case are as follows:

Case	PEF	Safety Factor
Case 1	0.7	2.0
Case 2	1.0	2.0

A1.3.3.4 Adjustment of the standard design pressure rating is not necessary when foam plastic insulating sheathing is installed directly over sheathing that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, or where the sheathing is fastened in a way that allows it to independently resist the design wind pressure. For such cases the standard design pressure rating is applied.

A1.4 Design Wind Speeds

A1.4.1 The wind velocity maps in ASCE 7-10 provide one source of design wind speeds for particular geographic regions. The velocities on these maps are stated in terms of "ultimate," 700-year return interval speeds. To be used in the procedure in this Annex, those velocities need to be converted to the ASD equivalent in accordance with A1.1.2, and the resulting velocity *V* used in the equation in A1.1.3. The 2012 and 2015 International Building Code and 2015 International Residential Code also contain maps based on ultimate wind speeds.

A1.4.2 Other maps are available that do not require conversion of wind velocities. Examples include the wind map in the 2012 International Residential Code, on which the velocities have already been converted from those on the ASCE 7-10 maps. Maps from previous editions of ASCE 7 used ASD velocities and do not require conversion. However, only editions since 1995 used the 3-second gust basis that is used in this Annex. The 1998, 2002, and 2005 editions of ASCE 7 continued the use of 3-second gust wind basis, but with improved hazard modeling of hurricane wind speeds first made in the 1998 edition. These previous editions also do not have the benefit of further improved hurricane wind modeling that was incorporated into the maps used in ASCE 7-10.

APPENDIX

(Nonmandatory Information)

X1. VINYL SIDING, BACKED SIDING, AND INSULATED VINYL SIDING

X1.1 Relationships among types of vinyl siding

X1.1.1 Conventional vinyl siding is covered by ASTM D3679, Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding. D3679 includes provisions for the materials and performance of vinyl siding, including minimum PVC composition and percentage of recycled material, dimensional requirements, impact resistance, resistance to surface distortion and deterioration, thermal expansion, windload resistance, etc.

X1.1.2 Backed vinyl siding is vinyl siding that includes an integral foam plastic backing material, and is covered by Specification D7445. That specification includes many of the same requirements as are found in D3679, which are applied to the vinyl siding "skin" of the product. Additional requirements, which apply to the foam backing itself, or to the full product including both siding and foam, are also included in Specification D7445

X1.1.3 Insulated vinyl siding, which is the subject of this standard specification, may be thought of as backed vinyl siding that is able to meet enhanced requirements. Chief among those is the requirement that insulated vinyl siding demonstrate a minimum thermal resistance, or R-value. While the foam backing of backed vinyl siding may, or may not, impart some R-value, it is not required to demonstrate that. To be considered "insulated vinyl siding" the product must demonstrate that it delivers the minimum R-value.

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X1.1.4 As with backed vinyl siding, insulated vinyl siding is composed of a vinyl siding "skin" and foam plastic insulation. The vinyl siding portion must meet specific requirements for vinyl siding, which parallel with those in D3679. As with backed vinyl siding, insulated vinyl siding is subjected to additional requirements that apply to the foam or to the full product including siding and foam. In some cases the minimum specification or performance level is higher for insulated vinyl siding compared to backed vinyl siding. This is consistent with the intent that insulated vinyl siding be understood as offering enhanced performance and tangible benefits over the more basic backed vinyl siding.

REFERENCES

(1) ASHRAE Handbook of Fundamentals, American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. Chapter 26, 1977.
(2) "Wind Forces on Structures," Transactions of the American Society of Civil Engineers, Vol 126, Part II, 1961, pp. 1124–1198.
(3) AAMA, CW 11-85, American Architectural Manufacturers Assn., Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing, American Architectural Manufacturers Assn., 1827 Walden Office Square - Suite 550, Schaumburg, IL.
(4) Thom, H. C. S., New Distribution of Extreme Winds in the United States , American Society of Civil Engineers, Environmental Engineering Conference Preprint 431, Dallas, TX, Feb. 6, 1967.
(5) Sachs, Peter, Wind Forces in Engineering, Pergamon Press, Elmsford, NY 1972.
(6) MacDonald, A. J., Wind Loading on Buildings, Applied Sciences Publishers, Ltd., Essex, England, 1975.
(7) Houghton, E., and Carruthers, N., Wind Forces on Buildings and Structures , John Wiley & Sons, New York, NY, 1976.

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D7793 - 17) that may impact the use of this standard. (December 1, 2020)

(1) Revised 1.1.

(2) Added 5.2.6 and 6.19.

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Designation: D7445 – 24

Standard Specification for

Rigid Poly(Vinyl Chloride) (PVC) Siding with Foam Plastic Backing (Backed Vinyl Siding)[11]

An American National Standard

This standard is issued under the fixed designation D7445; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope *

1.1 This specification establishes requirements for vinyl siding with integral foam plastic backing, where the siding is manufactured from rigid PVC compound. Performance requirements and test methods addressed by this standard include materials properties and dimensions, warp, shrinkage, impact strength, expansion, appearance, flame spread, and wind load resistance. Methods of indicating compliance with this specification are also provided.

NOTE 1—Backed vinyl siding is composed of two major components: the siding and the backing. It is intended that the siding portion comply with Specification D3679. Applicable portions of Specification D3679 are included in this specification. Additional requirements that pertain only to the backing as a separate material, or to the combination of siding and backing as a whole, are also included.

1.2 Backed vinyl siding shall be tested with the backing material in place or removed, as specified in the applicable requirement or test method.

1.3 The use of PVC recycled plastic in this product shall be in accordance with the requirements in Section 4.

1.4 Siding produced to this specification shall be installed in accordance with Practice D4756. Reference shall also be made to the manufacturer's installation instructions for the specific product to be installed.

NOTE 2—Information with regard to siding maintenance shall be obtained from the manufacturer.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 3—There is no known ISO equivalent to this standard.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[22]

D618 Practice for Conditioning Plastics for Testing

D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between –30°C and 30°C with a Vitreous Silica Dilatometer

D883 Terminology Relating to Plastics

[1] This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.24 on Plastic Building Products.

Current edition approved X 1, 2024. Published X 2024. Originally approved in 1979. Last previous edition approved in 2018 as D7445 – 18. DOI: 10.1520/D7445-24.

*A Summary of Changes section appears at the end of this standard.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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D1042 Test Method for Linear Dimensional Changes of Plastics Caused by Exposure to Heat and Moisture

D1435 Practice for Outdoor Weathering of Plastics

D1600 Terminology for Abbreviated Terms Relating to Plastics (Withdrawn 2024)[3]

D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

D2457 Test Method for Specular Gloss of Plastic Films and Solid Plastics

D3679 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding

D3892 Practice for Packaging/Packing of Plastics

D4226 Test Methods for Impact Resistance of Rigid Poly(Vinyl Chloride) (PVC) Building Products

D4756 Practice for Installation of Rigid Poly(Vinyl Chloride) (PVC) Siding and Soffit (Withdrawn 2023)[3]

D5206 Test Method for Windload Resistance of Rigid Plastic Siding

D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens

D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)[3]

D7793 Specification for Insulated Vinyl Siding

E84 Test Method for Surface Burning Characteristics of Building Materials

E631 Terminology of Building Constructions

E1753 Practice for Use of Qualitative Chemical Spot Test Kits for Detection of Lead in Dry Paint Films

G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

2.2 *ASCE Standard:*[4]

ASCE 7-10 Minimum Design loads for Buildings and Other Structures

2.3 *International Code Council:*[5]

International Building Code

International Residential Code

2.4 *Vinyl Siding Institute, Inc.:*[6]

VSI Vinyl Siding Installation Manual (2015)

2.5 *Structural Building Components Association:*[7]

ANSI/SBCA FS 100-2012 Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies

3. Terminology

3.1 Definitions are in accordance with Terminologies D883, E631, and D1600, unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *backed vinyl siding*—a vinyl cladding product sold with manufacturer-installed foam plastic backing material as an integral part of the cladding product. The vinyl cladding portion of backed vinyl siding meets the definition of vinyl siding. Backed vinyl siding is intended to be installed only with the integral backing.

3.2.2 *backing material; foam plastic backing*—a layer or layers of plastic that has been intentionally expanded to produce a reduced-density plastic containing voids consisting of open or closed cells distributed throughout the plastic.

3.2.3 *nominal*—the value that a manufacturer consistently uses to represent a specific property or dimension of a vinyl

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.

[5] Available from International Code Council (ICC), 500 New Jersey Ave., NW, 6th Floor, Washington, DC 20001, http://www.iccsafe.org.

[6] National Housing Center, 1201 15th Street NW, Suite 220, Washington, DC 20005, http://www.vinylsiding.org

[7] 6300 Enterprise Lane, Madison, WI 53719, http://www.sbcindustry.com

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siding product in public claims including, but not limited to, product literature, advertisements, quotations, and certificates of conformance.

3.2.4 *process average thickness*—the rolling, arithmetic mean of average specimen thicknesses measured according to 6.5 for a specific product during all productions runs for the most recent six month period.

3.2.5 *wind load design pressure rating*—the maximum wind pressure that a backed vinyl siding product is rated to withstand, based on testing under Test Method D5206.

3.2.5.1 *standard wind load design pressure rating*—the wind load design pressure rating for a siding product when installed 1) over a sheathing material designed and attached such that it is capable of resisting 100 % of positive and negative wind pressures occurring under design conditions at the building location; and 2) with the standard fastening method specified in building codes, general installation instructions, and the siding manufacturer's instructions.

3.2.5.2 *alternative wind load design pressure rating*—the wind load design pressure rating for a siding product when installed over a sheathing not designed and attached such that it is capable of resisting 100 % of positive and negative wind pressures occurring under design conditions at the building location, or when the siding is not fastened in the standard way; as specified by the manufacturer.

3.2.5.3 *Discussion*—The standard test conditions, configuration, and fastening method used in this specification are specified in 6.14, while alternative sheathing and installation conditions are specified by the manufacturer and must be reflected in the product's installation instructions. Alternative ratings apply only when the specified sheathing and fastening conditions are used. See Annex A1 for information on differences between the standard wind load design pressure rating and alternative wind load design pressure ratings, and how to determine standard and alternative design pressure ratings.

3.2.6 *temperate northern climate*—in weather testing, a North American metropolitan area testing site located within 73 to 100°W longitude and 37 to 45°N latitude.

3.2.7 *vinyl siding*—a shaped material, made principally from rigid poly(vinyl chloride) (PVC), that is used to clad exterior walls of buildings; in this standard, vinyl siding refers to the rigid profile to which the backing material is attached.

3.2.7.1 *Discussion*—Any exception to a homogeneous rigid PVC compound is present in a coextruded or laminated capstock.

4. Materials and Manufacture

4.1 The vinyl siding, exclusive of backing material, shall be made of one or more layers of poly(vinyl chloride) (PVC) compound. Any layers of materials other than poly (vinyl chloride) (PVC) compound shall be kept to less than 20 % by volume. This limitation does not apply to the backing material.

4.2 Where rigid PVC recycled plastic as defined in Guide D7209 is used, the siding containing the PVC recycled plastic shall meet all of the requirements of 3,Terminology; 4, Materials and Manufacture; and 5, Physical Requirements.

4.3 The poly(vinyl chloride) siding material, exclusive of backing material, when tested in accordance with Test Method D635, shall not exceed an average extent of burn of 4 in. (100 mm), with an average time of burn not to exceed 10 s. A minimum sample thickness of 0.035 in. (0.9 mm) is required. **Warning—**The flammability testing data, conclusions, and recommendations of Test Method D635 relate solely to the measurement and description of properties for classification of the poly(vinyl chloride) siding material in response to flame under controlled laboratory conditions and shall not be used for the description or appraisal of the fire hazard of vinyl siding under actual fire conditions.

4.4 The foam plastic backing shall have a Flame Spread Index not greater than 75 and a Smoke Developed Index not greater than 450 when tested separately under method E84.

4.5 The PVC compound when extruded into siding shall maintain uniform color and be free of any visual surface or structural changes, such as peeling, chipping, cracking, flaking, or pitting.

4.6 The PVC compound shall be compounded so as to provide the heat stability and weather exposure stability required for the siding market application.

4.7 Backed vinyl siding shall not contain elemental lead (Pb) or compounds of that material other than traces incidental to raw materials or the manufacturing process. This limitation applies to both PVC substrate and to any cap or film material, as well as the backing material. Compliance with this requirement shall be demonstrated by one of the methods in 6.16.

5. Physical Requirements

5.1 *Requirements Applicable to Vinyl Siding*—The provisions of 5.1.1 – 5.1.8 apply only to the vinyl siding, exclusive of any backing material. Where necessary to perform testing, the backing material shall be removed.

5.1.1 *Length and Width*—The nominal length and width of the siding shall be as agreed upon between the purchaser and the seller. The actual length shall not be less than $^{1}/_{4}$ in. (6.4 mm) of the nominal length and the actual width shall be within ± $^{1}/_{16}$ in. (1.6 mm) of the nominal width when measured in accordance with 6.3 and 6.4.

5.1.2 *Thickness*—These requirements pertain only to measurements of the portions of the siding that are exposed after

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installation of the panel, measured in accordance with the procedure in 6.5. The average thickness of each specimen shall be no less than 0.035 in. No individual measurement shall be thinner than 0.003 in. below the nominal thickness. The process average thickness as defined in 3.2.4 shall be no thinner than 0.001 in. below the nominal thickness.

5.1.3 *Camber*—A full length of siding (typically 10 or 12 ft (3.05 or 3.61 m)) shall not have a camber greater than $^{1}/_{8}$ in. (3.2 mm) when measured in accordance with 6.6.

5.1.4 *Heat Shrinkage*—The average heat shrinkage shall not exceed 3.0 % when determined by the method described in 6.7.

5.1.5 *Impact Resistance*—Siding shall have a minimum impact strength of 60 in.·lbf (6.78 J) when tested in accordance with 6.8.

5.1.6 *Coefficient of Linear Expansion*—The siding shall have a coefficient of linear expansion not greater than 4.5 by 10^{-5}in./in./°F (8.1 by 10^{-5} mm/mm/°C) when tested in accordance with 6.9.

5.1.7 *Gloss*—The gloss of smooth and embossed vinyl siding shall be uniform across the exposed surface. The average of all readings for a panel determined in 6.11.2.5 shall not differ from the manufacturer's specified gloss value more than the permitted variation in Table 1, and each individual reading shall not vary more than 10 points from the average. Gloss of smooth and embossed vinyl siding shall be tested in accordance with 6.11.

TABLE 1 Gloss Values

Manufacturer's Specified Gloss Value	Permitted Difference from Manufacturer's Specified Gloss Value
Less than or equal to 35	±8
Greater than 35	±10

5.1.8 *Uniformity of Color*—The color specified shall be uniform on the exposed surface of the vinyl siding panels, except on the case of variegated colors. When tested in accordance with 6.13, the total color change, ΔE, between a production specimen and the appropriate reference specimen or agreed-upon color coordinates shall not vary by more than 1.5, and the chromatic coordinates thereof shall not change by more than $\pm\Delta a_H = 1.0$ and $\pm\Delta b_H = 1.0$.

5.1.9 *Weathering:*

5.1.9.1 The vinyl siding shall maintain a uniform color and be free of any visual surface or structural changes such as peeling, chipping, cracking, flaking, and pitting when tested in accordance with 6.10.

NOTE 4—Weathering-conformance-testing requirements are to reflect performance of a "typical" extrusion siding profile representing a specific color of PVC compound and a specific extrusion technology. In no case is there an implied requirement for testing all the various shaped and sized siding profiles produced in this color. The lengthy outdoor weatherability testing for new products may be performed concurrently with market development and sales of siding to existing markets. Completion of weatherability testing prior to marketing of the product is not required.

5.2 *Requirements Applicable to Backed Vinyl Siding*—The provisions of 5.2.1 – 5.2.3 apply to backed vinyl siding, including the integral foam backing material. Testing shall be conducted with the backing material in place, as described in the referenced test method.

5.2.1 *Surface Distortion*—The *backed vinyl* siding shall be free of bulges, waves, and ripples when tested to a minimum temperature of 150°F (66°C) in accordance with the procedure in 6.12. This distortion is called "oil-canning."

5.2.2 *Wind Load Resistance*—The siding shall withstand a minimum static test pressure and a standard wind load design pressure rating shall be determined.

5.2.2.1 *Minimum Test Pressure*—Backed siding shall be able to withstand a minimum test pressure of 22.5 lbf/ft^2 (1077 Pa) when tested in accordance with 6.14. The average maximum sustained static test pressure determined in 6.14 shall be equal to or greater than this value. If the manufacturer of backed siding provides documentation to support compensation for pressure equalization, the test pressure shall be determined from Annex A1 using the documented pressure equalization factor.

NOTE 5—The static test pressure of 22.5 lbf/ft^2 (1077 Pa) for backed siding was established to withstand structural loading conditions that occur in wind exposures of approximately 110 mph (177 km/h) (V_{ASD}) for mean roof heights of 30 ft (9.1 m) and less in exposure category B, and corresponds to 30.0 lbf/ft^2 (1436 Pa) negative design pressure, to match the default wind design conditions of Table R703.3(1) in the 2015 International Residential Code. Provision is made for compensation for pressure equalization specific to the product if supporting documentation is provided, using procedures in Annex A1.

NOTE 6—Refer to Annex A1 for an explanation as to how the negative design pressure was established, and for applications where the effective negative design pressure as specified in ASCE 7-10 is different from 30.0 lbf/ft^2 (1436 Pa) (for example, wind-zone areas greater than about 110 mph (177 km/h) (V_{ASD}) (225 km/h (V_{ULT})) or mean roof height above 30 ft (9.1 m), or exposures other than exposure category B).

(1) The design-pressure values can be negative (suction loads) or positive. The negative values are the largest in

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magnitude and are the values used in this specification.

NOTE 7—In that the siding is being tested as a weather-resistant exterior product applied to an existing exterior structural wall, forces (negative) working to pull the siding off the wall, fasteners, or disengage locks will be the most important criteria for testing. Positive wind forces test the integrity of the total wall sections, and do not provide a measure of the performance of the siding.

5.2.2.2 *Standard Wind Load Design Pressure Rating*—The standard wind load design pressure rating shall be determined from the results of testing in accordance with 6.14, using the procedures described in A1.3.

NOTE 8—The standard design pressure rating is valid for applications where the siding is installed over sheathing and its fastening that are capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location. For applications over other sheathing, a different design pressure rating is applicable, and is determined in accordance with A1.3. Determination of a rating other than the standard design pressure rating is not required by this section.

5.2.2.3 *Alternative Design Pressure Ratings*—Design pressure ratings other than the standard wind load design pressure rating, for use with different sheathing materials or using different installation or fastening, are permitted to be determined in accordance with testing under 6.14, using the procedures in Annex A1.

5.2.3 *Nail Slot Allowance for Thermal Expansion*—For siding panels utilizing nail slots to allow for thermal expansion and contraction, the nail slot shall be sized to allow for the expected range of expansion and contraction over a range of 100°F. Compliance with this requirement shall be demonstrated either by the test method in 6.15 or by sizing of the nail slots according to the specifications in the following sections. The instrument used shall be capable of measuring to the nearest 0.01 in. The manufacturing tolerance shall not exceed -0.030 in.

5.2.3.1 For panels shorter than 6 ft (1829 mm) in length, the minimum nail slot width shall be $^{3}/_{8}$ in. (11.4 mm).

5.2.3.2 For panels 6 ft (1829 mm) in length or longer the minimum nail slot width shall be determined according to the following formula. The minimum width shall be the width resulting from application of the formula, rounded to the next lower quarter-inch. Regardless of the results of the calculation, the minimum nail slot width for panels 6 feet or longer shall be 1 in (25.4 mm).

$$WS = P_c \times (\alpha \times 100\,°F \times L) + T_c \qquad (1)$$

WS = minimum width of nail slot, in.,

P_c = center-pinning coefficient: 1 if manufacturer's instructions require panel to be center-pinned; 1.5 if center-pinning is not required,

α = coefficient of linear thermal expansion, 4.5×10^{-5} in./in./°F or actual known coefficient for material used, as determined by 6.9,

L = length of panel, inches, and

T_c = centering tolerance: 0.25 in.

5.2.4 *Flame Spread*—Backed vinyl siding shall have a Flame Spread Index not greater than 200 when tested in accordance with 6.17.

6. Test Methods

6.1 *General*—The inspection and test procedures contained in this section are used to determine the conformance of products to the requirements of this specification. Each producer who represents its products as conforming to this specification shall be permitted to use statistically based sampling plans that are appropriate for each manufacturing process, but shall keep the essential records necessary to document, with a high degree of assurance, his claim that all of the requirements of this specification have been met. Additional sampling and testing of the product, as agreed upon between the purchaser and the manufacturer, are not precluded by this section.

6.2 *Conditioning and Test Conditions*—Condition the test specimen in accordance with Procedure A of Practice D618 and test under those conditions, unless otherwise specified herein.

6.3 *Length*—Lay the specimen on a flat surface and measure with a steel tape. Measure the length of a siding panel to the nearest $^{1}/_{16}$ in. (1.6 mm) at the center, the butt edge, and the bottom of the top lock. The average of the three measurements is the actual length.

6.4 *Width*—Interlock two long specimens, each at least 26 in. (600 mm) long, in the normal mode for installation. Lay the two specimens on a flat surface. Measure to the nearest $^{1}/_{16}$ in. (1.6 mm), the distance between the lowest butt edge of the top specimen and the lowest butt edge of the bottom specimen. Commencing approximately 1 in. (25 mm) from one end of the

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specimens, make five measurements at 6 in. (152 mm) intervals, making sure that the measurement is made perpendicular to the butt edge. Average the measurements. The average constitutes the exposed width of siding.

6.5 Thickness shall be measured in accordance with Test Method A of Test Method D5947. The micrometer shall be calibrated in accordance with Section 8 of Test Method D5947. The thickness of the siding shall be measured at a minimum of 5 locations equally spaced across the entire portion of the siding that will be exposed after installation. All measurements shall be taken to the nearest 0.001 in. Calculate and report the average of these measurements. Also report the thinnest individual measurement.

6.6 *Camber*—Place a full length of siding (typically 10 or 12 ft (3.05 or 3.61 m)) on a flat surface alongside a straightedge at least as long as the siding specimen. Measure the maximum space between edge of the siding specimen and the straightedge for each edge to the nearest $^{1}/_{16}$ in. (1.6 mm).

6.7 *Heat Shrinkage:*

6.7.1 *Apparatus:*

6.7.1.1 *Scriber,*similar to that described in Test Method D1042, with the exception that the needle points shall be separated by 10 ± 0.01 in. (254 ± 0.254 mm).

6.7.1.2 *Test Media,*a controlled-temperature water bath of 5 gal (10 L) or more, equipped with an efficient stirrer that will maintain uniform temperature throughout. Heater and temperature-control devices must maintain the water at 160 ± 1°F (71 ± 0.5°C). Use a wire rack to raise and lower specimens into the water bath. As an alternative to the use of a water bath, the specimens may be heated for 30 min in a uniformly heated forced-air oven maintained at a temperature of 160 ± 1°F (71 ± 0.5°C).

6.7.1.3 Make measurements with any device capable of measuring the distance between two scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2 *Procedure:*

6.7.2.1 Cut three specimens from the siding panel, each 1 in. (25.4 mm) wide by 12 in. (305 mm) long. Cut one specimen from the center and one from each of the extreme edges of the flat surface. The long axis shall be parallel to the machine direction.

6.7.2.2 Condition specimens at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity for at least 24 h.

6.7.2.3 Make a slight mark with the scribe on each specimen so that a reference point will be clearly visible.

6.7.2.4 Place specimens in the test medium.

6.7.2.5 Remove specimens after 30 min and place on a flat surface until cool.

6.7.2.6 Repeat conditioning in accordance with 6.7.2.2.

6.7.2.7 Make a second mark with the scribe on each specimen, using the same center.

6.7.2.8 Measure the distance, *D*, between the scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2.9 Calculate the percent shrinkage as $(D/10) \times 100$.

6.7.2.10 Report the average shrinkage of the three specimens tested.

6.8 *Impact Resistance*—Test impact resistance of siding in accordance with Test Method D4226, Procedure A, impactor head configuration H.25. 4 in.-lb increments (0.5 in. height increments with 8 lb falling weight) shall be used. Minimum sample dimensions shall be 1.5 by 1.5 in. Samples shall be tested with the normally exposed surface facing up. Backed siding shall be tested with any backing material removed. Conditioning time for quality-control tests shall be at least 1 h.

6.8.1 For purposes of evaluating failure of the specimen under section 3.2.1 of Test Method D4226, a ductile tear of less than 0.2 in. (5 mm) in length shall not be considered a failure. Any brittle break of any dimensions is considered a failure.

6.9 *Coefficient of Linear Expansion*—Conduct this test in accordance with Test Method D696.

6.10 *Weatherability:*

6.10.1 A minimum of three samples shall be exposed at each of at least three test sites. Test sites shall be located in a northern temperate climate, represented by Cleveland, Ohio or Louisville, Kentucky; a hot, humid climate represented by Miami, Florida; and a hot, dry climate represented by Phoenix, Arizona. The samples shall be exposed for a minimum of 24 months.

6.10.2 Samples shall consist of a flat section of siding with minimum dimensions of 2 in. by 3 $^{3}/_{4}$ in. (25 mm by 95 mm).

6.10.3 Samples shall be representative of the product to be evaluated.

NOTE 9—Samples prepared in the laboratory in the same manner as commercial samples are permitted to be used as an alternative to a commercial part. If the commercial product is extruded, the laboratory specimen must be extruded; if the commercial product is injection molded, the laboratory specimen must be injection molded, and so forth.

6.10.4 Select a minimum of 4 specimens per sample per test site to allow for 3 test specimens and 1 file specimen for each sample evaluated.

6.10.5 Mark each specimen permanently to ensure retention of identity during and after exposure testing.

NOTE 10—Use of a vibratool leaves a permanent mark that satisfies this criterion.

6.10.6 All exposures shall be conducted at an angle of 45° South, plywood backed, in accordance with Practice D1435 and

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6.10.7 After a minimum of 24 months of exposure, remove the samples and inspect each exposed test specimen for appearance and surface condition. Record observations and inspection date in a permanent record.

6.11 *Gloss:*

6.11.1 *Apparatus*—Measure gloss using a 75° geometry glossmeter that meets the requirements of the Apparatus section of Test Method D2457.

6.11.2 *Procedure:*

6.11.2.1 Gloss measurements shall be made in accordance with the procedure in Section 9 of Test Method D2457, unless otherwise specified herein.

6.11.2.2 Measure gloss on one piece of siding on at least three widely separated sections across the width of the exposed surface of the panel. At least one reading shall be taken on each face of the panel. Use new surface area for each reading to avoid scratches caused by instrument contact. The area tested must be flat. If a flat area on the exposed surface cannot be found due to the style or depth of embossing of the panel being tested, then a non-exposed area of the panel shall be chosen in its place. Such locations shall be representative of the gloss of the area that will be exposed after installation.

6.11.2.3 Measure gloss parallel to the direction of embossing. When the embossing pattern is not apparent, measure the gloss in the direction of extrusion.

6.11.2.4 Each reading shall be within the appropriate limit specified in 5.1.7.

6.11.2.5 The average reading of all readings shall be used to represent the gloss of the sample.

6.12 *Surface Distortion:*

6.12.1 *Test Specimen/Apparatus:*

6.12.1.1 The test specimen shall consist of three courses of backed vinyl siding, a minimum of 6 ft (1.83 m) in length, mounted on a flat rigid frame in accordance with the manufacturer's recommended installation instructions.

(1) Horizontal Siding—The middle course shall consist of two lengths of backed vinyl siding, both with a factory-fabricated end, one section overlapping the other section. The end of the overlapping section shall be located not less than 3 in. (76 mm) and not more than 6 in. (152 mm) from the center of the course. Unless specified otherwise by the manufacturer's installation instructions, the insulation of the two lengths of backed vinyl siding shall be butted firmly together.

(2) Vertical Siding—The middle course shall consist of a single, uninterrupted backed vinyl siding panel, without overlap.

6.12.1.2 A thermocouple or other heat-sensing element shall be located at the horizontal midpoint of the backside of the middle course of backed vinyl siding. The heat-sensing element shall be in contact with the back of the vinyl cladding. Any backing material removed to facilitate placement of the heat sensing element shall be replaced.

6.12.1.3 *Radiant-Heat Rod,*600 W for each linear foot (0.31 m), mounted parallel to the middle course and approximately 32 in. (810 mm) away from the surface of the backed vinyl siding.

6.12.1.4 *Temperature-Control Device,*used to regulate the temperature of the radiant-heat rod, shall be able to maintain the conditions specified in 6.12.2.1.

6.12.1.5 *Gap Measurement Device*—A cylindrical pin gauge, $^{1}/_{4}$ ±0.005 in. (6±0.127 mm) in diameter is used to evaluate the size of any gap in the overlapped sections of horizontal backed vinyl siding during the heating period. The pin gauge is attached to a rod such that the gauge can be inserted into a gap while held parallel to the plane of the backed vinyl siding. The rod shall be sufficiently long to permit insertion of the gauge from beyond the edge to the test frame, not interfere with the exposure of the sample to radiant heat, and otherwise not interfere with conduct of the test.

6.12.2 *Procedure:*

6.12.2.1 Heat the test panel (middle course of backed vinyl siding) at a rate of 3.0 to 6.0°F/min (1.7 to 3.3°C/min) until a minimum temperature of 150°F (66°C) is achieved as measured by the heat-sensing element on the midpoint of the backside of the middle course. For temperatures equal to or greater than 130°F (54°C), the rate of heating is permitted to be not less than 2.0°F/min (1.1°C/min), provided that the average heating rate from the ambient temperature to 150°F (66°C) is within 3.0 to 6.0°F/min (1.7 to 3.3°C/min). When a temperature of 150°F (66°C) is attained, shut off the heat source.

6.12.2.2 During this heating period, observe the middle course of the backed vinyl siding for surface distortion and observe for any opening or gap at the end of the overlapped section. If the overlap appears to have opened to approximately $^{1}/_{4}$ in. (6 mm), attempt to insert the gap measurement device into the opening. If the device can be inserted in to the opening to any depth at any location along the overlap, the opening shall be considered to be at least $^{1}/_{4}$ in. (6 mm).

6.12.2.3 Failure is defined as:

(1) the appearance of bulges, waves, or ripples on any surface of the middle course of the backed vinyl siding;

(2) occurrence of a gap or opening $^{1}/_{4}$ in. (6 mm) or greater at any point along the end of the overlapped section, as determined by use of the gap measurement device, at any time or before a temperature of 150°F (66°C) is reached.

6.13 *Color Uniformity*—Calculate the difference between the L_H, a_H, and b_H color coordinates for a production specimen to

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those of either the appropriate reference specimen or the agreed upon color coordinates for that specific color product in accordance with Test Method D2244. Calculate the total difference *ΔE* between the production specimen and the reference specimen in accordance with Test Method D2244.

6.14 *Wind Load Resistance*—Conduct the test on wind load resistance of finished siding in accordance with Test Method D5206. The average maximum sustained static test pressure determined from this testing is used in 5.2.2. For purposes of determining compliance with the minimum test pressure and standard design pressure requirements in 5.2.2, the test structure shall be constructed with vertical studs 16 in. on center. The siding shall be tested with the foam plastic backing attached to the vinyl siding. The siding in the test installation shall be installed over wood sheathing with a nominal thickness of $^{7}/_{16}$ to $^{1}/_{2}$ in., and fastened as follows:

6.14.1 *Fastener type*—Roofing nail, smooth shank, 0.120 in. ($^{1}/_{8}$ in. nominal; 3.2 mm) shank diameter, $^{5}/_{16}$ in. (7.9 mm) head diameter, length as necessary to penetrate into sheathing and stud a total of 1 $^{1}/_{4}$ in. (32 mm). For vertical siding, length as necessary to penetrate the thickness of the sheathing plus $^{1}/_{4}$ in. (6.4 mm).

6.14.2 *Fastener Spacing*—Every 16 in. (406 mm) into center of stud for horizontal siding. For vertical siding, every 12 in. into sheathing only.

6.14.3 Fasteners shall not be driven tightly against the siding. Allow approximately $^{1}/_{32}$ in. (0.8 mm) clearance between the fastener head and siding surface.

NOTE 11—The installation details described 6.14 conform to the minimum requirements of the 2015 International Residential Code and the VSI Vinyl Siding Installation Manual.

6.15 *Nail Slot Allowance for Thermal Expansion*—As an alternative to conformance with the nail slot width specification in 5.2.3.1 or 5.2.3.2, provision for thermal expansion and contraction shall be demonstrated through the following test procedure.

6.15.1 *Samples*—At least 3 samples of each profile in which the siding is produced shall be provided. The length of each sample shall be at least 50 % of the longest length in which the profile is produced, and not shorter than 12 ft (3658 mm).

6.15.2 *Test Chamber*—The test chamber shall consist of an environmentally controlled room or compartment capable of providing an air temperature range of at least 0°F to 100°F (-18°C to 38°C) without exposure of the panel to radiant energy from heating or cooling elements. Air temperature shall be controlled such that a rate of temperature change of 2°F (1.11°C) per minute can be achieved over the full temperature range, and the minimum and maximum temperatures can be maintained for at least 15 minutes. Means for circulating air to provide a uniform air temperature throughout the chamber shall be provided. A vertical wall shall be provided for mounting of samples. The wall shall be insulated such that, with no panels mounted, the inner surface of the wall does not deviate more than 10°F (5.5°C) from the air temperature at the high and low temperature extremes after a holding period of 5 minutes. The test chamber shall be of sufficient size to accommodate the longest panel to be tested, including expected thermal expansion of the panel. Means shall be provided to measure the actual temperature of the surface of each panel at a minimum of 3 evenly-spaced locations along the length of the panel.

6.15.3 *Length Measurement*—A means for measuring the length of each sample throughout the temperature range shall be provided. The method utilized for length measurement shall not be influenced by the temperature of the chamber and shall have a minimum resolution of no greater than 0.0625 in. (1.59 mm).

6.15.4 *Procedure*—Install the sample panels on the wall inside the test chamber, following the manufacturer's instructions for fastener type, spacing, location and tightness. At ambient temperature measure and record the length of each panel and the temperature of the panel, averaged from a minimum of 3 locations along the length of the panel.

6.15.4.1 *Test Cycle*—Test cycles shall be performed by raising the air temperature to 100°F ± 5°F (38°C ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding the air temperature at 100°F (38°C ± 2.75°C) for 15 minutes, lowering the air temperature to 0°F ± 5°F (-18°C ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding at 0 °F (-18°C ± 2.75°C) for 15 minutes, and returning to ambient temperature at an average rate of 2 °F per minute.

6.15.4.2 *Conditioning*—Close the test chamber and perform at least 2 conditioning cycles using the procedure in 6.15.1. No interruption is required between conditioning cycles.

6.15.4.3 *Test*—Following completion of the conditioning cycles, conduct 3 test cycles using the procedure in 6.15.4.1. It is acceptable for the test cycles to follow immediately upon completion of the final conditioning cycle, and no interruption is required between test cycles. After a minimum holding period of 15 minutes at the high and low extremes of each test cycle, measure and record the length of each panel and the temperature of the panel, averaged from a minimum of 3 locations along the length of the panel.

6.15.5 *Normalization*—From among the length measurements recorded for all three cycles, identify the shortest and longest length of each panel, and the average panel temperature at the time that length was recorded. Determine the maximum difference in length, ΔL, and the maximum difference in temperature, ΔT, by subtracting the smaller from the larger. Normalize the change in length to the full length of the panel over a 100 °F (38 °C) temperature range using the following formula:

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$$E_t = \Delta L \times (100/\Delta T) \times (L_f/L_t) \quad (2)$$

E_t = total thermal expansion and contraction of a full length panel over a range of 100°F (38°C),

ΔL = maximum change in length of the tested panel,

ΔT = maximum change in temperature of the tested panel,

L_f = longest length in which the panel is produced, and

L_t = actual length of the panel as tested.

6.15.6 *Acceptable Performance*—When tested according to this procedure, the result of ($E_t \times 2$) + 0.25 in. for each of the 3 samples for each profile shall not be greater than the width of the nail slot. If the manufacturer's installation instructions require the panel to be center-pinned, the result of E_t + 0.25 in. for each of the 3 samples for each profile shall not be greater than the width of the nail slot.

6.16 *Lead Content:*

6.16.1 Testing for lead content shall be conducted on backed vinyl siding using a rhodizinate-type lead swab test kit conforming to Practice E1753. Testing shall be performed in accordance with the test kit manufacturer's instructions. The backed vinyl siding shall be deemed to comply with 4.7 if the test shows a negative or not-detected result; that is, the test does not indicate the presence of lead. The test shall be conducted separately on the substrate and on any cap or film material.

6.16.2 As an alternative to the method in 6.16.1, and as a means of resolving any ambiguous results from that method, an analytical method capable of detecting lead at least as low as 0.02 percent by sample weight shall be employed. Under this alternative, neither the substrate nor any cap or film shall contain a concentration of lead in excess of 0.02 percent by weight.

6.17 *Flame Spread*—Conduct the test on flame spread of finished backed vinyl siding in accordance with Test Method E84. The test specimen shall either be self-supporting by its own structural characteristics or held in place by added supports along the test specimen surface, or secured from the back side.

7. Packaging and Package Marking

7.1 The siding shall be packed in such a manner as to provide reasonable protection against damage in ordinary handling, transportation, and storage.

7.2 Provisions of Practice D3892 shall apply to this specification.

7.3 To aid identification of siding conforming to all requirements of this specification, producers and distributors shall include a statement of compliance in conjunction with their name and address on product labels, invoices, sales literature, and the like. The following statement is suggested when sufficient space is available:

This PVC siding conforms to all the requirements established in ASTM Specification D7445, developed cooperatively with the industry and published by ASTM.

Full responsibility for the conformance of this product to the specification is assumed by (name and address of producer or distributor).

7.4 The following abbreviated statement is suggested when available space on labels is insufficient for the full statement: Conforms to ASTM Specification D7445 (name and address of producer or distributor).

7.5 The standard wind load design pressure rating determined in accordance with 5.2.2.2 shall be stated on the product or on the product package by one of the means in 7.5.1 or 7.5.2.

7.5.1 The package shall be marked or labeled with the standard wind load design pressure rating. The marking shall be in the format "Standard Wind Load Design Pressure Rating: ##.# psf (ASD)".

7.5.2 The standard design pressure rating shall be included on a line imprint or other marking on the front (outward-facing) surface of all siding panels. It is not required that the marking be visible after installation, provided that the marking can be revealed and read by detaching the lower edge lock of an adjacent course, without removal of any fasteners. The standard design pressure marking shall be stated at least once per panel. The marking shall be in the format "Std Design Pressure Rating: ##.# psf (ASD)".

7.5.3 At the option of the manufacturer, additional marking or labeling of the package or product with alternative wind load design pressure ratings determined in accordance with 5.2.2.3 for use with alternative sheathings, wall configurations or fastening methods is permitted. The marking shall use the format specified in 7.5, shall indicate the type of sheathing or wall configuration for which it is applicable, and shall refer to the manufacturer's instructions for more information and any installation requirements.

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8. Keywords

8.1 plastic building products; plastic weatherability; recycled plastic; rigid PVC siding; specification

ANNEX

(Mandatory Information)

A1. WIND LOAD RESISTANCE TEST DESIGN FACTORS

A1.1 *Wind Load Criteria:*

A1.1.1 ASCE 7-10 is the basis for determining the design pressures used in this specification. Design wind loads are determined on an ASD basis in this specification.

NOTE A1.1—In previous editions of ASCE 7, wind loads were determined using wind speed maps based on a 50-year return period. In ASCE 7-10, maps based on a 700-year return period are used which, for any given location, produce a wind speed approximately 30 % greater than that of the previous maps. This larger magnitude (higher return period) wind speed, referred to as the ultimate wind speed, (V_{ULT}), is used directly (with a load factor of 1.0) to determine nominal wind loads on a Strength Design (LRFD) or "ultimate" wind load basis. When Allowable Stress Design (ASD) is used, ASCE 7-10 provides for these ultimate wind loads, determined from the ultimate wind speed map velocities, to be multiplied by a load factor of 0.6. Alternatively, the adjustment can be made directly to the wind velocity, which is the approach taken in this method (see A1.1.2). This procedure produces results consistent with past ASD wind loads.

A1.1.2 It is necessary to determine whether the wind velocity to be used is based on the maps in ASCE 7-10 or on older maps designed for direct application of ASD. Wind velocity, V, based on ASD is used in this method. Wind speeds determined using the maps in ASCE7-10, referred to as V_{ULT}, are converted to ASD wind speeds, V_{ASD}, by multiplying by the square root of 0.6. Wind speeds based on maps using an ASD basis do not require conversion (see A1.3). Thus:

$$V = V_{ASD} = V_{ULT} \times \sqrt{0.6} \qquad \text{(A1.1)}$$

The V determined in this section is used in the following calculations.

A1.1.3 The velocity pressures, q, used in this specification have been computed using the following equation:

$$q = 0.00256\, K_z K_d V^2 I\,(\,lb/sq\,ft\,) = 0.613\, K_z\, K_d\, V^2 I\,(N/m^2) \qquad \text{(A1.2)}$$

V = wind velocity, mph (km/h). The basic wind speed corresponds to a 3-s gust speed at 33 ft (10.1 m) above ground in exposure category C, as described in ASCE 7-10. A velocity of $V = V_{ASD}$ = 110 mph (177 km/h) was used in this specification. (See Note A1.2and Note A1.3.)

I = "importance factor" as described in editions of ASCE 7 prior to ASCE 7-10. A value of 1.0 is used. This factor is not used where the wind speed has been determined from a map in ASCE 7-10. (See Note A1.4.)

K_z = "velocity pressure coefficient" as described in ASCE 7-10. A "K_z" of 0.70 was used in the wind pressure calculations, which is the value from ASCE 7-10 for a mean roof height of 30 ft (9.1 m) above ground level and Exposure Category B.

K_d = "wind directionality factor" as described in ASCE 7-10. A "K_d" of 0.85 is used.

A1.1.4 Thus, for the given velocity and factors, the velocity pressure = 18.43 lbf/ft^2 (882 Pa).

NOTE A1.2—As explained in Note A1.1, the wind velocity used in this method is converted from the V_{ULT} given by wind speed maps in ASCE 7-10 to V_{ASD} using the equation in A1.1.2. A V_{ULT} wind speed of approximately 140 mph from the maps is equivalent to a V_{ASD} of 110 mph, which is the velocity V used in this specification.

NOTE A1.3—In ASCE 7-10 the default wind speeds are given for exposure category C, and a table is provided to adjust this wind speed for other exposure categories. Since most backed vinyl siding is installed on buildings located in exposure category B, the velocity pressure coefficient, K_z is included in the equation to make this adjustment.

NOTE A1.4—Editions of ASCE 7 prior to ASCE 7-10 included an importance factor to represent the relative significance of the building and the consequences of its loss. Because most backed vinyl siding is installed on residential and light commercial buildings, the importance factor was set at 1.0 by default. ASCE 7-10 has removed the importance factor from the velocity pressure equation, and instead provides a

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different wind speed map for each of the building importance categories (referred to as risk categories in ASCE 7-10). Thus the importance factor will already have been incorporated into the wind speed determined from the appropriate map, and the importance factor is not used for determining velocity pressure using wind speeds from ASCE 7-10 maps.

A1.1.5 ASCE 7-10 recommends various internal and external pressure coefficients, which include gust response factors. These coefficients vary with the effective area of the cladding component, the location of the cladding component relative to building corners, and the configuration of the building (open versus enclosed). The internal and external pressure coefficients are taken from Table 26.11-1 and Figure 30.4-1 of ASCE 7-10. The effective area is taken as 10 square ft (the area of one piece of siding), an enclosed building is assumed, and factors for the building corners are used. The pressure coefficients are as follows:

$$\textit{Internal Pressure Coefficient} = \pm 0.18 \qquad \text{(A1.3)}$$

$$\textit{External Pressure Coefficient} = +1.00 \textit{ and } -1.40$$

The design pressure is calculated by multiplying the velocity pressures by the algebraic sum of the internal and external pressure coefficients.

A1.2 *Design Pressure:*

NOTE A1.5—Because the wind velocity has already been adjusted from an ultimate basis to an ASD basis at the beginning of these calculations, the design pressure determined in this step is an ASD load. This correlates to the design pressure requirements stated in tables in the 2015 International Residential Code and other codes which have also been adjusted to an ASD basis. However, the required design pressures in some other codes and design standards have not been adjusted to an ASD basis. Where required design pressures are based on ultimate wind loads determined from ASCE 7-10 wind speeds, those loads must be multiplied by 0.60 to match the design pressure determined from this equation.

$$\textit{Positive Design Pressure} = (18.43)(1.00+0.18) = 21.74\ \textit{psf} \qquad \text{(A1.4)}$$

$$\textit{Negative Design Pressure} = (18.43)\,(-1.40-0.18) = -29.12\ \textit{psf}$$

A1.2.1 The negative values (suction loads) are the largest in magnitude and are the design values used in this specification. Research conducted by various organizations[8,8] [99] has shown that a certain amount of pressure equalization occurs through residential siding products installed with sheathing under high dynamic pressures. In light of this pressure equalization, the design pressure in the ASCE 7-10 wind load standards is reduced by a factor of 0.5 for backed siding.

A1.2.2 Therefore, the required test pressures are calculated as follows:

$$P_t = D_P \times PEF \times 1.5 \qquad \text{(A1.5)}$$

where:

P_t = test pressure, lbf/ft^2 (Pa),

D_P = design pressure, lbf/ft^2 (Pa),

PEF = pressure equalization factor, backed siding, 0.5, and

1.5 = safety factor.

A1.2.2.1 If documentation in support of the use of compensation for pressure equalization other than 0.5 is provided, use the calculation in A1.2.2, substituting the appropriate pressure equalization factor.

A1.2.3 Using the above equations, in a 110 mph (177 km/h) (V_{ASD}) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, the required minimum uniform load test pressure for backed siding is 21.84 lbf/ft^2 (1046 Pa).

A1.2.3.1 For compliance with 5.2.2, the referenced design pressure has been rounded to -30.0 lbf/ft^2 (1436 Pa) to match

[8] Vinyl Siding Pressure Equalization Factor, Architectural Testing, Inc. Report No. 01–40776.01, September 2002.

[9] Morrison M.J., Cope A.D. "Wind Performance and Evaluation Methods of Multi-Layered Wall Assemblies." Structures Congress, 2735-2748, Portland, OR, 2015.

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the standard design conditions specified by the 2015 International Residential Code. When tested under Test Method D5206, the siding must attain an average maximum sustained static test pressure equal to or greater than the corresponding minimum test pressure of 22.5 lb/ft^2 (1077 Pa).

A1.2.4 For applications where the effective design pressure is greater than -30.0 lbf/ft^2 (1436 Pa) (for example, wind zone areas greater than 110 mph (177 km/h) (V_{ASD}), mean roof height over 30 ft (9.1 m), or exposure conditions other than Exposure B), refer to ASCE 7-10 for the effective design pressure. To be shown to be suitable for the application, when tested under Test Method D5206 the siding must attain an average maximum sustained static test pressure equal to or greater than the minimum test pressure determined by the formula in A1.2.2, using the design pressure, D_P, determined for the application using the procedure in A1.1.2 through A1.2.

A1.2.5 These loading conditions apply only to siding installed without an air space directly over sheathing of a type and fastening method that is capable of independently resisting both positive and negative wind design pressures at the building location. Examples of such sheathing include oriented strand board (OSB) and plywood fastened to resist the design wind pressures. For applications where the siding is installed over open studding, without sheathing, rapid pressure equalization does not occur. In these applications, the load the siding will see is equal to the total design pressure and the pressure equalization factor (PEF) is set to 1.0. The static test pressure required for products used under these conditions is as follows:

$$P_t = D_P \times PEF \times 1.5 \qquad \text{(A1.6)}$$

where:

P_t = static test pressure, lbf/ft^2 (Pa),

D_P = design pressure, lbf/ft^2 (Pa),

PEF = pressure equalization factor, 1.0, and

1.5 = safety factor.

A1.2.5.1 Therefore in a 110 mph (177 km/h) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, siding installed without sheathing would require a uniform load test pressure of 43.72 lbf/ft^2 (2093 Pa).

NOTE A1.6—Building codes and backed vinyl siding installation instructions require backed vinyl siding to be installed over sheathing, so calculation of minimum test pressure for siding installed without sheathing is essentially moot. However, the calculation has been retained for completeness and comparison with other installation conditions.

A1.2.6 When siding is installed over sheathing that is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, a greater percentage of the total wind pressure is transferred to the siding and its fasteners. This has the effect of partially or completely countering the effect of the pressure equalization factor. In these cases a value between 0.5 and 1.0 is used for the pressure equalization factor (PEF).

A1.2.6.1 In addition, in cases where failure of the siding would result in failure of the exterior wall covering assembly (that is, siding and sheathing) a safety factor of greater than 1.5 is indicated.

A1.2.6.2 If the adjusted PEF for a given combination of siding and sheathing is known, and an appropriate safety factor is used, a minimum test pressure can be determined using the equation in A1.2.1. However, it is normally more appropriate to make an adjustment for alternative sheathings when determining the design pressure rating, as discussed in A1.3.

NOTE A1.7—Where the sheathing is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, the layer of siding over the sheathing, and its fastening through the sheathing, act to reinforce the sheathing such that the whole wall covering (siding-sheathing) assembly is capable of resisting such wind pressures. Because siding is tested by itself (not as part of a siding-sheathing assembly) in Test Method D5206, the adjustment of test pressure (before the test) or of the design pressure (after the test) ensures that the wind load resistance of the assembly as a whole is reflected in the rating of the siding.

NOTE A1.8—In some high wind hazard regions, such as south Florida, the exterior wall covering assembly may also be required to meet wind-borne debris impact resistance criteria which would affect the choice of sheathing material to be used together with siding. Such considerations are beyond the scope of this standard.

A1.3 *Wind Design Pressure Rating (Maximum Allowable Pressure):*

A1.3.1 A design pressure rating is the maximum wind pressure that a particular backed vinyl siding product is rated to be able to withstand. It is used in building design and building codes to determine the acceptability of a siding product for use under the design wind conditions for a specific application. To be acceptable, a siding's design pressure rating must be equal to or greater than the design pressure for the specific building at the specific location. The design pressure rating is determined from the average maximum sustained static test pressure for a siding product produced by testing under Test Method D5206,

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the pressure equalization factor, and a safety factor.

A1.3.2 *Standard Design Pressure Rating*—The standard design pressure rating is used for applications where the siding is installed over a sheathing type and fastening method that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location.

A1.3.2.1 The standard design pressure rating assumes that the siding is fastened to the building in the standard manner, with the minimum fastener type, size, spacing, and penetration depth prescribed in Chapter 7 of the International Residential Code and the VSI Vinyl Siding Installation Manual. The installation of the siding for testing under Test Method D5206 must be consistent with these minimum fastening requirements. However, this does not prevent additional testing, using different fastening, to support design pressure ratings for other applications, such as special high wind installations.

A1.3.2.2 The pressure equalization factor and safety factor are the same as those used to determine the test pressure in A1.2.1, using the following equation:

$$D_{Rstd} = \frac{P_m}{(PEF \times SF)} \qquad (0)$$

where:

D_{Rstd} = standard design pressure rating, lbf/ft^2 (Pa),

P_m = average maximum sustained static test pressure, lbf/ft^2 (Pa),

PEF = pressure equalization factor, 0.5, and

SF = safety factor, 1.5.

A1.3.3 *Alternative Design Pressure Ratings*—Design pressure ratings for applications other than the standard conditions described above can be developed. Common circumstances where this is done include the use of alternative fastening methods in order to achieve a higher design pressure rating, and cases where the sheathing is not capable of independently resisting wind pressures under design conditions, which necessitates a reduction in the siding's design pressure rating.

A1.3.3.1 *Alternative Fastening*—Where an alternative fastening method is specified by the manufacturer, the siding is permitted to be tested under Test Method D5206 using the specified fastening. The resulting average maximum sustained static test pressure is used in the above equation to determine the alternative design pressure rating. In order for this alternative rating to be realized, the siding must be installed using the alternative method, and the rating must be clearly tied to installation requirements in manufacturer's literature and instructions.

A1.3.3.2 *Alternative Sheathing*—An adjusted design pressure rating for use of the siding over sheathings not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, as discussed in A1.2.6, can be calculated using the above equation if the appropriate PEF and safety factor are specified.

A1.3.3.3 Alternative PEF and safety factor values have been documented (see 2009 and 2012 International Residential Code, section R703.11.2) for one type of sheathing, foam plastic insulating sheathing complying with ANSI/SBCA FS 100. Two wall assembly cases are considered: 1) where the interior surface of the wall is covered with gypsum wall board or equivalent; and 2) where the interior surface of the wall is not covered with gypsum wall board or equivalent. In both cases the siding is installed directly over foam sheathing, which is then attached directly to framing, without intervening sheathing. The PEF and safety factor for each case are as follows:

Case	PEF	Safety Factor
Case 1	0.7	2.0
Case 2	1.0	2.0

A1.3.3.4 Adjustment of the standard design pressure rating is not necessary when foam plastic insulating sheathing is installed directly over sheathing that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, or where the sheathing is fastened in a way that allows it to independently resist the design wind pressure. For such cases the standard design pressure rating is applied.

A1.4 *Design Wind Speeds:*

A1.4.1 The wind velocity maps in ASCE 7-10 provide one source of design wind pressures for particular geographic regions. The velocities on these maps are stated in terms of "ultimate", 700-year return interval speeds. To be used in the procedure in this Annex, those velocities need to be converted to the ASD equivalent in accordance with A1.1.2, and the resulting velocity V used in the equation in A1.1.3. The 2012 and 2015 International Building Code and 2015 International Residential Code also contain maps based on ultimate wind speeds.

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A1.4.2 Other maps are available that do not require conversion of wind velocities. Examples include the wind map in the 2012 International Residential Code, on which the velocities have already been converted from those on the ASCE 7-10 maps. Maps from previous editions of ASCE 7 used ASD velocities and do not require conversion. However, only editions since 1995 used the 3-second gust basis that is used in this annex. The 1998, 2002, and 2005 editions of ASCE 7 continued the use of 3-second gust wind basis, but with improved hazard modeling of hurricane wind speeds first made in the 1998 edition. These previous editions also do not have the benefit of further improved hurricane hazard modeling that was incorporated into the maps used in ASCE 7-10.

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SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D7445–18) that may impact the use of this standard. (X 1, 2024)

(1) Revised 1.1.
(2) Added 5.2.4 and 6.17.

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S11892-A1Rationale

This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: D7445 – 24

An American National Standard

Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding with Foam Plastic Backing (Backed Vinyl Siding)[1]

This standard is issued under the fixed designation D7445; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification establishes requirements for vinyl siding with integral foam plastic backing, where the siding is manufactured from rigid PVC compound. Performance requirements and test methods addressed by this standard include materials properties and dimensions, warp, shrinkage, impact strength, expansion, appearance, flame spread, and wind load resistance. Methods of indicating compliance with this specification are also provided.

NOTE 1—Backed vinyl siding is composed of two major components: the siding and the backing. It is intended that the siding portion comply with Specification D3679. Applicable portions of Specification D3679 are included in this specification. Additional requirements that pertain only to the backing as a separate material, or to the combination of siding and backing as a whole, are also included.

1.2 Backed vinyl siding shall be tested with the backing material in place or removed, as specified in the applicable requirement or test method.

1.3 The use of PVC recycled plastic in this product shall be in accordance with the requirements in Section 4.

1.4 Siding produced to this specification shall be installed in accordance with Practice D4756. Reference shall also be made to the manufacturer's installation instructions for the specific product to be installed.

NOTE 2—Information with regard to siding maintenance shall be obtained from the manufacturer.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 3—There is no known ISO equivalent to this standard.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing
D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer
D883 Terminology Relating to Plastics
D1042 Test Method for Linear Dimensional Changes of Plastics Caused by Exposure to Heat and Moisture
D1435 Practice for Outdoor Weathering of Plastics
D1600 Terminology for Abbreviated Terms Relating to Plastics (Withdrawn 2024)[3]
D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
D2457 Test Method for Specular Gloss of Plastic Films and Solid Plastics
D3679 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding
D3892 Practice for Packaging/Packing of Plastics
D4226 Test Methods for Impact Resistance of Rigid Poly-(Vinyl Chloride) (PVC) Building Products
D4756 Practice for Installation of Rigid Poly(Vinyl Chloride) (PVC) Siding and Soffit (Withdrawn 2023)[3]
D5206 Test Method for Windload Resistance of Rigid Plastic Siding

[1] This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.24 on Plastic Building Products.

Current edition approved X 1, 2024. Published X 2024. Originally approved in 1979. Last previous edition approved in 2018 as D7445 – 18. DOI: 10.1520/D7445-24.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

***A Summary of Changes section appears at the end of this standard**

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D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens
D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)[3]
D7793 Specification for Insulated Vinyl Siding
E84 Test Method for Surface Burning Characteristics of Building Materials
E631 Terminology of Building Constructions
E1753 Practice for Use of Qualitative Chemical Spot Test Kits for Detection of Lead in Dry Paint Films
G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

2.2 *ASCE Standard:*[4]
ASCE 7-10 Minimum Design loads for Buildings and Other Structures

2.3 *International Code Council:*[5]
International Building Code
International Residential Code

2.4 *Vinyl Siding Institute, Inc.:*[6]
VSI Vinyl Siding Installation Manual (2015)

2.5 *Structural Building Components Association:*[7]
ANSI/SBCA FS 100-2012 Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies

3. Terminology

3.1 Definitions are in accordance with Terminologies D883, E631, and D1600, unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *backed vinyl siding*—a vinyl cladding product sold with manufacturer-installed foam plastic backing material as an integral part of the cladding product. The vinyl cladding portion of backed vinyl siding meets the definition of vinyl siding. Backed vinyl siding is intended to be installed only with the integral backing.

3.2.2 *backing material; foam plastic backing*—a layer or layers of plastic that has been intentionally expanded to produce a reduced-density plastic containing voids consisting of open or closed cells distributed throughout the plastic.

3.2.3 *nominal*—the value that a manufacturer consistently uses to represent a specific property or dimension of a vinyl siding product in public claims including, but not limited to, product literature, advertisements, quotations, and certificates of conformance.

3.2.4 *process average thickness*—the rolling, arithmetic mean of average specimen thicknesses measured according to 6.5 for a specific product during all productions runs for the most recent six month period.

3.2.5 *wind load design pressure rating*—the maximum wind pressure that a backed vinyl siding product is rated to withstand, based on testing under Test Method D5206.

3.2.5.1 *standard wind load design pressure rating*—the wind load design pressure rating for a siding product when installed 1) over a sheathing material designed and attached such that it is capable of resisting 100 % of positive and negative wind pressures occurring under design conditions at the building location; and 2) with the standard fastening method specified in building codes, general installation instructions, and the siding manufacturer's instructions.

3.2.5.2 *alternative wind load design pressure rating*—the wind load design pressure rating for a siding product when installed over a sheathing not designed and attached such that it is capable of resisting 100 % of positive and negative wind pressures occurring under design conditions at the building location, or when the siding is not fastened in the standard way; as specified by the manufacturer.

3.2.5.3 *Discussion*—The standard test conditions, configuration, and fastening method used in this specification are specified in 6.14, while alternative sheathing and installation conditions are specified by the manufacturer and must be reflected in the product's installation instructions. Alternative ratings apply only when the specified sheathing and fastening conditions are used. See Annex A1 for information on differences between the standard wind load design pressure rating and alternative wind load design pressure ratings, and how to determine standard and alternative design pressure ratings.

3.2.6 *temperate northern climate*—in weather testing, a North American metropolitan area testing site located within 73 to 100°W longitude and 37 to 45°N latitude.

3.2.7 *vinyl siding*—a shaped material, made principally from rigid poly(vinyl chloride) (PVC), that is used to clad exterior walls of buildings; in this standard, vinyl siding refers to the rigid profile to which the backing material is attached.

3.2.7.1 *Discussion*—Any exception to a homogeneous rigid PVC compound is present in a coextruded or laminated capstock.

4. Materials and Manufacture

4.1 The vinyl siding, exclusive of backing material, shall be made of one or more layers of poly(vinyl chloride) (PVC) compound. Any layers of materials other than poly (vinyl chloride) (PVC) compound shall be kept to less than 20 % by volume. This limitation does not apply to the backing material.

4.2 Where rigid PVC recycled plastic as defined in Guide D7209 is used, the siding containing the PVC recycled plastic shall meet all of the requirements of 3,Terminology; 4, Materials and Manufacture; and 5, Physical Requirements.

4.3 The poly(vinyl chloride) siding material, exclusive of backing material, when tested in accordance with Test Method D635, shall not exceed an average extent of burn of 4 in. (100 mm), with an average time of burn not to exceed 10 s. A minimum sample thickness of 0.035 in. (0.9 mm) is required. **Warning—**The flammability testing data, conclusions, and recommendations of Test Method D635 relate solely to the

[4] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.
[5] Available from International Code Council (ICC), 500 New Jersey Ave., NW, 6th Floor, Washington, DC 20001, http://www.iccsafe.org.
[6] National Housing Center, 1201 15th Street NW, Suite 220, Washington, DC 20005, http://www.vinylsiding.org
[7] 6300 Enterprise Lane, Madison, WI 53719, http://www.sbcindustry.com

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measurement and description of properties for classification of the poly(vinyl chloride) siding material in response to flame under controlled laboratory conditions and shall not be used for the description or appraisal of the fire hazard of vinyl siding under actual fire conditions.

4.4 The foam plastic backing shall have a Flame Spread Index not greater than 75 and a Smoke Developed Index not greater than 450 when tested separately under method E84.

4.5 The PVC compound when extruded into siding shall maintain uniform color and be free of any visual surface or structural changes, such as peeling, chipping, cracking, flaking, or pitting.

4.6 The PVC compound shall be compounded so as to provide the heat stability and weather exposure stability required for the siding market application.

4.7 Backed vinyl siding shall not contain elemental lead (Pb) or compounds of that material other than traces incidental to raw materials or the manufacturing process. This limitation applies to both PVC substrate and to any cap or film material, as well as the backing material. Compliance with this requirement shall be demonstrated by one of the methods in 6.16.

5. Physical Requirements

5.1 *Requirements Applicable to Vinyl Siding*—The provisions of 5.1.1 – 5.1.8 apply only to the vinyl siding, exclusive of any backing material. Where necessary to perform testing, the backing material shall be removed.

5.1.1 *Length and Width*—The nominal length and width of the siding shall be as agreed upon between the purchaser and the seller. The actual length shall not be less than ¼ in. (6.4 mm) of the nominal length and the actual width shall be within ± 1⁄16 in. (1.6 mm) of the nominal width when measured in accordance with 6.3 and 6.4.

5.1.2 *Thickness*—These requirements pertain only to measurements of the portions of the siding that are exposed after installation of the panel, measured in accordance with the procedure in 6.5. The average thickness of each specimen shall be no less than 0.035 in. No individual measurement shall be thinner than 0.003 in. below the nominal thickness. The process average thickness as defined in 3.2.4 shall be no thinner than 0.001 in. below the nominal thickness.

5.1.3 *Camber*—A full length of siding (typically 10 or 12 ft (3.05 or 3.61 m)) shall not have a camber greater than ⅛ in. (3.2 mm) when measured in accordance with 6.6.

5.1.4 *Heat Shrinkage*—The average heat shrinkage shall not exceed 3.0 % when determined by the method described in 6.7.

5.1.5 *Impact Resistance*—Siding shall have a minimum impact strength of 60 in.·lbf (6.78 J) when tested in accordance with 6.8.

5.1.6 *Coefficient of Linear Expansion*—The siding shall have a coefficient of linear expansion not greater than 4.5 by 10^{-5}in./in./°F (8.1 by 10^{-5} mm/mm/°C) when tested in accordance with 6.9.

5.1.7 *Gloss*—The gloss of smooth and embossed vinyl siding shall be uniform across the exposed surface. The average of all readings for a panel determined in 6.11.2.5 shall not differ from the manufacturer's specified gloss value more than the permitted variation in Table 1, and each individual reading shall not vary more than 10 points from the average. Gloss of smooth and embossed vinyl siding shall be tested in accordance with 6.11.

5.1.8 *Uniformity of Color*—The color specified shall be uniform on the exposed surface of the vinyl siding panels, except on the case of variegated colors. When tested in accordance with 6.13, the total color change, ΔE, between a production specimen and the appropriate reference specimen or agreed-upon color coordinates shall not vary by more than 1.5, and the chromatic coordinates thereof shall not change by more than $\pm\Delta a_H = 1.0$ and $\pm\Delta b_H = 1.0$.

5.1.9 *Weathering:*

5.1.9.1 The vinyl siding shall maintain a uniform color and be free of any visual surface or structural changes such as peeling, chipping, cracking, flaking, and pitting when tested in accordance with 6.10.

NOTE 4—Weathering-conformance-testing requirements are to reflect performance of a "typical" extrusion siding profile representing a specific color of PVC compound and a specific extrusion technology. In no case is there an implied requirement for testing all the various shaped and sized siding profiles produced in this color. The lengthy outdoor weatherability testing for new products may be performed concurrently with market development and sales of siding to existing markets. Completion of weatherability testing prior to marketing of the product is not required.

5.2 *Requirements Applicable to Backed Vinyl Siding*—The provisions of 5.2.1 – 5.2.3 apply to backed vinyl siding, including the integral foam backing material. Testing shall be conducted with the backing material in place, as described in the referenced test method.

5.2.1 *Surface Distortion*—The *backed vinyl* siding shall be free of bulges, waves, and ripples when tested to a minimum temperature of 150°F (66°C) in accordance with the procedure in 6.12. This distortion is called "oil-canning."

5.2.2 *Wind Load Resistance*—The siding shall withstand a minimum static test pressure and a standard wind load design pressure rating shall be determined.

5.2.2.1 *Minimum Test Pressure*—Backed siding shall be able to withstand a minimum test pressure of 22.5 lbf/ft^2 (1077 Pa) when tested in accordance with 6.14. The average maximum sustained static test pressure determined in 6.14 shall be equal to or greater than this value. If the manufacturer of backed siding provides documentation to support compensation for pressure equalization, the test pressure shall be determined from Annex A1 using the documented pressure equalization factor.

NOTE 5—The static test pressure of 22.5 lbf/ft^2 (1077 Pa) for backed siding was established to withstand structural loading conditions that occur in wind exposures of approximately 110 mph (177 km/h) (V_{ASD}) for mean roof heights of 30 ft (9.1 m) and less in exposure category B, and corresponds to 30.0 lbf/ft^2 (1436 Pa) negative design pressure, to match the default wind design conditions of Table R703.3(1) in the 2015 International Residential Code. Provision is made for compensation for pressure equalization specific to the product if supporting documentation

TABLE 1 Gloss Values

Manufacturer's Specified Gloss Value	Permitted Difference from Manufacturer's Specified Gloss Value
Less than or equal to 35	±8
Greater than 35	±10

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is provided, using procedures in Annex A1.

NOTE 6—Refer to Annex A1 for an explanation as to how the negative design pressure was established, and for applications where the effective negative design pressure as specified in ASCE 7-10 is different from 30.0 lbf/ft^2 (1436 Pa) (for example, wind-zone areas greater than about 110 mph (177 km/h) (V_{ASD}) (225 km/h (V_{ULT})) or mean roof height above 30 ft (9.1 m), or exposures other than exposure category B).

(1) The design-pressure values can be negative (suction loads) or positive. The negative values are the largest in magnitude and are the values used in this specification.

NOTE 7—In that the siding is being tested as a weather-resistant exterior product applied to an existing exterior structural wall, forces (negative) working to pull the siding off the wall, fasteners, or disengage locks will be the most important criteria for testing. Positive wind forces test the integrity of the total wall sections, and do not provide a measure of the performance of the siding.

5.2.2.2 *Standard Wind Load Design Pressure Rating*—The standard wind load design pressure rating shall be determined from the results of testing in accordance with 6.14, using the procedures described in A1.3.

NOTE 8—The standard design pressure rating is valid for applications where the siding is installed over sheathing and its fastening that are capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location. For applications over other sheathing, a different design pressure rating is applicable, and is determined in accordance with A1.3. Determination of a rating other than the standard design pressure rating is not required by this section.

5.2.2.3 *Alternative Design Pressure Ratings*—Design pressure ratings other than the standard wind load design pressure rating, for use with different sheathing materials or using different installation or fastening, are permitted to be determined in accordance with testing under 6.14, using the procedures in Annex A1.

5.2.3 *Nail Slot Allowance for Thermal Expansion*—For siding panels utilizing nail slots to allow for thermal expansion and contraction, the nail slot shall be sized to allow for the expected range of expansion and contraction over a range of 100°F. Compliance with this requirement shall be demonstrated either by the test method in 6.15 or by sizing of the nail slots according to the specifications in the following sections. The instrument used shall be capable of measuring to the nearest 0.01 in. The manufacturing tolerance shall not exceed -0.030 in.

5.2.3.1 For panels shorter than 6 ft (1829 mm) in length, the minimum nail slot width shall be ⅜ in. (11.4 mm).

5.2.3.2 For panels 6 ft (1829 mm) in length or longer the minimum nail slot width shall be determined according to the following formula. The minimum width shall be the width resulting from application of the formula, rounded to the next lower quarter-inch. Regardless of the results of the calculation, the minimum nail slot width for panels 6 feet or longer shall be 1 in (25.4 mm).

$$WS = P_c \times (\alpha \times 100\,°F \times L) + T_c \quad (1)$$

WS = minimum width of nail slot, in.,
P_c = center-pinning coefficient: 1 if manufacturer's instructions require panel to be center-pinned; 1.5 if center-pinning is not required,
α = coefficient of linear thermal expansion, 4.5×10^{-5} in./in./°F or actual known coefficient for material used, as determined by 6.9,
L = length of panel, inches, and
T_c = centering tolerance: 0.25 in.

5.2.4 *Flame Spread*—Backed vinyl siding shall have a Flame Spread Index not greater than 200 when tested in accordance with 6.17.

6. Test Methods

6.1 *General*—The inspection and test procedures contained in this section are used to determine the conformance of products to the requirements of this specification. Each producer who represents its products as conforming to this specification shall be permitted to use statistically based sampling plans that are appropriate for each manufacturing process, but shall keep the essential records necessary to document, with a high degree of assurance, his claim that all of the requirements of this specification have been met. Additional sampling and testing of the product, as agreed upon between the purchaser and the manufacturer, are not precluded by this section.

6.2 *Conditioning and Test Conditions*—Condition the test specimen in accordance with Procedure A of Practice D618 and test under those conditions, unless otherwise specified herein.

6.3 *Length*—Lay the specimen on a flat surface and measure with a steel tape. Measure the length of a siding panel to the nearest 1/16 in. (1.6 mm) at the center, the butt edge, and the bottom of the top lock. The average of the three measurements is the actual length.

6.4 *Width*—Interlock two long specimens, each at least 26 in. (600 mm) long, in the normal mode for installation. Lay the two specimens on a flat surface. Measure to the nearest 1/16 in. (1.6 mm), the distance between the lowest butt edge of the top specimen and the lowest butt edge of the bottom specimen. Commencing approximately 1 in. (25 mm) from one end of the specimens, make five measurements at 6 in. (152 mm) intervals, making sure that the measurement is made perpendicular to the butt edge. Average the measurements. The average constitutes the exposed width of siding.

6.5 Thickness shall be measured in accordance with Test Method A of Test Method D5947. The micrometer shall be calibrated in accordance with Section 8 of Test Method D5947. The thickness of the siding shall be measured at a minimum of 5 locations equally spaced across the entire portion of the siding that will be exposed after installation. All measurements shall be taken to the nearest 0.001 in. Calculate and report the average of these measurements. Also report the thinnest individual measurement.

6.6 *Camber*—Place a full length of siding (typically 10 or 12 ft (3.05 or 3.61 m)) on a flat surface alongside a straightedge at least as long as the siding specimen. Measure the maximum space between edge of the siding specimen and the straightedge for each edge to the nearest 1/16 in. (1.6 mm).

6.7 *Heat Shrinkage:*
6.7.1 *Apparatus:*

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6.7.1.1 *Scriber,* similar to that described in Test Method D1042, with the exception that the needle points shall be separated by 10 ± 0.01 in. (254 ± 0.254 mm).

6.7.1.2 *Test Media,* a controlled-temperature water bath of 5 gal (10 L) or more, equipped with an efficient stirrer that will maintain uniform temperature throughout. Heater and temperature-control devices must maintain the water at 160 ± 1°F (71 ± 0.5°C). Use a wire rack to raise and lower specimens into the water bath. As an alternative to the use of a water bath, the specimens may be heated for 30 min in a uniformly heated forced-air oven maintained at a temperature of 160 ± 1°F (71 ± 0.5°C).

6.7.1.3 Make measurements with any device capable of measuring the distance between two scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2 *Procedure:*

6.7.2.1 Cut three specimens from the siding panel, each 1 in. (25.4 mm) wide by 12 in. (305 mm) long. Cut one specimen from the center and one from each of the extreme edges of the flat surface. The long axis shall be parallel to the machine direction.

6.7.2.2 Condition specimens at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity for at least 24 h.

6.7.2.3 Make a slight mark with the scribe on each specimen so that a reference point will be clearly visible.

6.7.2.4 Place specimens in the test medium.

6.7.2.5 Remove specimens after 30 min and place on a flat surface until cool.

6.7.2.6 Repeat conditioning in accordance with 6.7.2.2.

6.7.2.7 Make a second mark with the scribe on each specimen, using the same center.

6.7.2.8 Measure the distance, *D*, between the scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2.9 Calculate the percent shrinkage as (*D*/10) × 100.

6.7.2.10 Report the average shrinkage of the three specimens tested.

6.8 *Impact Resistance*—Test impact resistance of siding in accordance with Test Method D4226, Procedure A, impactor head configuration H.25. 4 in.-lb increments (0.5 in. height increments with 8 lb falling weight) shall be used. Minimum sample dimensions shall be 1.5 by 1.5 in. Samples shall be tested with the normally exposed surface facing up. Backed siding shall be tested with any backing material removed. Conditioning time for quality-control tests shall be at least 1 h.

6.8.1 For purposes of evaluating failure of the specimen under section 3.2.1 of Test Method D4226, a ductile tear of less than 0.2 in. (5 mm) in length shall not be considered a failure. Any brittle break of any dimensions is considered a failure.

6.9 *Coefficient of Linear Expansion*—Conduct this test in accordance with Test Method D696.

6.10 *Weatherability:*

6.10.1 A minimum of three samples shall be exposed at each of at least three test sites. Test sites shall be located in a northern temperate climate, represented by Cleveland, Ohio or Louisville, Kentucky; a hot, humid climate represented by Miami, Florida; and a hot, dry climate represented by Phoenix, Arizona. The samples shall be exposed for a minimum of 24 months.

6.10.2 Samples shall consist of a flat section of siding with minimum dimensions of 2 in. by 3 ¾ in. (25 mm by 95 mm).

6.10.3 Samples shall be representative of the product to be evaluated.

NOTE 9—Samples prepared in the laboratory in the same manner as commercial samples are permitted to be used as an alternative to a commercial part. If the commercial product is extruded, the laboratory specimen must be extruded; if the commercial product is injection molded, the laboratory specimen must be injection molded, and so forth.

6.10.4 Select a minimum of 4 specimens per sample per test site to allow for 3 test specimens and 1 file specimen for each sample evaluated.

6.10.5 Mark each specimen permanently to ensure retention of identity during and after exposure testing.

NOTE 10—Use of a vibratool leaves a permanent mark that satisfies this criterion.

6.10.6 All exposures shall be conducted at an angle of 45° South, plywood backed, in accordance with Practice D1435 and G147.

6.10.7 After a minimum of 24 months of exposure, remove the samples and inspect each exposed test specimen for appearance and surface condition. Record observations and inspection date in a permanent record.

6.11 *Gloss:*

6.11.1 *Apparatus*—Measure gloss using a 75° geometry glossmeter that meets the requirements of the Apparatus section of Test Method D2457.

6.11.2 *Procedure:*

6.11.2.1 Gloss measurements shall be made in accordance with the procedure in Section 9 of Test Method D2457, unless otherwise specified herein.

6.11.2.2 Measure gloss on one piece of siding on at least three widely separated sections across the width of the exposed surface of the panel. At least one reading shall be taken on each face of the panel. Use new surface area for each reading to avoid scratches caused by instrument contact. The area tested must be flat. If a flat area on the exposed surface cannot be found due to the style or depth of embossing of the panel being tested, then a non-exposed area of the panel shall be chosen in its place. Such locations shall be representative of the gloss of the area that will be exposed after installation.

6.11.2.3 Measure gloss parallel to the direction of embossing. When the embossing pattern is not apparent, measure the gloss in the direction of extrusion.

6.11.2.4 Each reading shall be within the appropriate limit specified in 5.1.7.

6.11.2.5 The average reading of all readings shall be used to represent the gloss of the sample.

6.12 *Surface Distortion:*

6.12.1 *Test Specimen/Apparatus:*

6.12.1.1 The test specimen shall consist of three courses of backed vinyl siding, a minimum of 6 ft (1.83 m) in length, mounted on a flat rigid frame in accordance with the manufacturer's recommended installation instructions.

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(1) Horizontal Siding—The middle course shall consist of two lengths of backed vinyl siding, both with a factory-fabricated end, one section overlapping the other section. The end of the overlapping section shall be located not less than 3 in. (76 mm) and not more than 6 in. (152 mm) from the center of the course. Unless specified otherwise by the manufacturer's installation instructions, the insulation of the two lengths of backed vinyl siding shall be butted firmly together.

(2) Vertical Siding—The middle course shall consist of a single, uninterrupted backed vinyl siding panel, without overlap.

6.12.1.2 A thermocouple or other heat-sensing element shall be located at the horizontal midpoint of the backside of the middle course of backed vinyl siding. The heat-sensing element shall be in contact with the back of the vinyl cladding. Any backing material removed to facilitate placement of the heat sensing element shall be replaced.

6.12.1.3 *Radiant-Heat Rod,* 600 W for each linear foot (0.31 m), mounted parallel to the middle course and approximately 32 in. (810 mm) away from the surface of the backed vinyl siding.

6.12.1.4 *Temperature-Control Device,* used to regulate the temperature of the radiant-heat rod, shall be able to maintain the conditions specified in 6.12.2.1.

6.12.1.5 *Gap Measurement Device*—A cylindrical pin gauge, ¼ ± 0.005 in. (6 ± 0.127 mm) in diameter is used to evaluate the size of any gap in the overlapped sections of horizontal backed vinyl siding during the heating period. The pin gauge is attached to a rod such that the gauge can be inserted into a gap while held parallel to the plane of the backed vinyl siding. The rod shall be sufficiently long to permit insertion of the gauge from beyond the edge to the test frame, not interfere with the exposure of the sample to radiant heat, and otherwise not interfere with conduct of the test.

6.12.2 *Procedure:*

6.12.2.1 Heat the test panel (middle course of backed vinyl siding) at a rate of 3.0 to 6.0°F/min (1.7 to 3.3°C/min) until a minimum temperature of 150°F (66°C) is achieved as measured by the heat-sensing element on the midpoint of the backside of the middle course. For temperatures equal to or greater than 130°F (54°C), the rate of heating is permitted to be not less than 2.0°F/min (1.1°C/min), provided that the average heating rate from the ambient temperature to 150°F (66°C) is within 3.0 to 6.0°F/min (1.7 to 3.3°C/min). When a temperature of 150°F (66°C) is attained, shut off the heat source.

6.12.2.2 During this heating period, observe the middle course of the backed vinyl siding for surface distortion and observe for any opening or gap at the end of the overlapped section. If the overlap appears to have opened to approximately ¼ in. (6 mm), attempt to insert the gap measurement device into the opening. If the device can be inserted in to the opening to any depth at any location along the overlap, the opening shall be considered to be at least ¼ in. (6 mm).

6.12.2.3 Failure is defined as:

(1) the appearance of bulges, waves, or ripples on any surface of the middle course of the backed vinyl siding;

(2) occurrence of a gap or opening ¼ in. (6 mm) or greater at any point along the end of the overlapped section, as determined by use of the gap measurement device, at any time or before a temperature of 150°F (66°C) is reached.

6.13 *Color Uniformity*—Calculate the difference between the L_H, a_H, and b_H color coordinates for a production specimen to those of either the appropriate reference specimen or the agreed upon color coordinates for that specific color product in accordance with Test Method D2244. Calculate the total difference ΔE between the production specimen and the reference specimen in accordance with Test Method D2244.

6.14 *Wind Load Resistance*—Conduct the test on wind load resistance of finished siding in accordance with Test Method D5206. The average maximum sustained static test pressure determined from this testing is used in 5.2.2. For purposes of determining compliance with the minimum test pressure and standard design pressure requirements in 5.2.2, the test structure shall be constructed with vertical studs 16 in. on center. The siding shall be tested with the foam plastic backing attached to the vinyl siding. The siding in the test installation shall be installed over wood sheathing with a nominal thickness of 7/16 to ½ in., and fastened as follows:

6.14.1 *Fastener type*—Roofing nail, smooth shank, 0.120 in. (⅛ in. nominal; 3.2 mm) shank diameter, 5/16 in. (7.9 mm) head diameter, length as necessary to penetrate into sheathing and stud a total of 1 ¼ in. (32 mm). For vertical siding, length as necessary to penetrate the thickness of the sheathing plus ¼ in. (6.4 mm).

6.14.2 *Fastener Spacing*—Every 16 in. (406 mm) into center of stud for horizontal siding. For vertical siding, every 12 in. into sheathing only.

6.14.3 Fasteners shall not be driven tightly against the siding. Allow approximately 1/32 in. (0.8 mm) clearance between the fastener head and siding surface.

NOTE 11—The installation details described 6.14 conform to the minimum requirements of the 2015 International Residential Code and the VSI Vinyl Siding Installation Manual.

6.15 *Nail Slot Allowance for Thermal Expansion*—As an alternative to conformance with the nail slot width specification in 5.2.3.1 or 5.2.3.2, provision for thermal expansion and contraction shall be demonstrated through the following test procedure.

6.15.1 *Samples*—At least 3 samples of each profile in which the siding is produced shall be provided. The length of each sample shall be at least 50 % of the longest length in which the profile is produced, and not shorter than 12 ft (3658 mm).

6.15.2 *Test Chamber*—The test chamber shall consist of an environmentally controlled room or compartment capable of providing an air temperature range of at least 0°F to 100°F (-18°C to 38°C) without exposure of the panel to radiant energy from heating or cooling elements. Air temperature shall be controlled such that a rate of temperature change of 2°F (1.11°C) per minute can be achieved over the full temperature range, and the minimum and maximum temperatures can be maintained for at least 15 minutes. Means for circulating air to provide a uniform air temperature throughout the chamber shall be provided. A vertical wall shall be provided for mounting of samples. The wall shall be insulated such that, with no panels mounted, the inner surface of the wall does not

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deviate more than 10°F (5.5°C) from the air temperature at the high and low temperature extremes after a holding period of 5 minutes. The test chamber shall be of sufficient size to accommodate the longest panel to be tested, including expected thermal expansion of the panel. Means shall be provided to measure the actual temperature of the surface of each panel at a minimum of 3 evenly-spaced locations along the length of the panel.

6.15.3 *Length Measurement*—A means for measuring the length of each sample throughout the temperature range shall be provided. The method utilized for length measurement shall not be influenced by the temperature of the chamber and shall have a minimum resolution of no greater than 0.0625 in. (1.59 mm).

6.15.4 *Procedure*—Install the sample panels on the wall inside the test chamber, following the manufacturer's instructions for fastener type, spacing, location and tightness. At ambient temperature measure and record the length of each panel and the temperature of the panel, averaged from a minimum of 3 locations along the length of the panel.

6.15.4.1 *Test Cycle*—Test cycles shall be performed by raising the air temperature to 100°F ± 5°F (38°C ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding the air temperature at 100°F (38°C ± 2.75°C) for 15 minutes, lowering the air temperature to 0°F ± 5°F (-18°C ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding at 0 °F (-18°C ± 2.75°C) for 15 minutes, and returning to ambient temperature at an average rate of 2 °F per minute.

6.15.4.2 *Conditioning*—Close the test chamber and perform at least 2 conditioning cycles using the procedure in 6.15.1. No interruption is required between conditioning cycles.

6.15.4.3 *Test*—Following completion of the conditioning cycles, conduct 3 test cycles using the procedure in 6.15.4.1. It is acceptable for the test cycles to follow immediately upon completion of the final conditioning cycle, and no interruption is required between test cycles. After a minimum holding period of 15 minutes at the high and low extremes of each test cycle, measure and record the length of each panel and the temperature of the panel, averaged from a minimum of 3 locations along the length of the panel.

6.15.5 *Normalization*—From among the length measurements recorded for all three cycles, identify the shortest and longest length of each panel, and the average panel temperature at the time that length was recorded. Determine the maximum difference in length, ΔL, and the maximum difference in temperature, ΔT, by subtracting the smaller from the larger. Normalize the change in length to the full length of the panel over a 100 °F (38 °C) temperature range using the following formula:

$$E_t = \Delta L \times (100/\Delta T) \times (L_f/L_t) \quad (2)$$

E_t = total thermal expansion and contraction of a full length panel over a range of 100°F (38°C),
ΔL = maximum change in length of the tested panel,
ΔT = maximum change in temperature of the tested panel,
L_f = longest length in which the panel is produced, and
L_t = actual length of the panel as tested.

6.15.6 *Acceptable Performance*—When tested according to this procedure, the result of $(E_t \times 2) + 0.25$ in. for each of the 3 samples for each profile shall not be greater than the width of the nail slot. If the manufacturer's installation instructions require the panel to be center-pinned, the result of $E_t + 0.25$ in. for each of the 3 samples for each profile shall not be greater than the width of the nail slot.

6.16 *Lead Content:*

6.16.1 Testing for lead content shall be conducted on backed vinyl siding using a rhodizinate-type lead swab test kit conforming to Practice E1753. Testing shall be performed in accordance with the test kit manufacturer's instructions. The backed vinyl siding shall be deemed to comply with 4.7 if the test shows a negative or not-detected result; that is, the test does not indicate the presence of lead. The test shall be conducted separately on the substrate and on any cap or film material.

6.16.2 As an alternative to the method in 6.16.1, and as a means of resolving any ambiguous results from that method, an analytical method capable of detecting lead at least as low as 0.02 percent by sample weight shall be employed. Under this alternative, neither the substrate nor any cap or film shall contain a concentration of lead in excess of 0.02 percent by weight.

6.17 *Flame Spread*—Conduct the test on flame spread of finished backed vinyl siding in accordance with Test Method E84. The test specimen shall either be self-supporting by its own structural characteristics or held in place by added supports along the test specimen surface, or secured from the back side.

7. Packaging and Package Marking

7.1 The siding shall be packed in such a manner as to provide reasonable protection against damage in ordinary handling, transportation, and storage.

7.2 Provisions of Practice D3892 shall apply to this specification.

7.3 To aid identification of siding conforming to all requirements of this specification, producers and distributors shall include a statement of compliance in conjunction with their name and address on product labels, invoices, sales literature, and the like. The following statement is suggested when sufficient space is available:

This PVC siding conforms to all the requirements established in ASTM Specification D7445, developed cooperatively with the industry and published by ASTM.

Full responsibility for the conformance of this product to the specification is assumed by (name and address of producer or distributor).

7.4 The following abbreviated statement is suggested when available space on labels is insufficient for the full statement: Conforms to ASTM Specification D7445 (name and address of producer or distributor).

7.5 The standard wind load design pressure rating determined in accordance with 5.2.2.2 shall be stated on the product or on the product package by one of the means in 7.5.1 or 7.5.2.

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7.5.1 The package shall be marked or labeled with the standard wind load design pressure rating. The marking shall be in the format "Standard Wind Load Design Pressure Rating: ##.# psf (ASD)".

7.5.2 The standard design pressure rating shall be included on a line imprint or other marking on the front (outward-facing) surface of all siding panels. It is not required that the marking be visible after installation, provided that the marking can be revealed and read by detaching the lower edge lock of an adjacent course, without removal of any fasteners. The standard design pressure marking shall be stated at least once per panel. The marking shall be in the format "Std Design Pressure Rating: ##.# psf (ASD)".

7.5.3 At the option of the manufacturer, additional marking or labeling of the package or product with alternative wind load design pressure ratings determined in accordance with 5.2.2.3 for use with alternative sheathings, wall configurations or fastening methods is permitted. The marking shall use the format specified in 7.5, shall indicate the type of sheathing or wall configuration for which it is applicable, and shall refer to the manufacturer's instructions for more information and any installation requirements.

8. Keywords

8.1 plastic building products; plastic weatherability; recycled plastic; rigid PVC siding; specification

ANNEX

(Mandatory Information)

A1. WIND LOAD RESISTANCE TEST DESIGN FACTORS

A1.1 *Wind Load Criteria:*

A1.1.1 ASCE 7-10 is the basis for determining the design pressures used in this specification. Design wind loads are determined on an ASD basis in this specification.

NOTE A1.1—In previous editions of ASCE 7, wind loads were determined using wind speed maps based on a 50-year return period. In ASCE 7-10, maps based on a 700-year return period are used which, for any given location, produce a wind speed approximately 30 % greater than that of the previous maps. This larger magnitude (higher return period) wind speed, referred to as the ultimate wind speed, (V_{ULT}), is used directly (with a load factor of 1.0) to determine nominal wind loads on a Strength Design (LRFD) or "ultimate" wind load basis. When Allowable Stress Design (ASD) is used, ASCE 7-10 provides for these ultimate wind loads, determined from the ultimate wind speed map velocities, to be multiplied by a load factor of 0.6. Alternatively, the adjustment can be made directly to the wind velocity, which is the approach taken in this method (see A1.1.2). This procedure produces results consistent with past ASD wind loads.

A1.1.2 It is necessary to determine whether the wind velocity to be used is based on the maps in ASCE 7-10 or on older maps designed for direct application of ASD. Wind velocity, V, based on ASD is used in this method. Wind speeds determined using the maps in ASCE7-10, referred to as V_{ULT}, are converted to ASD wind speeds, V_{ASD}, by multiplying by the square root of 0.6. Wind speeds based on maps using an ASD basis do not require conversion (see A1.3). Thus:

$$V = V_{ASD} = V_{ULT} \times \sqrt{0.6} \quad \text{(A1.1)}$$

The V determined in this section is used in the following calculations.

A1.1.3 The velocity pressures, q, used in this specification have been computed using the following equation:

$$q = 0.00256\, K_z K_d V^2 I(\ lb/sq\ ft\ ) = 0.613\, K_z\, K_d\, V^2 I\ (N/m^2) \quad \text{(A1.2)}$$

V = wind velocity, mph (km/h). The basic wind speed corresponds to a 3-s gust speed at 33 ft (10.1 m) above ground in exposure category C, as described in ASCE 7-10. A velocity of $V = V_{ASD}$ = 110 mph (177 km/h) was used in this specification. (See Note A1.2and Note A1.3.)

I = "importance factor" as described in editions of ASCE 7 prior to ASCE 7-10. A value of 1.0 is used. This factor is not used where the wind speed has been determined from a map in ASCE 7-10. (See Note A1.4.)

K_z = "velocity pressure coefficient" as described in ASCE 7-10. A "K_z" of 0.70 was used in the wind pressure calculations, which is the value from ASCE 7-10 for a mean roof height of 30 ft (9.1 m) above ground level and Exposure Category B.

K_d = "wind directionality factor" as described in ASCE 7-10. A "K_d" of 0.85 is used.

A1.1.4 Thus, for the given velocity and factors, the velocity pressure = 18.43 lbf/ft^2 (882 Pa).

NOTE A1.2—As explained in Note A1.1, the wind velocity used in this method is converted from the V_{ULT} given by wind speed maps in ASCE 7-10 to V_{ASD} using the equation in A1.1.2. A V_{ULT} wind speed of approximately 140 mph from the maps is equivalent to a V_{ASD} of 110 mph, which is the velocity V used in this specification.

NOTE A1.3—In ASCE 7-10 the default wind speeds are given for exposure category C, and a table is provided to adjust this wind speed for other exposure categories. Since most backed vinyl siding is installed on buildings located in exposure category B, the velocity pressure coefficient, K_z is included in the equation to make this adjustment.

NOTE A1.4—Editions of ASCE 7 prior to ASCE 7-10 included an importance factor to represent the relative significance of the building and the consequences of its loss. Because most backed vinyl siding is installed on residential and light commercial buildings, the importance factor was set at 1.0 by default. ASCE 7-10 has removed the importance factor from the velocity pressure equation, and instead provides a different wind speed map for each of the building importance categories (referred to as risk categories in ASCE 7-10). Thus the importance factor will already have been incorporated into the wind speed determined from the appropriate

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map, and the importance factor is not used for determining velocity pressure using wind speeds from ASCE 7-10 maps.

A1.1.5 ASCE 7-10 recommends various internal and external pressure coefficients, which include gust response factors. These coefficients vary with the effective area of the cladding component, the location of the cladding component relative to building corners, and the configuration of the building (open versus enclosed). The internal and external pressure coefficients are taken from Table 26.11-1 and Figure 30.4-1 of ASCE 7-10. The effective area is taken as 10 square ft (the area of one piece of siding), an enclosed building is assumed, and factors for the building corners are used. The pressure coefficients are as follows:

$$\textit{Internal Pressure Coefficient} = \pm 0.18 \quad \text{(A1.3)}$$

$$\textit{External Pressure Coefficient} = +1.00 \textit{ and } -1.40$$

The design pressure is calculated by multiplying the velocity pressures by the algebraic sum of the internal and external pressure coefficients.

A1.2 *Design Pressure:*

NOTE A1.5—Because the wind velocity has already been adjusted from an ultimate basis to an ASD basis at the beginning of these calculations, the design pressure determined in this step is an ASD load. This correlates to the design pressure requirements stated in tables in the 2015 International Residential Code and other codes which have also been adjusted to an ASD basis. However, the required design pressures in some other codes and design standards have not been adjusted to an ASD basis. Where required design pressures are based on ultimate wind loads determined from ASCE 7-10 wind speeds, those loads must be multiplied by 0.60 to match the design pressure determined from this equation.

$$\textit{Positive Design Pressure} = (18.43)(1.00+0.18) = 21.74\ \textit{psf} \quad \text{(A1.4)}$$

$$\textit{Negative Design Pressure} = (18.43)(-1.40-0.18) = -29.12\ \textit{psf}$$

A1.2.1 The negative values (suction loads) are the largest in magnitude and are the design values used in this specification. Research conducted by various organizations[8,9] has shown that a certain amount of pressure equalization occurs through residential siding products installed with sheathing under high dynamic pressures. In light of this pressure equalization, the design pressure in the ASCE 7-10 wind load standards is reduced by a factor of 0.5 for backed siding.

A1.2.2 Therefore, the required test pressures are calculated as follows:

$$P_t = D_P \times PEF \times 1.5 \quad \text{(A1.5)}$$

where:

P_t = test pressure, lbf/ft^2 (Pa),
D_P = design pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, backed siding, 0.5, and
1.5 = safety factor.

A1.2.2.1 If documentation in support of the use of compensation for pressure equalization other than 0.5 is provided, use the calculation in A1.2.2, substituting the appropriate pressure equalization factor.

A1.2.3 Using the above equations, in a 110 mph (177 km/h) (V_{ASD}) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, the required minimum uniform load test pressure for backed siding is 21.84 lbf/ft^2 (1046 Pa).

A1.2.3.1 For compliance with 5.2.2, the referenced design pressure has been rounded to -30.0 lbf/ft^2 (1436 Pa) to match the standard design conditions specified by the 2015 International Residential Code. When tested under Test Method D5206, the siding must attain an average maximum sustained static test pressure equal to or greater than the corresponding minimum test pressure of 22.5 lb/ft^2 (1077 Pa).

A1.2.4 For applications where the effective design pressure is greater than -30.0 lbf/ft^2 (1436 Pa) (for example, wind zone areas greater than 110 mph (177 km/h) (V_{ASD}), mean roof height over 30 ft (9.1 m), or exposure conditions other than Exposure B), refer to ASCE 7-10 for the effective design pressure. To be shown to be suitable for the application, when tested under Test Method D5206 the siding must attain an average maximum sustained static test pressure equal to or greater than the minimum test pressure determined by the formula in A1.2.2, using the design pressure, D_P, determined for the application using the procedure in A1.1.2 through A1.2.

A1.2.5 These loading conditions apply only to siding installed without an air space directly over sheathing of a type and fastening method that is capable of independently resisting both positive and negative wind design pressures at the building location. Examples of such sheathing include oriented strand board (OSB) and plywood fastened to resist the design wind pressures. For applications where the siding is installed over open studding, without sheathing, rapid pressure equalization does not occur. In these applications, the load the siding will see is equal to the total design pressure and the pressure equalization factor (PEF) is set to 1.0. The static test pressure required for products used under these conditions is as follows:

$$P_t = D_P \times PEF \times 1.5 \quad \text{(A1.6)}$$

where:

P_t = static test pressure, lbf/ft^2 (Pa),
D_P = design pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, 1.0, and
1.5 = safety factor.

A1.2.5.1 Therefore in a 110 mph (177 km/h) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, siding installed without sheathing would require a uniform load test pressure of 43.72 lbf/ft^2 (2093 Pa).

NOTE A1.6—Building codes and backed vinyl siding installation instructions require backed vinyl siding to be installed over sheathing, so calculation of minimum test pressure for siding installed without sheathing is essentially moot. However, the calculation has been retained for completeness and comparison with other installation conditions.

A1.2.6 When siding is installed over sheathing that is not capable of independently resisting both positive and negative

[8] Vinyl Siding Pressure Equalization Factor, Architectural Testing, Inc. Report No. 01–40776.01, September 2002.

[9] Morrison M.J., Cope A.D. "Wind Performance and Evaluation Methods of Multi-Layered Wall Assemblies." Structures Congress, 2735-2748, Portland, OR, 2015.

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wind pressures occurring under design conditions at the building location, a greater percentage of the total wind pressure is transferred to the siding and its fasteners. This has the effect of partially or completely countering the effect of the pressure equalization factor. In these cases a value between 0.5 and 1.0 is used for the pressure equalization factor (PEF).

A1.2.6.1 In addition, in cases where failure of the siding would result in failure of the exterior wall covering assembly (that is, siding and sheathing) a safety factor of greater than 1.5 is indicated.

A1.2.6.2 If the adjusted PEF for a given combination of siding and sheathing is known, and an appropriate safety factor is used, a minimum test pressure can be determined using the equation in A1.2.1. However, it is normally more appropriate to make an adjustment for alternative sheathings when determining the design pressure rating, as discussed in A1.3.

NOTE A1.7—Where the sheathing is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, the layer of siding over the sheathing, and its fastening through the sheathing, act to reinforce the sheathing such that the whole wall covering (siding-sheathing) assembly is capable of resisting such wind pressures. Because siding is tested by itself (not as part of a siding-sheathing assembly) in Test Method D5206, the adjustment of test pressure (before the test) or of the design pressure (after the test) ensures that the wind load resistance of the assembly as a whole is reflected in the rating of the siding.

NOTE A1.8—In some high wind hazard regions, such as south Florida, the exterior wall covering assembly may also be required to meet wind-borne debris impact resistance criteria which would affect the choice of sheathing material to be used together with siding. Such considerations are beyond the scope of this standard.

A1.3 *Wind Design Pressure Rating (Maximum Allowable Pressure):*

A1.3.1 A design pressure rating is the maximum wind pressure that a particular backed vinyl siding product is rated to be able to withstand. It is used in building design and building codes to determine the acceptability of a siding product for use under the design wind conditions for a specific application. To be acceptable, a siding's design pressure rating must be equal to or greater than the design pressure for the specific building at the specific location. The design pressure rating is determined from the average maximum sustained static test pressure for a siding product produced by testing under Test Method D5206, the pressure equalization factor, and a safety factor.

A1.3.2 *Standard Design Pressure Rating*—The standard design pressure rating is used for applications where the siding is installed over a sheathing type and fastening method that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location.

A1.3.2.1 The standard design pressure rating assumes that the siding is fastened to the building in the standard manner, with the minimum fastener type, size, spacing, and penetration depth prescribed in Chapter 7 of the International Residential Code and the VSI Vinyl Siding Installation Manual. The installation of the siding for testing under Test Method D5206 must be consistent with these minimum fastening requirements. However, this does not prevent additional testing, using different fastening, to support design pressure ratings for other applications, such as special high wind installations.

A1.3.2.2 The pressure equalization factor and safety factor are the same as those used to determine the test pressure in A1.2.1, using the following equation:

$$D_{Rstd} = \frac{P_m}{(PEF \times SF)} \quad (0)$$

where:

D_{Rstd} = standard design pressure rating, lbf/ft^2 (Pa),
P_m = average maximum sustained static test pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, 0.5, and
SF = safety factor, 1.5.

A1.3.3 *Alternative Design Pressure Ratings*—Design pressure ratings for applications other than the standard conditions described above can be developed. Common circumstances where this is done include the use of alternative fastening methods in order to achieve a higher design pressure rating, and cases where the sheathing is not capable of independently resisting wind pressures under design conditions, which necessitates a reduction in the siding's design pressure rating.

A1.3.3.1 *Alternative Fastening*—Where an alternative fastening method is specified by the manufacturer, the siding is permitted to be tested under Test Method D5206 using the specified fastening. The resulting average maximum sustained static test pressure is used in the above equation to determine the alternative design pressure rating. In order for this alternative rating to be realized, the siding must be installed using the alternative method, and the rating must be clearly tied to installation requirements in manufacturer's literature and instructions.

A1.3.3.2 *Alternative Sheathing*—An adjusted design pressure rating for use of the siding over sheathings not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, as discussed in A1.2.6, can be calculated using the above equation if the appropriate PEF and safety factor are specified.

A1.3.3.3 Alternative PEF and safety factor values have been documented (see 2009 and 2012 International Residential Code, section R703.11.2) for one type of sheathing, foam plastic insulating sheathing complying with ANSI/SBCA FS 100. Two wall assembly cases are considered: 1) where the interior surface of the wall is covered with gypsum wall board or equivalent; and 2) where the interior surface of the wall is not covered with gypsum wall board or equivalent. In both cases the siding is installed directly over foam sheathing, which is then attached directly to framing, without intervening sheathing. The PEF and safety factor for each case are as follows:

Case	PEF	Safety Factor
Case 1	0.7	2.0
Case 2	1.0	2.0

A1.3.3.4 Adjustment of the standard design pressure rating is not necessary when foam plastic insulating sheathing is installed directly over sheathing that is capable of independently resisting both positive and negative wind pressures

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occurring under design conditions at the building location, or where the sheathing is fastened in a way that allows it to independently resist the design wind pressure. For such cases the standard design pressure rating is applied.

A1.4 *Design Wind Speeds:*

A1.4.1 The wind velocity maps in ASCE 7-10 provide one source of design wind pressures for particular geographic regions. The velocities on these maps are stated in terms of "ultimate", 700-year return interval speeds. To be used in the procedure in this Annex, those velocities need to be converted to the ASD equivalent in accordance with A1.1.2, and the resulting velocity *V* used in the equation in A1.1.3. The 2012 and 2015 International Building Code and 2015 International Residential Code also contain maps based on ultimate wind speeds.

A1.4.2 Other maps are available that do not require conversion of wind velocities. Examples include the wind map in the 2012 International Residential Code, on which the velocities have already been converted from those on the ASCE 7-10 maps. Maps from previous editions of ASCE 7 used ASD velocities and do not require conversion. However, only editions since 1995 used the 3-second gust basis that is used in this annex. The 1998, 2002, and 2005 editions of ASCE 7 continued the use of 3-second gust wind basis, but with improved hazard modeling of hurricane wind speeds first made in the 1998 edition. These previous editions also do not have the benefit of further improved hurricane hazard modeling that was incorporated into the maps used in ASCE 7-10.

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SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D7445–18) that may impact the use of this standard. (X 1, 2024)

(1) Revised 1.1.

(2) Added 5.2.4 and 6.17.

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TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

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S11893

Date Submitted	02/07/2025	**Section**	202	**Proponent**	Fernando Pages
Chapter	2	**Affects HVHZ**	No	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Summary of Modification

Add definition for exterior soffits.

Rationale

The proposed [RB] Exterior Soffit definition clarifies materials and assemblies in the Florida Building Code. Applied to exterior overhangs, soffits are distinct components in varied appliactions serving functional and aesthetic purposes.Ensure consistent interpretation and enforcement of code requirements, particularly regarding fire resistance, moisture protection, and material performance in exterior conditions

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Adds clarity on where specific code sections apply, su as the underside of elevated buildings.

Impact to building and property owners relative to cost of compliance with code

None.

Impact to industry relative to the cost of compliance with code

None

Impact to small business relative to the cost of compliance with code

None.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This will enhance building performance by providing clear guidance on soffit construction, ensuring durability, safety, and compliance where codes previously lacked explicit standards.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This will enhance building performance by providing clear guidance on soffit construction, ensuring durability, safety, and compliance where codes previously lacked explicit standards.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not descriminate.

Does not degrade the effectiveness of the code

Does not degrade.

Alternate Language

2nd Comment Period

S11893-A2

Proponent Fernando Pages **Submitted** 8/21/2025 4:05:29 PM **Attachments** Yes

Rationale:

The proposed [RB] Exterior Soffit definition clarifies materials and assemblies in the Florida Building Code. Applied to exterior overhangs, soffits are distinct components in various applications serving functional and aesthetic purposes. Ensure consistent interpretation and enforcement of code requirements, especially regarding wind and fire resistance, moisture protection, and material performance in exterior conditions.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Adds clarity on where specific code sections apply, such as the underside of elevated buildings.

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Impact to small business relative to the cost of compliance with code

None.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This will improve building performance by offering clear guidance on soffit construction, ensuring durability, safety, and compliance where codes previously lacked specific standards.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This will improve building performance by offering clear guidance on soffit construction, ensuring durability, safety, and compliance where codes previously lacked specific standards.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate.

Does not degrade the effectiveness of the code

Does not degrade.

S11893-A2Text Modification

See attachment

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S11893-A2Text Modification

Modification # 11893

Code Version	2026
Code Change Cycle	2026 Triennial Original Modification 01/03/2025 - 02/18/2025
Sub Code	Building
Chapter & Topic	Chapter 2 - Definitions
Section	202

Summary

Add definition for exterior soffits.

Text of Modification

Add definition

EXTERIOR SOFFIT: A material or assembly of materials installed on the underside of exterior building projections, including roof overhangs, attached carports, porch ceilings, and the underside of floor systems of elevated structures using pilings or column construction.

Modify

1410.2 General wind requirements.

Soffits and fascias shall be capable of resisting the component and cladding loads for walls determined in accordance with Chapter 16 using an effective wind area of 10 square feet (0.93 m^2).

Exception: The design wind pressure on exterior soffits applied to the bottom horizontal surface of elevated buildings shall be determined in accordance with ASCE 7.

Add the soffit definition to FBCR to harmonize with the change to FBC

Chapter 2 Definitions

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S11893-A2Text Modification

EXTERIOR SOFFIT: A material or assembly of materials installed on the underside of exterior building projections, including roof overhangs, attached carports, porch ceilings, and the underside of floor systems of elevated structures using pilings or column construction.

Add to R703.1.2.1 Wind resistance of exterior soffits.

Exterior soffits and their attachments shall comply with Section R704.

Exception: The design wind pressure on exterior soffits applied to the bottom horizontal surface of elevated buildings shall be determined in accordance with ASCE 7.

Rational

The proposed [RB] Exterior Soffit definition clarifies materials and assemblies in the Florida Building Code. Applied to exterior overhangs, soffits are distinct components in various applications serving functional and aesthetic purposes. Ensure consistent interpretation and enforcement of code requirements, especially regarding wind and fire resistance, moisture protection, and material performance in exterior conditions.

FISCAL

Adds clarity on where specific code sections apply, such as the underside of elevated buildings.

Impact owner

None

Impact industry

None

Impact on small business

None

Requirements

This will improve building performance by offering clear guidance on soffit construction, ensuring durability, safety, and compliance where codes previously lacked specific standards.

Strengths

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S11893-A2Text Modification

This will improve building performance by offering clear guidance on soffit construction, ensuring durability, safety, and compliance where codes previously lacked specific standards.

Discriminate

Does not discriminate.

Degrade

Does not degrade.

S11893Text Modification

EXTERIOR SOFFIT: A material or assembly of materials applied to the underside of an exterior ceiling or overhang, including attached carports, porch ceilings, and elevated buildings that create a full story above grade plane.

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TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

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S12109

Date Submitted	02/14/2025	**Section**	202	**Proponent**	Jennifer Bridge
Chapter	2	**Affects HVHZ**	No	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Summary of Modification

Proposed revision to the definition of wind-borne debris region

Rationale

Simulation shows that the risk of wind-borne debris damage exists whether an Exposure D condition is due to the proximity to open water on the coast or to a lake with at least 5000 ft of fetch in the upwind direction. Simulation also shows that the risk of wind-borne debris damage due to a 130 mph wind speed where an Exposure D condition exists upwind of the decreases below the risk for an Exposure B condition for a 140 mph wind speed at a distance of approximately 3000 ft from the water line.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

Increased cost for required wind-borne debris opening protection in areas 3000 ft from where an Exposure D condition exists upwind of the waterline (including inland lakes). Reduced cost associated with property damage when protective coverings mitigate wind-borne debris damage.

Impact to industry relative to the cost of compliance with code

None

Impact to small business relative to the cost of compliance with code

Increased cost for required wind-borne debris opening protection in areas 3000 ft from where an Exposure D condition exists upwind of the waterline (including inland lakes). Reduced cost associated with property damage when protective coverings mitigate wind-borne debris damage.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Impacts the safety and welfare of the public during hurricane events.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Strengthens the code as it applies to the protection of buildings from wind-borne debris damage.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No products specified in proposed modification.

Does not degrade the effectiveness of the code

Does not reduce requirements for wind-borne debris protection.

Alternate Language

2nd Comment Period

S12109-A1

Proponent T Stafford **Submitted** 8/24/2025 12:11:46 PM **Attachments** Yes

Rationale:

This comment reflects a compromise between the original proposal and the current Wind-borne Debris Region (WBDR) in the FBC. Even with the reduced applicability of the WBDR adjacent to Exposure D conditions (3000 ft vs 1 mile specified in ASCE 7-22) in the original proposal, the practical limitations of enforcement and understanding the specific location of the WBDR remain where wind speeds are between 130 mph and 140 mph. Additionally, the original proposal as written would reduce the WBDR from current requirements in coastal areas of the 130 mph to 140 mph range by changing the applicability from 1 mile to 3000 feet. The coastal areas are the most likely to be affected by wind-borne debris from hurricanes. If approved, this comment would change the WBDR to apply in all areas where the wind speed is 130 mph. It would maintain current areas where protection is required (V = 140 mph; and within one mile of the coastal mean high water line where V = 130). However, in regions where the wind speed is between 130 mph and 140 mph “and” located more than 1 mile from the coastal mean high water line, buildings would be permitted to be designed as partially enclosed in accordance with ASCE 7 as an alternative to protecting glazed openings. See attached figure for a visual representation for Risk Category II. This proposal would represent a significant improvement in the wind resistance of buildings in this region with little added cost. It provides the option for homeowners and building owners to protect glazed openings or design the building as partially enclosed. Designing a building as partially enclosed will result in minimal cost increase but will increase the design pressures on every part of the building – roof-to-wall connections, windows, siding, roof decking, most roof coverings, etc. We believe this to be a better path forward.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No impact to local entities relative to enforcement of the code. This proposed modification will make enforcement of the WBDR criteria in this region significantly easier than the original proposal.

Impact to building and property owners relative to cost of compliance with code

This proposed modification would result in a slight increase in cost of compliance with the code for building and property owners.

Impact to industry relative to the cost of compliance with code

No impact to industry relative to the cost of compliance with the code.

Impact to small business relative to the cost of compliance with code

Increased cost for required wind-borne debris opening protection in areas 3000 ft from where an Exposure D condition exists upwind of the waterline (including inland lakes). Reduced cost associated with property damage when protective coverings mitigate wind-borne debris damage.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposed modification is directly connected to the health, safety, and welfare of the general public by expanding the Wind-borne Debris Region in the code but providing cost effective options for compliance with the code in the expanded areas.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification strengthens the code by expanding the Wind-borne Debris Region but provides cost effective options for compliance with the code in the expanded areas.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

This proposed modification does not degrade the effectiveness of the code.

S12109-A1Text Modification

WIND-BORNE DEBRIS REGION. Areas within hurricane-prone regions located ~~in accordance with one of the following:~~ where the ultimate design wind speed, V_{ult}, is 130 mph (58 m/s) or greater.

~~1. Within 3,000 ft (0.94 km) of the mean high-water line where an Exposure D condition exists upwind at the waterline and the ultimate design wind speed, V_{ult}, is 130 mph (58 m/s) or greater; or~~

~~2. In areas where the ultimate design wind speed, V_{ult}, is 140 mph (63.6 m/s) or greater; or Hawaii.~~

1609.1.2 Protection of openings. In wind-borne debris regions, glazed openings in buildings shall be impact resistant or protected with an impact-resistant covering meeting the requirements of ANSI/DASMA 115 (for garage doors and rolling doors) or TAS 201, 202 and 203, AAMA 506, ASTM E1996 and ASTM E1886 referenced herein, or an approved impact-resistant standard as follows:

1. Glazed openings located within 30 feet (9144 mm) of grade shall meet the requirements of the large missile test of ASTM E1996.

2. Glazed openings located more than 30 feet (9144 mm) above grade shall meet the provisions of the small missile test of ASTM E1996.

3. Storage sheds that are not designed for human habitation and that have a floor area of 720 square feet (67 m^2) or less are not required to comply with the mandatory windborne debris impact standards of this code.

4. Openings in sunrooms, balconies or enclosed porches constructed under existing roofs or decks are not required to be protected provided the spaces are separated from the building interior by a wall and all openings in the separating wall are protected in accordance with Section 1609.1.2 above. Such spaces shall be permitted to be designed as either partially enclosed or enclosed structures.

5. Buildings located more than 1 mile from the coastal mean high water line where the ultimate design wind speed, V_{ult}, is less than 140 mph (63.6 m/s) are permitted to be designed as partially enclosed in accordance with ASCE 7 in lieu of protecting exterior glazed openings from wind-borne debris.

Exception: (*no change*)

Page: 1

Mod12109_A1_TextOfModification.pdf

S12109Text Modification

WIND-BORNE DEBRIS REGION. Areas within hurricane-prone regions located:

~~1. Within 1 mile (1.61 km) of the coastal mean high water line where the ultimate design wind speed, V_{ult}, is 130 mph (58 m/s) or greater; or~~

1. Within 3,000 ft (0.94 km) of the mean high-water line where an Exposure D condition exists upwind at the waterline and the ultimate design wind speed, V_{ult}, is 130 mph (58 m/s) or greater; or

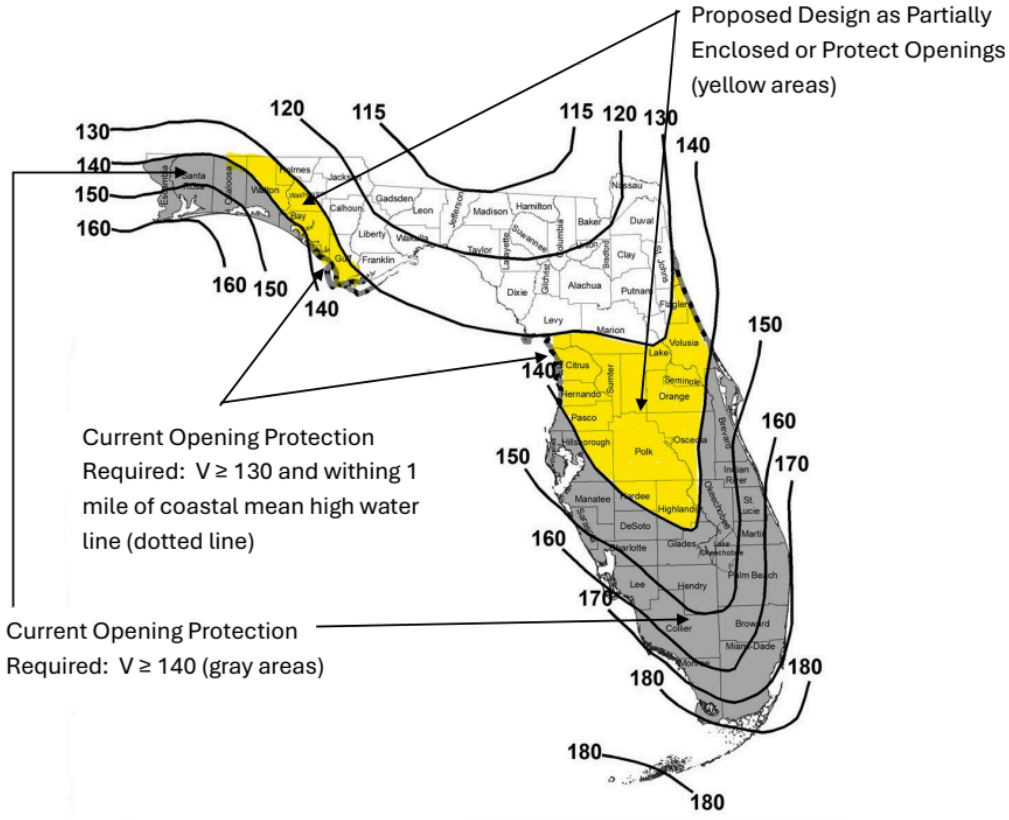
2. In areas where the ultimate design wind speed, V_{ult}, is 140 mph (63.6 m/s) or greater.

For *Risk Category* II buildings and other structures and *Risk Category* III buildings and other structures, except health care facilities, the wind-borne debris region shall be based on Figure 1609.3(1). For *Risk Category* III health care facilities, the wind-borne debris region shall be based on Figure 1609.3(2). For Risk Category IV buildings and other structures, the wind-borne debris region shall be based on Figure 1609.3(3).

Page: 1

Mod12109_TextOfModification.pdf

S12109-A1Rationale



Mod_12109_A1_Rationale_WBDR DWG.pdf Page: 1

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

15

S11894

Date Submitted	02/07/2025	**Section**	1410	**Proponent**	Fernando Pages
Chapter	14	**Affects HVHZ**	No	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

1410.3 1410.3(2)

Summary of Modification

Remove the J-channel at the wall junction from the drawing, as it is not a required element, to prevent creating unnecessary code requirements.

Rationale

Removes the J-channel from the wall juncture, as it is not a structural element or required. Other top-of-wall termination options exist, allowing for design flexibility.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
No impact.
Impact to building and property owners relative to cost of compliance with code
No timpact
Impact to industry relative to the cost of compliance with code
Removes extrenous elements form drawing.
Impact to small business relative to the cost of compliance with code
None.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Clarifes the soffit instalation requirments.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Imprves the code by removing extrenous elements.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not descriminate

Does not degrade the effectiveness of the code

Does not degrade

Alternate Language

2nd Comment Period

Proponent Fernando Pages **Submitted** 8/20/2025 11:58:26 AM **Attachments** Yes

S11894-A1

Rationale:

Corrects omission pointed out by TAC, namely, adds back the note to nail adjacent to wall.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
No impact

Impact to building and property owners relative to cost of compliance with code
No impact

Impact to industry relative to the cost of compliance with code
Removes extraneous elements from the drawings.

Impact to small business relative to the cost of compliance with code
None.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Suports building resiliance

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Improves the code by removing extraneous elements.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
Does not discriminate

Does not degrade the effectiveness of the code
Does not degrade

S11894-A1Text Modification

See the new drawings attached.

[Modify Figure 1410.3(1) to remove J-Channel.

[Modify Figure 1410.3(2) to remove J-Chanel and add midspan support].

Page: 1

Mod11894_A1_TextOfModification.pdf

S11894-A1Text Modification

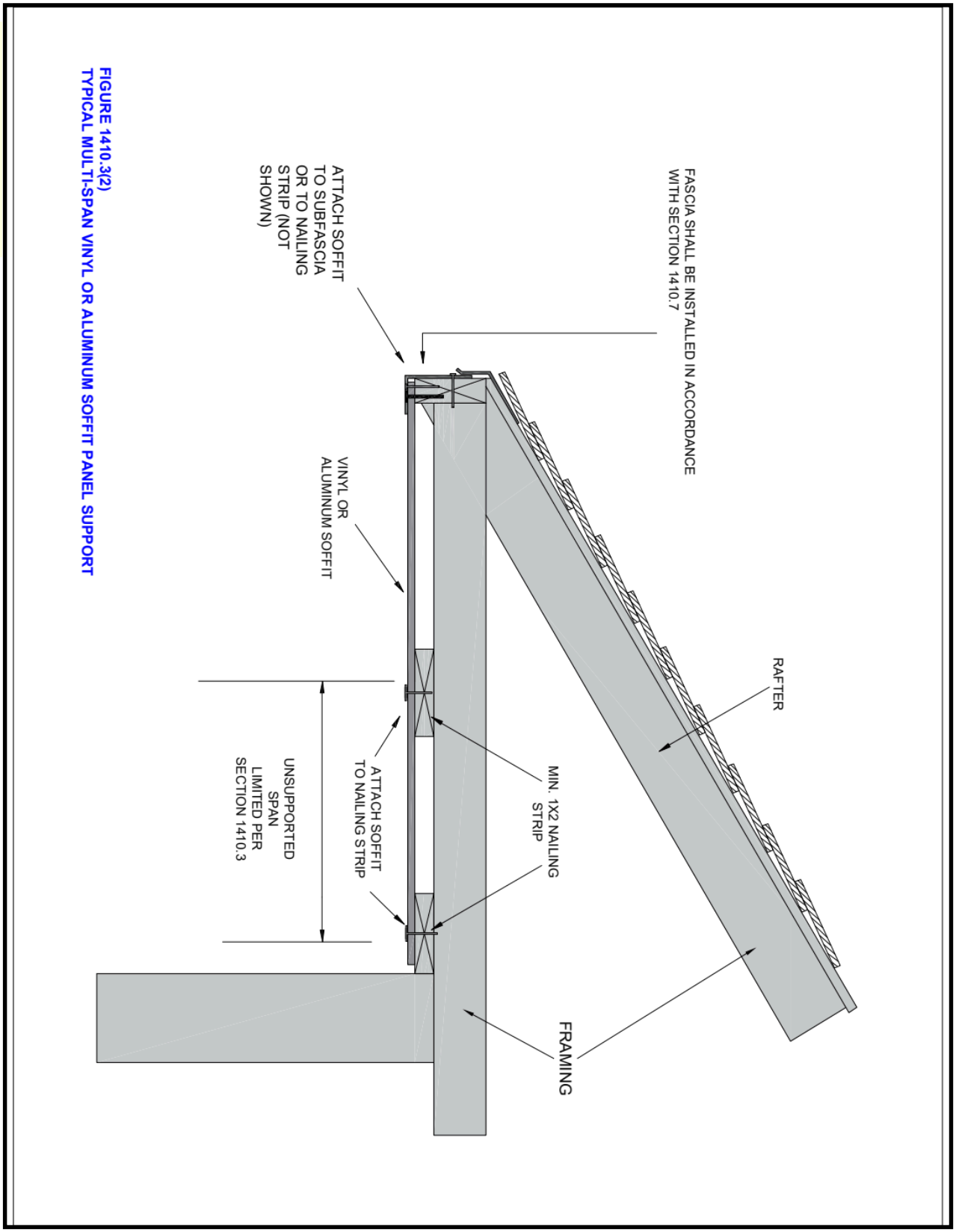


FIGURE 1410.3(2)
TYPICAL MULTI-SPAN VINYL OR ALUMINUM SOFFIT PANEL SUPPORT

Mod_11894_A1_Text_FIGURE 1410.3(2).pdf Page: 1

S11894-A1Text Modification

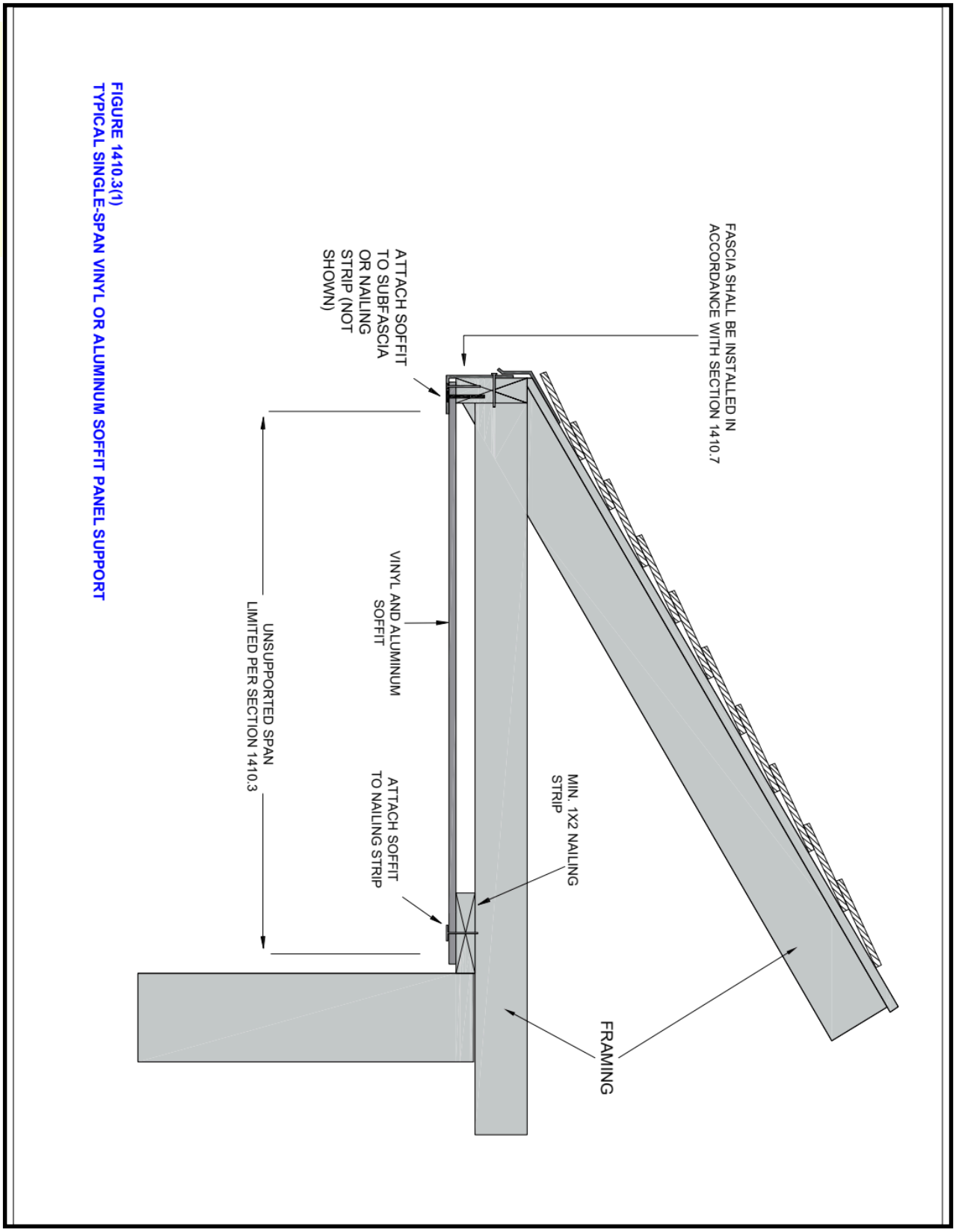


FIGURE 1410.3(1)
TYPICAL SINGLE-SPAN VINYL OR ALUMINUM SOFFIT PANEL SUPPORT

Mod_11894_A1_Text_FIGURE 1410.3(1).pdf Page: 1

S11894Text Modification

[Remove J-Channel from figure 1410.3(1). See attahcment.

[Modify Figure 1410.3(2) to remove J-Chanel and add midspan suport].

FBCB Drawing 4 will replace Figure 1410.3(2) Multi-span vinyl or alum……

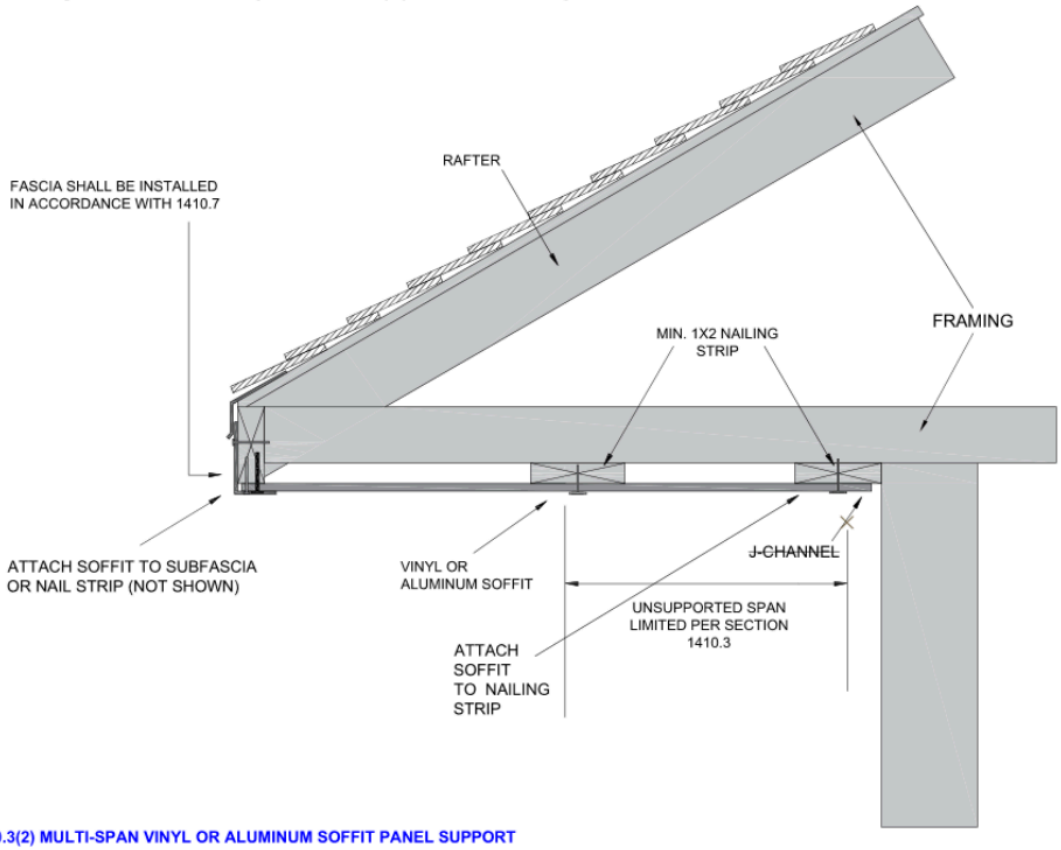


FIGURE 1410.3(2) MULTI-SPAN VINYL OR ALUMINUM SOFFIT PANEL SUPPORT

Page: 1

Mod11894_TextOfModification.pdf

S11894Text Modification

FBCB Drawing 4 will replace Figure 1410.3(2) Multi-span vinyl or alum……

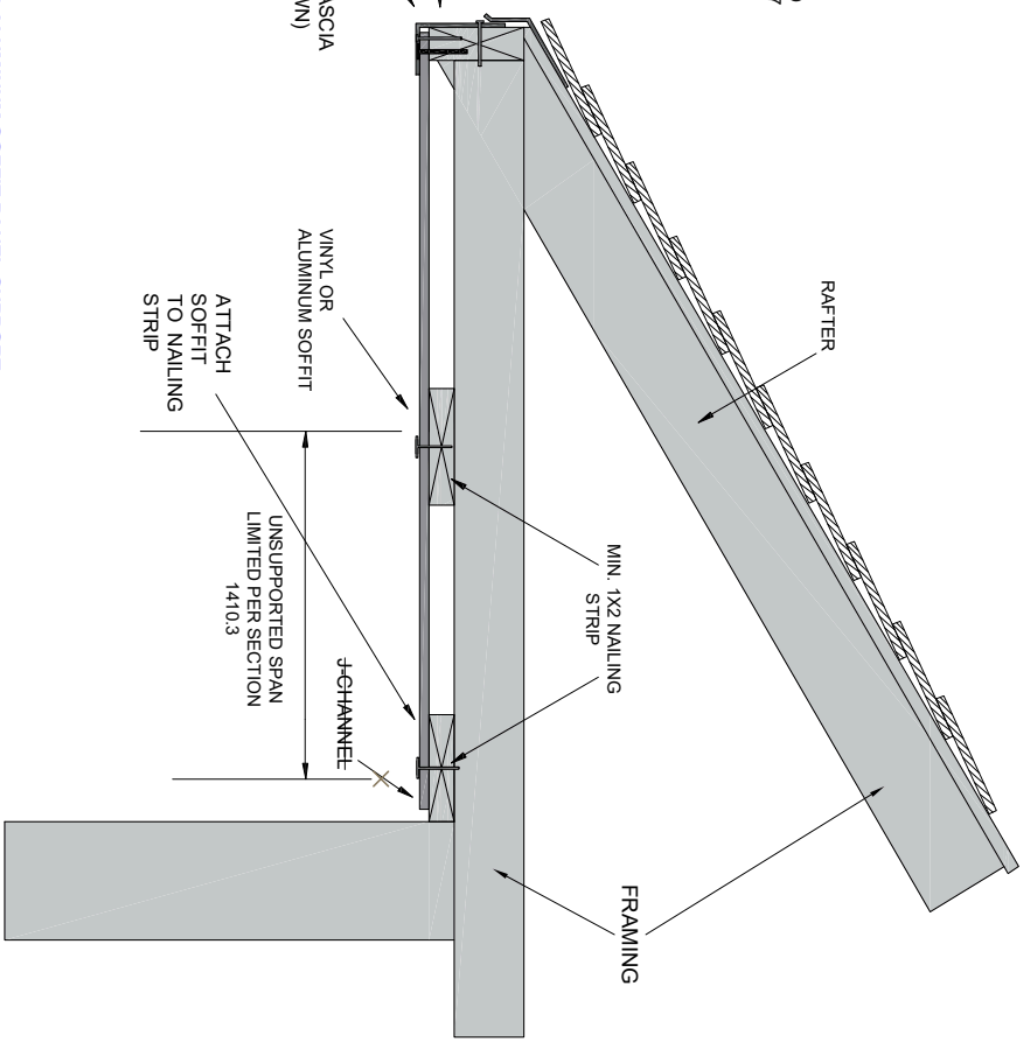


FIGURE 1410.3(2) MULTI-SPAN VINYL OR ALUMINUM SOFFIT PANEL SUPPORT

Mod_11894_Text_1410.3(2).pdf Page: 1

S11894Text Modification

FBCB Drawing 3 will replace Figure 1410.3 (1) Single-Span Vinyl or Alum....

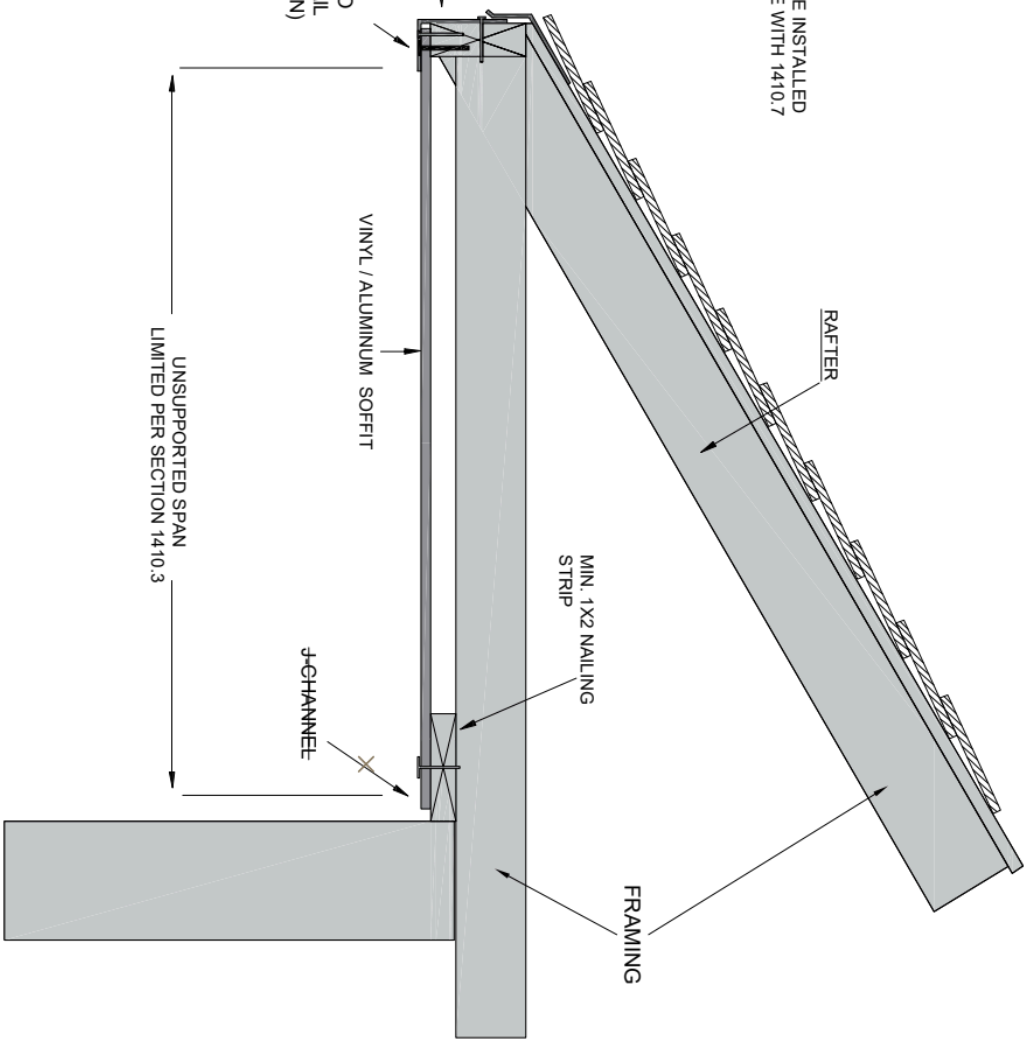


FIGURE 1410.3(1) SINGLE-SPAN VINYL OR ALUMINUM EXTERIOR SOFFIT PANEL SUPPORT

Mod_11894_Text_1410.3(1).pdf Page: 1

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

16

SP11976

Date Submitted	02/13/2025	**Section**	1612.4	**Proponent**	Rebecca Quinn obo FL Div Emerg Mgnt
Chapter	16	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Summary of Modification

Rectifies disconnect with the NFIP minimum requirements that was created in the 2024 IBC (see 11175/S116-22 AMPC4). ASCE 24 has provisions for temporary structures (less than 180 days), which are Flood Design Class 1. They may be at-grade and ‘wet floodproofed.’ FEMA proposing same for 2027 IBC.

Rationale

The 2024 IBC language completely circumvents all flood requirements for “public occupancy structures” (see 11175/S116-22 AMPC4). The “controlled occupancy procedures” have nothing to do with reducing flood damage, including collateral damage by debris generated by unregulated temporary structures. In addition to what ASCE 24 has for temporary structures, local floodplain management regulations have similar requirements for structures other than buildings. FEMA submitted a proposal to make the same changes in 2027 IBC (which would carry forward to the 10th Ed FBC). In addition, FEMA proposes, and FDEM concurs, to restrict temporary structures from high-risk areas, including floodway (thus no encroachment analysis required) and Zone V (which would require significant anchoring).

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Clarifies requirements for temporary structures in flood hazard areas.

Impact to building and property owners relative to cost of compliance with code

There may be some cost impact for those who would proposing ‘public occupancy temporary structures” and those who would propose putting temporary structures in floodways and Zone V.

Impact to industry relative to the cost of compliance with code

None

Impact to small business relative to the cost of compliance with code

There may be some cost impact for those who would otherwise propose putting temporary structures in floodways and Zone V (e.g., event planners)

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Yes, reduces damage and debris.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Yes, reduces damage and debris.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No change to flood damage-resistant material requirement.

Does not degrade the effectiveness of the code

No, code already allows temporary structures.

Alternate Language

2nd Comment Period

SP11976-A1

Proponent Rebecca Quinn obo FL Div Emerg Mgnt **Submitted** 8/7/2025 8:46:59 AM **Attachments** No

Rationale:
This comment does three things. First, it does not keep the prohibition on putting temporary structures in floodways and coastal high hazard areas. Second, it was pointed out during the International Code Council first Committee Action Hearing that other environmental loads for temporary structures are “scaled-back” from full loads required for other structures. At this time, there is no rational basis for a reduction of flood loads; satisfying the wind load provisions in Sec. 3103 provides some resistance to flooding and is equivalent to “techniques that minimize damage” in ASCE 24. The second-period submission is the same that the proponent worked out with a representative of the ASCE 7 temporary structure load committee and was submitted for the second Committee Action Hearing scheduled for October. That subcommittee is expected to consider reduction factors for flood loads, and the outcome may be in the 2028 edition of ASCE 7. The proposal also clarifies flood openings only required in rigid walls (not flexible fabrics). Third, a definition for Flood Design Class, based on the definition in ASCE 24, is added. The term is used in Sec. 1603.1.7 and this proposal.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Meets the intent to minimize flood damage and clarifies requirements for temporary structures in flood hazard areas.

Impact to building and property owners relative to cost of compliance with code
No additional cost to anchor to resist wind, some added cost for temporary structures with rigid walls and those that have mechanical and electric.

Impact to industry relative to the cost of compliance with code
Some for those that manufacture rigid-walled temporary structures and mechanical equipment for temporary structures.

Impact to small business relative to the cost of compliance with code
There may be some cost impact for those who would otherwise propose putting temporary structures in floodways and Zone V (e.g., event planners)

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Yes, reduces damage and debris.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Yes, reduces damage and debris.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
No change to flood damage-resistant material requirement.

Does not degrade the effectiveness of the code
no, code already allows temporary structures

SP11976-A1Text Modification

FLOOD DESIGN CLASS. Classification of buildings and other structures for determination of flood loads and conditions, and determination of minimum elevation requirements on the basis of risk associated with unacceptable performance.

-

1612.4 Design and construction. The design and construction of *buildings* and *structures* located in *flood hazard areas*, including *coastal high hazard areas* and *coastal A zones*, shall be in accordance with Chapter 5 of ASCE 7 and ASCE 24. Elevators, escalators, conveying systems and their components shall conform to ASCE 24 and ASME A17.1/CSA B44 as applicable.

Exception: *Temporary structures* complying with Section 3103.6.1.3.

3103.5.1.3 Flood loads. ~~Public-occupancy temporary structures need not be designed for flood loads specified in Section 1612. Controlled-occupancy procedures in accordance with Section 3103.8 shall be implemented.~~ Temporary structures located in flood hazard areas shall conform with the wet floodproofing requirements of ASCE 24 for structures assigned Flood Design Class 1 as modified by the following:

1. Design for wind loads in accordance with Sec. 3103.5.1.2 shall be permitted in lieu of design for flood loads in ASCE 7.

2. Temporary structures with rigid walls shall have flood openings in those walls.

3. Mechanical equipment and electric service shall elevated to or above the base flood elevation.

Controlled occupancy procedures in accordance with Section 3103.6 shall be implemented for public-occupancy temporary structure.

Page: 1

Mod11976_A1_TextOfModification.pdf

SP11976Text Modification

1612.4 Design and construction. The design and construction of *buildings* and *structures* located in *flood hazard areas*, including *coastal high hazard areas* and *coastal A zones*, shall be in accordance with Chapter5 of ASCE7 and ASCE24. Elevators, escalators, conveying systems and their components shall conform to ASCE 24 and ASME A17.1/CSA B44 as applicable.

~~**Exception:** *Temporary structures* complying with Section 3103.6.1.3.~~

Delete and substitute as follows:

3103.6.1.3 Flood loads. ~~*Public occupancy temporary structures* need not be designed for flood loads specified in Section 1612. Controlled occupancy procedures in accordance with Section 3103.8 shall be implemented.~~ Temporary structures shall not be located in floodways and coastal high hazard areas. Temporary structures located in flood hazard areas other than floodways and coastal high hazard areas shall comply with Section 1612.

Page: 1

Mod11976_TextOfModification.pdf

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

17

SP12017

Date Submitted	02/13/2025	**Section**	1612.4	**Proponent**	Rebecca Quinn obo FL Div Emerg Mgnt
Chapter	16	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Summary of Modification

Add provisions for structures in flood hazard areas other than buildings, including structures that are roofed but not walled. Such structures include pole barns, gazebos, platforms, boat shelters, and RV shade structures.

Rationale

Fills an apparent gap in floodplain requirements for structures other than buildings. Adds provisions for those structures , including structures that are roofed but not walled. Such structures include pole barns, gazebos, platforms, boat shelters, and recreational vehicle shade structures. There are no elevation requirements for these structures because unlike buildings that shelter occupancies, they do not have ‘lowest floors.’ However, they must resist flooding to minimize damage to the structures and to minimize damage caused by battering debris when those structures do not resist loads.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Provides clarity for structures that do not have explicit requirements in the FBC when those structures are located in flood hazard areas.

Impact to building and property owners relative to cost of compliance with code
Some increase cost for structures that have mechanical, plumbing and electrical service.

Impact to industry relative to the cost of compliance with code
Clarifies general performance expectations for structures other than buildings.

Impact to small business relative to the cost of compliance with code
Clarifies general performance expectations for structures other than buildings.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Yes, minimize damage.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Clarifies general performance expectations for structures other than buildings.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Repeats general expectation that materials below flood levels must resist flood damage.

Does not degrade the effectiveness of the code

Clarifies general performance expectations for structures other than buildings.

Alternate Language

2nd Comment Period

SP12017-A1

Proponent Rebecca Quinn obo FL Div Emerg Mgnt **Submitted** 8/7/2025 8:57:12 AM **Attachments** No

Rationale:
This comment retains the original proposal and adds “unwalled,” the term used in Dec Statement 2024-026. Unwalled can be taken to mean no walls. Not fully walled means can have one, two or three walls – but the fourth side is open. The original proposal, as modified, fills an apparent gap in floodplain requirements for structures other than buildings. Adds provisions for those structures, including structures that are roofed but are not fully walled or are unwalled (term used in DS-2024-026). Such structures include pole barns, animal run-in shelters, gazebos, platforms, boat shelters, and recreational vehicle shade structures. There are no elevation requirements for these structures because unlike buildings that shelter occupancies, they do not have ‘lowest floors.’ However, they must resist flooding to minimize damage to the structures and to minimize damage caused by battering debris when those structures do not resist loads.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Provides clarity for structures that do not have explicit requirements in the FBC when those structures are located in flood hazard areas.

Impact to building and property owners relative to cost of compliance with code
Some increase cost for structures that have mechanical, plumbing and electrical service.

Impact to industry relative to the cost of compliance with code
Clarifies general performance expectations for structures other than buildings.

Impact to small business relative to the cost of compliance with code
Clarifies general performance expectations for structures other than buildings.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Yes, minimize damage, unchanged with the addition of "unwalled."

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Clarifies general performance expectations for structures other than buildings.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
Repeats general expectation that materials below flood levels must resist flood damage.

Does not degrade the effectiveness of the code
Clarifies general performance expectations for structures other than buildings.

SP12017-A1Text Modification

1612.4.3 Structures other than buildings. Structures other than buildings, including structures with roofs that are unwalled or not fully walled, shall:

1. Be anchored to prevent flotation, collapse or lateral movement resulting from hydrostatic loads, including the effects of buoyancy, during conditions of the base flood.

2. Be constructed of flood damage-resistant materials.

3. Have mechanical, plumbing, and electrical systems above the base flood elevation or meet the requirements of ASCE 24, except that minimum electric service required to address life safety and electric code requirements is permitted below the base flood elevation provided it conforms to the provisions of the electrical part of building code for wet locations.

Page: 1

Mod12017_A1_TextOfModification.pdf

SP12017Text Modification

1612.4.3 Structures other than buildings. Structures other than buildings, including structures with roofs that are not fully walled, shall:
1. Be anchored to prevent flotation, collapse or lateral movement resulting from hydrostatic loads, including the effects of buoyancy, during conditions of the base flood.
2. Be constructed of flood damage-resistant materials.
3. Have mechanical, plumbing, and electrical systems above the base flood elevation or meet the requirements of ASCE 24, except that minimum electric service required to address life safety and electric code requirements is permitted below the base flood elevation provided it conforms to the provisions of the electrical part of building code for wet locations.

Page: 1

Mod12017_TextOfModification.pdf

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

18

SP12034

Date Submitted	02/13/2025	**Section**	1612.4	**Proponent**	Jaime Gascon
Chapter	16	**Affects HVHZ**	Yes	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

12040

Summary of Modification

Provides reference to an acceptable test standard to qualify passive flood resistant products based on performance testing.

Rationale

Guidance to a flood testing protocol or approved flood resistance test for products being qualified for use in Special Flood Hazard Areas is needed. It will serve to properly qualify flood resistance performance of passive systems.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Saves time by making available an adopted standard that is acceptable for code compliance.
Impact to building and property owners relative to cost of compliance with code
Saves costs by knowing what is acceptable for code compliance.
Impact to industry relative to the cost of compliance with code
Saves costs by testing to an adopted standard that is acceptable for code compliance.
Impact to small business relative to the cost of compliance with code
Saves costs by testing to an adopted standard that is acceptable for code compliance.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Improves the code by use of an adopted standard that is acceptable for code compliance.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Strengthens the code by use of an adopted standard that is acceptable for code compliance.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not discriminate since it allows for other approved testing to also be used.

Does not degrade the effectiveness of the code

It does not degrade the code, but serves to improve it by providing guidance with a standard.

Alternate Language

2nd Comment Period

SP12034-A2

Proponent Rebecca Quinn obo FL Div Emerg Mgnt **Submitted** 8/24/2025 11:51:10 AM **Attachments** Yes

Rationale:
ANSI/FM Approvals 2510-2020, standard for “flood mitigation equipment,” was published in 2020. It applies to “flood barriers for opening barrier and perimeter barrier applications” (passive and active) and mitigation valves and pumps. It is cited in ASCE 24, Flood Resistant Design and Construction (2024). Alternate Language adds ANSI/FM standard and provides for use of measures, passive and active, with approval of building officials –necessary clarification. Some manufacturers have not completed testing and FM 2510 certification, and likely even fewer satisfied TAS 204. RDPs might develop individual designs for unique situations that manufactured and certified products cannot address. Miami-Dade proposes to require all dry floodproofing passive measures (“flood resistance materials”) used in every jurisdiction to meet TAS 204-26. Other TASs cited are related to HVHZ and wind-borne debris regions. See separate comment submitted for SP12040 (the TAS). • TAS 204 is not applicable in Coastal A Zones, yet the FBC allows dry floodproofing in those areas. Alt Language addresses by stating it applies “where dry floodproofing is permitted by this code.” • TAS 204 is explicitly only for “passive” measures. The obvious question is about measures that require people to take action. Requiring passive measures only if tested by TAS 204 or another resistance test would end the standard of practice for +50 years by precluding individual certification. Alt Language addresses by providing for approval by the building official as an option. FBC defines Dry Floodproofing and 1612.4 refers to ASCE 24 for design and construction. Dry floodproofing includes those that are passive and do not rely on people (e.g., solid walls, special flood glass, special doors that seal every time closed), and those that require human intervention (e.g., to install panels and barriers). See attachment for additional paragraph about construction documents and design in accordance with ASCE 24.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Saves time and increases confidence when certified products are specified in designs.

Impact to building and property owners relative to cost of compliance with code
Saves some costs when design professionals specify use of certified products.

Impact to industry relative to the cost of compliance with code
Design industry will save time and costs when they can specify certified products. Manufacturing industry incurs costs for testing, but whether to seek certification is a choice.

Impact to small business relative to the cost of compliance with code
Saves costs by testing to an adopted standard that is acceptable for code compliance.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Improves reliability of dry floodproofed buildings when certified products are used.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Improves reliability of dry floodproofed buildings when certified products are used.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
In addition to offering two testing standards, allows continuation of standard practice over last +50 years by relying on design professional certification.

Does not degrade the effectiveness of the code
Improves effectiveness when certified products are specified.

2nd Comment Period

SP12034-A1

Proponent Jaime Gascon **Submitted** 8/13/2025 1:19:20 PM **Attachments** No

Rationale:

This MOD was denied by the Special OCC TAC and Approved as Submitted (9/2) by the Structural TAC. This alternative language intends to clarify the questions raised on the proposed charging language as to when the new testing protocol can be used. It is intended for 'passive' systems only and the language has been adjusted accordingly.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Saves time by making available and directing users of the code to a standard for testing passive flood resistance products.

Impact to building and property owners relative to cost of compliance with code

Saves cost by knowing what is acceptable for code compliance.

Impact to industry relative to the cost of compliance with code

Saves cost by knowing what is acceptable for code compliance.

Impact to small business relative to the cost of compliance with code

Saves costs by testing to an adopted standard that is acceptable for code compliance.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Improves the code by referencing an adopted standard that is acceptable for code compliance.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Strengthens the code by referencing an adopted standard that is acceptable for code compliance.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not discriminate since it allows for other approved testing to also be used.

Does not degrade the effectiveness of the code

It does not degrade the code, but enhances it by providing guidance with a new standard protocol.

SP12034-A2Text Modification

Replace:

1612.4.3 Testing of Dry Floodproofing Measures. Where dry floodproofing is permitted by this code, materials, products and assemblies specified by registered design professionals as part of dry floodproofing measures shall meet the following, as applicable:

here human intervention is not required (passive), meet the test requirements of ANSI/FM 2510, TAS 204 or an approved test standard, unless otherwise approved by the building official.

here human intervention is required (active), meet the test requirements of ANSI/FM 2510 or an approved test standard, unless otherwise approved by the building official.

ADD to Chapter 35:

ANSI/FM 2510—20. American National Standard for Flood Mitigation Equipment.

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Approvals

ANSI
American National Standards Institute

ANSI/FM APPROVALS 2510-2020
REVISION OF ANSI/FM APPROVALS 2510-2014
APPROVED SEPTEMBER 14, 2020

American National Standard for Flood Mitigation Equipment

September 2020

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FOREWORD

NOTE: This foreword is introductory only and is not part of American National Standard FM 2510.

This standard is intended to be used to evaluate the components and performance of flood mitigation equipment.

This American National Standard has been developed by the canvass method of standards development of the American National Standards Institute (ANSI). FM Approvals is an ANSI-accredited standards developing organization (SDO).

Approval of an American National Standard requires verification by ANSI that the principles of openness and due process have been followed and that a consensus of those directly and materially affected by the standard has been achieved. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution. Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached.

The American National Standards Institute does not develop standards nor will it in any circumstances give an interpretation of any American National Standard. Requests for interpretations of this test standard shall be addressed to FM Approvals.

ANSI regulations require that this American National Standard shall be revised, reaffirmed or withdrawn within five years of the date of publication.

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1. INTRODUCTION

1.1. PURPOSE

1.1.1. This standard states the examination and test requirements for flood mitigation equipment for use in riverine, tidal, or rainfall related flood conditions.

1.2. SCOPE

1.2.1. This standard encompasses the design and performance requirements for flood mitigation equipment for use in controlling riverine tidal or rainfall related flood conditions. Flood mitigation equipment is categorized for specific flood protection applications which are designated by:

- Function (permanent or contingent)
- Operation (active or passive)
- For flood barriers, the intended application for protection (i.e., opening vs. perimeter)

1.2.2. This standard sets performance requirements for flood abatement equipment in the following product categories:

- Flood Barriers for Opening Barrier Applications
- Flood Barriers for Perimeter Barrier Applications
- Flood Mitigation Valves
- Flood Mitigation Pumps
- Penetration Sealing Devices

1.2.2.1. Flood glazing, as defined in Section 1.9, is considered a type of flood barrier that may be evaluated for opening barrier or perimeter barrier applications. The evaluation of flood glazing shall include the seal made between the glazing panel and the structural frame as well as the seal made between the frame and the structural opening.

1.2.2.2. For the purposes of evaluation to this Standard and applying the appropriate protocol, sluice gates, as defined in Section 1.9, are considered a type of flood barrier for opening barrier applications.

1.2.2.3. Penetration sealing devices include products used to seal the area around a surface penetration or the area within the penetration itself, the later which includes pipe plugs.

1.2.3. Flood barriers for opening barrier applications are evaluated and tested for quasi-static flood conditions.

1.2.4. Flood barriers for perimeter barrier applications are evaluated and tested for quasi-static and riverine flood conditions.

1.2.5. Flood barriers for coastal applications are not included in the scope of this Standard. Protection from tidal-related flood events is included in the scope of the Standard only for applications away from the coast where only quasi-static flood conditions are present.

1.2.6. Wind loading effects on flood barriers are not included in the scope of the evaluation. A full engineering analysis must be conducted by persons acceptable by the Authorities Having Jurisdiction (AHJ) to determine possible wind loading, as well as combined hydrostatic and wind loading, on a barrier structure.

1.2.7. The certification of flood barriers applies only at water levels up to the maximum depth rating, as identified on the product label. Water levels exceeding this amount are outside the scope of this certification.

1.2.8. Flood mitigation pump types included in the scope of this standard consist of submersible and pedestal type sump pumps as well as self-priming pumps.

1.2.9. Flood mitigation pumps are evaluated and Approved as pump packages only, complete with pump, driver, controller, coupling, and other components listed in Appendix C.

1.2.10. Certification to this Standard is limited to the flood mitigation product. Flood waters may produce high hydrostatic or hydrodynamic loading on a protected structure. Appropriate measures must be taken to ensure that an external wall structure (or similar) is able to withstand anticipated flood loading, including any site specific concerns. Some wall construction assemblies often are able to withstand 3 ft (0.9 m) or less of flood loading without needing reinforcement or additional waterproofing. A full engineering analysis must be conducted by persons acceptable by the Authorities Having Jurisdiction (AHJ).

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1.2.11. In addition to the general design requirements specified in this Standard, local construction codes and/or agency regulations must also be considered in the design of a flood mitigation product or system.

1.3. BASIS FOR REQUIREMENTS

1.3.1. The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.

1.3.2. The requirements of this standard reflect tests and practices used to examine characteristics of flood mitigation equipment. Flood mitigation equipment having characteristics not anticipated by this standard may be tested if demonstrated performance is equal or superior to that required by this standard, or if the intent of the standard is met.

Alternatively, flood mitigation equipment that has met all of the requirements identified in this standard may not be acceptable if other conditions which adversely affect performance exist or if the intent of this standard is not met. It is the sole discretion of the testing laboratory.

1.4. BASIS FOR ANSI SPECIFICATION

1.4.1. Certification is based upon satisfactory evaluation of the product and the manufacturer. Examination and tests on production samples shall be performed to evaluate:

- The suitability of the product
- The performance of the product as specified by the manufacturer
- The durability and reliability of the product

1.4.2. Since each flood mitigation system is unique in its operation and design, component testing shall be performed on a case-by-case basis. If deemed necessary, additional tests which are not included in this standard may be required at the discretion of the test laboratory.

1.4.3. A satisfactory evaluation of the flood abatement equipment's "Design, Installation, Operation and Maintenance Manual" is required. The evaluation shall be performed to ensure that the document is accurate and complete.

1.5. SYSTEM OF UNITS

Units of measurement used in this standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximated. Conversion of U.S. customary units is in accordance with the Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing and Materials (ASTM) SI 10. Two units of measurement (liter and bar), outside of, but recognized by SI, are commonly used in the international scientific community and are used in this standard.

1.6. NORMATIVE REFERENCES

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document (including any amendments) applies:

ASME Publications
The American Society
of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990
www.asme.org

ASME *Boiler and Pressure Vessel Code, Section VIII- Rules for Construction of Pressure Vessels, Division 1*

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ASTM Publications American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959	ASTM A351 – *Standard Specification for Castings, Austenitic, for Pressure Containing Parts* ASTM B16 - *Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines* ASTM B117 – *Standard Practice for Operating Salt Spray (Fog) Apparatus* ASTM D412 – *Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Elastomers – Tension* ASTM D395 – *Standard Test Methods for Rubber Property – Compression Set* ASTM D572 - *Standard Test Method for Rubber – Deterioration by Heat and Oxygen* ASTM D573 – *Standard Test Method for Rubber – Deterioration in an Air Oven* ASTM D1056 – Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber ASTM D5602 – *Standard Test Method for Static Puncture Resistance of Roofing Membrane Specimens* ASTM G155 – *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*
International Standards Organization 1 rue de Varembé Case Postale 56 CH-1211 Geneve 20 Switzerland	IISO 17025 – *General Requirements for the Competence of Testing and Calibration Laboratories*
United States Department of Transportation (D.O.T.) Washington, DC	*Code of Federal Regulations, Title 49, Transportation*, Parts 171 through 180

1.7. DEFINITIONS

For purposes of this standard, the following terms apply.

Accepted	This term refers to installations acceptable to the authority having jurisdiction and enforcing the applicable installation rules. Acceptance is based upon an overall evaluation of the installation. Acceptance is not a characteristic of a product. It is installation specific. A product accepted for one installation may not be acceptable elsewhere.
Active Flood Barrier or Flood Mitigation Product	A flood barrier or other flood mitigation product which requires human intervention for manual deployment. Active flood barriers or flood mitigation products may either be permanent or contingent.
Automatic Flood Barrier or Flood Mitigation Product	A permanent passive barrier or other flood mitigation product that automatically deploys without need for human intervention when flood conditions are detected. Types of automatic barriers may include, but are not limited to, buoyancy driven (horizontal or vertical) and (pneumatic or hydraulic activated by water sensors).
Backwater Valve	Backwater valves are a type of flood mitigation valve typically installed in drainage or sanitary systems and designed to prevent reverse flow into a protected structure and/or area. Standard flapper or swing type check valves are a common example. Backwater valves may be configured in either a normally open position or normally closed position and may be used for in-line or end of line applications.
Characteristic Curve	Graphic representation of the variation of a pump's outlet pressure (total head), efficiency and/or brake horsepower versus the pump's capacity at a constant speed. Multiple rated speeds may be represented with multiple curves on a single plot.

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Contingent Flood Barrier or Flood Mitigation Product	A barrier or flood mitigation product that is not permanently installed and affixed to a structure and which requires some level of transportation and manual deployment. Some elements of the barrier/product may be permanently pre-installed (i.e. frame), but the main components are temporary and require manual deployment. Contingent flood barriers or flood mitigation products may only be classified as active protection
Deflection	The distance a flood barrier has moved from its original location during an applied force event. Deflection may be movement/displacement or distortion of the barrier structure itself. Permanent deflection is the distance the flood barrier has moved from its original location after the applied force is removed.
Deployment Time	The amount of time required for deployment and/or operation of an active flood mitigation product.
Dry-Side (or Land Side)	The side of a flood barrier or flood mitigation product that is protected from flood waters.
Flexible Rubber Type Valves	Flexible rubber type valves, also commonly referred to as duckbill check valves, are a type of flood mitigation valve which uses flexible rubber material to function as the valve mechanism. The position of the flexible rubber flap, or duckbill, is directly manipulated by the water and direction of flow. This provides for automatic open/close function resulting in flow only in the desired direction. Flexible rubber type valves may be constructed entirely of flexible rubber material or may be encased in a solid body.
Flood Doors	Any door, permanent or otherwise, which provides complete coverage of an exterior or interior door opening with the principle function of preventing flood waters into a structure.
Flood Glazing	A permanent, passive flood barrier constructed of reinforced glass material that is set and sealed within a structural frame. The frame is then installed and sealed within the structural opening. Flood glazing barriers may be configured as single panels (i.e. windows) or as multiple panels in a modular series to form a wall structure of the desired length. Flood glazing may also be installed within another permanent barrier structure such as a flood wall. Flood glazing may be used for opening barrier and/or perimeter barrier applications.
Flood Mitigation Pumps	A pump used for the removal of unwanted flood water. Types of flood mitigation pumps include but are not limited to submersible, pedestal, and self-priming pumps. Flood mitigation pumps may be utilized in one or more of the following applications; as part of a flood barrier system to remove water resulting from leakage past the barrier, permanently installed in a building as part of a water removal system (i.e. drainage system with sump), and/or a portable device used for removal of unwanted flood waters from a desired location.
Flood Mitigation Valve	This term refers to any style of valve that is used to mitigate the passage of water into a protected area during flood events. These products may be installed in-line or at the end of line outflow locations. Backwater valves are a type of flood mitigation valve. Other non-standard designs may also be utilized for this intended purpose, such as flexible rubber type valves.
Flood Panel Barrier	A flood barrier consisting of a large rigid panel(s) as the main structural element. During a flood event, the panel is manually affixed to a pre-installed barrier frame, or other pre-installed receiver components, at the location of deployment.
Flood Plank Barrier	A flood barrier consisting of multiple rigid planks which are guided through a vertical frame and stacked on top of each other to form a wall structure.
Leakage Rate	The rate at which water moves past or through a flood barrier or other flood mitigation product from the wet-side to the dry-side of the barrier, expressed as gallons per hour per linear foot (liters per hour per linear meter) length of seal.
Major Repair	A repair made to a flood barrier during the performance testing that requires changes to barrier design by the manufacturer.

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Maximum Load	Maximum radial hydraulic load on the impeller of a flood mitigation pump at any point on the performance curve based on a specific gravity of 1.0. This usually occurs at the point of maximum total discharge head.
Maximum Power	The greatest speed-corrected power required to drive a flood mitigation pump at rated speed and at any point along its characteristic curve, and through the pumps total run out condition.
Minor Repair	A small repair made to a flood barrier during the performance test series. A repair will constitute as a "minor repair" only if; (1) the repair can be easily replicated by the end user, and (2) the Design, Installation, Operation, and Maintenance Manual instructs how to conduct the repair. If a minor repair becomes part of the deployment procedure in the Design, Installation, Operation, and Maintenance Manual, it will no longer be considered a repair.
Nationally Recognized Testing Laboratory (NRTL)	A laboratory which is listed and recognized by the United States Department of Labor, Occupational Safety & Health Administration's (OSHA) Directorate of Science, Technology, and Medicine program. The program recognizes private sector organizations as NRTL's, and recognition signifies that an organization has met the necessary qualifications specified in the regulations for the Program. The NRTL determines that specific equipment and materials ("products") meet consensus-based standards of safety to provide the assurance, required by OSHA, that these products are safe for use in the U.S. workplace.
Normally Closed Backwater Valve	A backwater valve designed in such a manner that when installed, the backflow prevention element remains closed until flow causes it to open.
Normally Open Backwater Valve	A backwater valve designed in such a manner as not to interfere with the movement of the air through the connected pipework. When installed, the backflow prevention element is in a normally open position.
Opening Barrier Applications	Applications in which a flood barrier is used to protect against water entering through an opening in a structure between two linear points (i.e. doorway, window, receiving bay, etc.). The barrier is supported by the permanent structure on both sides or along the full perimeter of the barrier/opening. Typical products used in opening barrier applications include flood doors, flood panels, and flood planks. Other products may include, but are not limited to, flexible membrane barriers, sluice gates, and flood glazing. Flood barriers certified for opening barrier applications are evaluated/tested to withstand quasi-static flood conditions.
Overtopping	The action of water flowing over the top of a flood barrier.
Passive Barrier or Flood Mitigation Product	A permanent barrier or other flood mitigation product that, after its initial installation, either requires no deployment or requires no human intervention for deployment. Examples of passive protection are engineered flood walls, flood glazing, penetration seals around pipes/cables, and automatic flood barriers. Passive barriers or flood mitigation products may only be classified as permanent.
Pedestal Pump	A pump that is comprised of; a pumping element in a sump, pit, or a low point, and a motor mounted on a column or pedestal extended vertically above the pumping element. The motor is not be exposed to the water in the sump, pit, or low point.
Perimeter Barrier	Applications in which a flood barrier is used to prevent flood water from entering an area surrounding a protected structure. Flood barriers evaluated for perimeter barrier applications may be contingent or permanent. The barrier is installed at some distance away from the protected structure allowing for additional flood mitigation methods (i.e. flood mitigation pumps) to be used to control any seepage before it reaches the protected structure. Perimeter barriers may be configured as a full perimeter wall or a terminating wall which may or may not be supported by a permanent structure. Flood barriers Approved for perimeter barrier applications are evaluated/tested to withstand quasi-static and riverine flood conditions.

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Permanent Flood Barrier or Flood Mitigation Product	A barrier or flood mitigation product that is pre-installed and permanently affixed to a structure. Permanent barriers or flood mitigation products may or may not require manual deployment. Examples of permanent barriers requiring manual deployment include flood doors, hinged gates, sluice gates, etc.
Rated Capacity	The rate at which a flood mitigation pump delivers water, in gal./min. (L/min), at rated pressure and rated speed.
Rated Pressure	The outlet pressure in pounds per square inch - psi (kilopascals -kPa) developed by a flood mitigation pump when operating at rated capacity.
Riverine Flood Conditions	Flooding of or produced by a river causing water, debris and sediments to be transported onto a flood plain. Riverine flood conditions include various degrees of wave action and water currents, as well as the potential for large debris impact.
Seal	The location on a barrier where the product meets the ground or wall of the structure to prevent water from moving from the wet-side to the dry-side. A seal can also be made between different components or sections within a flood barrier. The linear length of seal, as determined based on the product type, is used for calculation of the leakage rate.
Self-Priming Pump	A flood mitigation pump which, when activated, will evacuate its passages of air and automatically draw in water to the suction side to commence pumping without the need for human intervention.
Shutoff Pressure	The net pressure in psi (kPa) developed by a flood mitigation pump at rated speed with zero flow.
Sluice Gate	A gate installed at the end of a sluice used to control water level and the flow from one area to another.
Structural Opening	Any opening where water can flow through such as doors, windows, air bricks/vent bricks, portals, garage entrance/loading dock entrance, etc.
Submersible Pump	A pump that consists of both the pumping element and the motor in a protective housing which allows the system to run properly when submerged in a liquid.
Sump Pump	A pump powered by an electric motor used for the removal of ground water drainage from a sump, pit or low point in a foundation. Types of sump pumps include, but are not limited to, pedestal and submersible.
Total Discharge Head	The gauge reading in psi (kPa) at the discharge of a flood mitigation pump converted to feet of liquid and corrected to the pump centerline elevation.
Total Dynamic Head	The difference between the total discharge head and the total suction head, or between the total discharge head and the total suction lift, whichever is applicable.
Total Suction Head	The gauge reading in psi (kPa) at the suction of a flood mitigation pump, converted to feet of liquid and corrected to the pump centerline elevation. This condition is present when the liquid supply level is above the pump centerline and the suction pressure is above atmospheric.

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Total Suction Lift	The gauge reading in inHg (mmHg) at the suction of a flood mitigation pump, converted to feet of liquid and corrected to the pump centerline elevation. This condition is present when the liquid supply level is below the pump centerline and the suction pressure is below atmospheric.
Wet-Side (or River-Side)	The side of a flood barrier or flood mitigation product that is subjected to flood waters.

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2. GENERAL INFORMATION

2.1. PRODUCT INFORMATION

2.1.1. Flood mitigation equipment is designated and categorized by function (permanent vs, contingent) and operation (active vs. passive). This standard defines protection with the following types of flood mitigation equipment.

- Flood barriers for perimeter barrier applications
- Flood barriers for opening barrier applications
- Flood mitigation valves
- Penetration sealing devices
- Flood mitigation pumps

2.1.2. In order to meet the intent of this standard, mitigation equipment shall be examined on a model-by-model, type-by-type, manufacturer-by-manufacturer, and plant-by-plant basis. This is predicated on the basis that identical designs, fabricated in identical materials by different manufacturers have been seen to perform differently in testing. Sample flood mitigation equipment, selected in conformance to this criterion, shall satisfy all of the requirements of this standard.

2.2. APPLICATION REQUIREMENTS

The manufacturer shall provide the following preliminary information that gives a full description of the construction of the flood abatement equipment. All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level.

Test programs will be scheduled only upon receipt of all material listed herein. All foreign language documents shall be provided with English translation.

2.2.1. Marketing/Ordering Literature - Showing general specifications and functions of the system.

2.2.2. Model Number Breakdown - A specification or drawing showing all system variations and options to be examined.

2.2.3. The Design, Installation, Operation, and Maintenance Manual.

2.2.4. Quality Control Procedures - Document(s) detailing routine testing and final inspection procedures: receiving inspection; in-process inspection; final inspection, and calibration of measuring and testing equipment used. In addition, procedures must detail the system acceptance testing once the flood mitigation equipment system is installed.

2.2.5. Documentation Control Specification - Proposed method of controlling critical documents which may be identified in the Documentation Section of the Test Report. These drawings shall be listed in the report issued at the conclusion of the test program. The testing laboratory shall be notified of changes to these documents.

2.2.6. Production Drawings - The following drawings shall be provided:

- Electrical schematic(s)
- Final assembly drawings and parts lists sufficient to detail primary components (all), operator controls, and their locations
- Complete set of mechanical drawings for all machined parts
- Complete part specifications (including manufacturer's model numbers, size, ratings, etc.) for all purchased parts
- Specification sheets for all parts/components
- Drawings showing all construction details
- Product label drawing(s) showing all required marking information. The label drawing shall show the proposed label location on the equipment and artwork showing the manufacturer's name, address, model and serial numbers, equipment ratings, and warning markings.

2.2.7. The number and location of manufacturing facilities.

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2.3. REQUIREMENTS FOR SAMPLES FOR EXAMINATION

Sample requirements are to be determined by the testing laboratory following review of the preliminary information. Sample requirements may vary depending on design features and/or the results of any testing. It is the manufacturer's responsibility to submit samples representative of production. Any decision to use data generated utilizing prototype components or prototype systems is at the sole discretion of the testing laboratory.

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3. GENERAL REQUIREMENTS

3.1. REVIEW OF DOCUMENTATION

During the initial investigation and prior to testing, the manufacturer's specifications, technical data sheets, and design details shall be reviewed to assess the ease and practicality of installation and use. The system and its components shall be capable of being used within the limits of the investigation.

3.2. PHYSICAL OR STRUCTURAL CONSTRUCTION FEATURES

3.2.1. Flood Barries for Opening Barrier and Perimeter Barrier Applications

3.2.1.1. All materials used in flood barriers shall be suitable for the intended application. Flood barrier components shall be constructed of corrosion resistant materials. When unusual materials are used, additional testing may be necessary to verify their suitability.

3.2.1.2. Flood glazing is considered a type of flood barrier that may be configured for opening barrier or perimeter barrier applications, and shall be evaluated as such.

3.2.1.3. Flood glazing shall be constructed with reinforced glass designed to crack but not shatter, when subjected to debris impact. The glass shall demonstrate the ability to withstand debris impact without compromising structural integrity while maintaining an acceptable amount of leakage.

3.2.1.4. Air / Nitrogen / other gas cylinder(s) for pressurized seal systems shall meet the applicable requirements of either the ASME Boiler and Pressure Vessel Code, Section VIII or Code of Federal Regulations, Title 49, Transportation, Parts 171 through 180; or equivalent national standard of the country of use, reference section 4.9.

3.2.1.5. Manually operated caps, valves, and other mechanisms required for proper functioning of the barrier, must have a securing, locking, and/or supervising component

3.2.1.6. The design of automatic barriers shall be such that major debris that could impact the barrier's functionality is prevented from entering the system prior to deployment. Other debris shall be able to be flushed from the system during periodic maintenance

3.2.1.7. Automatic barriers shall have a method for manual deployment

3.2.1.8. Automatic barriers shall be evaluated for reliability when any component is exposed to an outside load condition (i.e. vehicular, personnel traffic, etc.) while in the open position. The manufacturer shall provide a complete analysis which illustrates the product's ability to withstand any anticipated load conditions over the expected life of the barrier. The analysis shall include at a minimum; maximum deflection under load, permanent deflection based on simulated live loads, and a failure analysis of the deployment equipment. The analysis shall be reviewed for accuracy and completeness by the testing laboratory.

3.2.1.9. Flood barriers for opening barrier and perimeter barrier applications shall be constructed so as to be reasonably watertight and shall mitigate seepage to a level within the maximum requirement. Maximum seepage rates of flood barriers for opening barrier applications are provided in Appendix D for various opening widths and design water heights

3.2.2. Flood Mitigation Valves

3.2.2.1. Flood mitigation valves shall be designed and evaluated for in-line and/or end of line applications

3.2.2.2. Backwater valves designed to be normally closed shall be constructed that when the device is installed at the required 1:48 slope (1/4 in. per foot) with respect to the direction of flow, the check member will be in a closed position when no fluid is discharged. The valve shall be designed so that any solids accumulated under low flow conditions are flushed through the valve during full design flow conditions.

3.2.2.3. Backwater valves designed to be normally open shall be constructed that when the device is installed at the required 1:48 slope (1/4 in. per foot) with respect to the direction of flow, the check member will be in an open position but will close when fluid backflow occurs.

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3.2.2.4. The internal working parts of a backwater valve, such as valve seat, flap, hinge pins, and stems, shall be copper alloy in accordance with ASTM B16, stainless steel in accordance with ASTM A351, or equally corrosion resisting material.

3.2.2.5. A backwater valve shall be designed and constructed that when installed in its proper operating position, the upper face of the device shall be parallel to the invert of the outlet so that the slope of the device can be readily determined by placing a level on the top of the face.

3.2.2.6. Flood mitigation valves shall be designed to provide access to working components for repair or replacement. The size of the access shall be based upon the requirements necessary to perform the repair or maintenance. The access cover shall be water and air tight once installed. This does not apply to flexible rubber type flood mitigation valves with no mechanical moving parts requiring maintenance and/or replacement.

3.2.2.7. Parts that are used to affect sealing in flood mitigation valves shall be secured in a manner that will maintain proper alignment of mating surfaces. Movement of any stationary parts shall not loosen or detach them during handling or operation of the unit. All seals and parts used to affect sealing shall be replaceable.

3.2.3. Flood Mitigation Pumps

3.2.3.1. Flood Mitigation Pump Packages

A flood mitigation pump manufacturer shall be able to supply the necessary pump accessories (See Appendix C) to provide a complete pump package installation. This responsibility includes control for: design, component sourcing, manufacturing, certification testing, production testing, proper operation and sizing of the pump and the accessories (Appendix C), quality control, and assembly locations.

3.2.3.2. Physical or Design Features

3.2.3.2.1. Connections to suction and discharge piping shall be made with flanged or threaded connections that are compliant to a recognized national or international standard. The use of other styles of connections will be at the sole discretion of the testing laboratory.

3.2.3.2.2. Manufacturers must provide a characteristic curve for each flood mitigation pump. Characteristic curves of discharge pressure (total dynamic head) vs. capacity shall be provided for all rated pump speeds. For submersible pumps, discharge pressure shall be in terms of total dynamic head. For self-priming pumps with suction lift capabilities, multiple performance curves shall be generated for varying degrees of suction lift, up to the maximum rated suction lift.

3.2.3.2.3. A flood mitigation pump shall have solids handling capability to protect against clogging caused by potential floating debris in flood waters. The solids handling capability, expressed as a maximum solid diameter, shall be clearly stated in the manufacturer's technical literature. Pumps shall be fitted with a means of protection from clogging by use of a strainer, or screening, sized to limit the maximum solid size entering the pump to within the stated capability.

3.2.3.2.4. Pump casings shall be designed for easy clean out/flushing in case of clogging, without the use of specialized tools.

3.2.3.2.5. Sealing at the pump shaft may be accomplished with either traditional packing, or mechanical seals.

3.2.3.2.6. Flood mitigation pumps shall be capable of turning on and off manually. In addition, pumps can have the capability of an optional automatic start and stop feature. Automatic operation shall turn on or off by responding to the appropriate water levels in a sump as indicated by the operation of a mechanical float switch, liquid level sensor, or pressure transducer.

3.2.3.2.7. Flood mitigation pumps shall be provided with a manual means for stopping the equipment. This may be located on the control panel on the assembly itself, or via a remote switch.

3.2.3.2.8. Flood mitigation pumps that may be installed in different orientations, shall be tested in each orientation, or it shall be stated which orientation for which the Approval has been granted.

3.2.3.2.9. Electrical devices used as part of a flood mitigation pump package intended for hazardous (classified) locations, requiring explosionproof or submerged service, the examination of electrical components is to include applicable Hazloc evaluations per applicable standards.

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3.2.3.2.10. Submersible pumps require a minimum submergence level for continuous operation. Operation under conditions outside of this range may cause significant damage to the pump. Performance ratings for submersible pumps shall be in reference to the pump while at the minimum submergence level and minimum total suction head.

3.2.3.2.11. Self-priming pumps may be designed to utilize various means of drawing water into the pump casing. The manufacturer's literature shall clearly outline the proper operation of the equipment in order to establish prime within the pump. It shall also indicate the amount of lift that each model of pump can produce.

3.2.3.2.12. Skid mounted or frame encased units shall have lifting points clearly marked in order to avoid damage to the unit during transportation.

3.2.3.2.13. Trailer mounted units shall be identified as compliant for over the road travel, or not. All trailer mounted units shall be provided with adjustable supports that may be used to level the unit for operation.

3.2.3.2.14. In order to account for the application, flood mitigation pumps may be driven by electric motors or internal combustion engines.

3.2.3.2.15. Due to the range of pumps considered for flood mitigation applications, the requirements for internal combustion engine drivers have been written around the use of gasoline powered engines up to 15 hp, and diesel engines from 15 hp and larger. Evaluation of engines utilizing other fuels will be on a case-by-case basis at the sole discretion of the testing laboratory.

3.2.3.2.16. Internal combustion engines may be started either by electrical or mechanical means. Where practical, smaller internal combustion engines units with electric start shall also have a manual recoil starting method as a back-up in case of low battery level. Larger engines shall be fitted with an integral starter motor, storage battery, and alternator / generator as a means for cranking the engine.

3.2.3.3. Internal Combustion Engines – Gasoline Engines

3.2.3.3.1. Gasoline engines shall be designed to close-couple to the pump only.

3.2.3.3.2. A manual starting method shall be provided as a means to start the engine. Electric start is permitted, but only with manual recoil as a back-up means for starting the equipment. The addition of electric start shall also be accompanied by a starter motor, solenoid, battery provided to crank the engine, and a means to recharge the battery while the engine is running.

3.2.3.3.3. Gasoline engines may be provided as air cooled or liquid cooled. Any integral fans used to draw cooling air over the engine shall be guarded to provide protection for personnel operating the equipment. Liquid cooled engines shall be provided with a fill port and expansion reservoir in order to reduce the loss of primary coolant due to thermal expansion.

3.2.3.3.4. Gasoline engines may be provided as single speed, or with an adjustable throttle. If provided with an adjustable throttle, markings shall be provided to indicate the direction for increase and decrease of engine speed in proximity to the point of adjustment. Gasoline engines shall not be designed to operate above 3600 rpm.

3.2.3.3.5. Gasoline engines shall be internally lubricated with engine oil that is mechanically circulated throughout the engine. Oil fill and drain ports shall be readily identified either by color, marking, or symbol. The engine oil lubrication path shall pass through a readily replaceable engine oil filter that is readily identifiable, and requires no specialized tools to access or change during maintenance.

3.2.3.3.6. Gasoline engines shall draw their fuel from a fuel tank provided as part of the entire pump assembly. The fuel tank shall be mounted so that fuel is fed to the carburetor via gravity, or with a manual push bulb initial priming assistance. The fuel line between the storage tank and the carburetor shall have a quarter turn valve in it with markings for OPEN and CLOSE clearly marked. The fuel pick-up within the tank shall be located above the lowest point in order to reduce chances for debris making it into the combustion chamber or shall be fitted with a strainer / screen.

3.2.3.3.7. Gasoline engines shall draw their combustion air through a readily replaceable filter media in order to prevent air borne debris from entering the combustion chamber.

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3.2.3.3.8. Gasoline engines shall be provided with a muffler to reduce the sound generated. The exhaust and muffler shall be guarded to provide protection from operators of the equipment.

3.2.3.3.9. Gasoline engines shall be designed for use in outdoor environments. Therefore, the electrical connections, air intake, and fuel system shall be designed to operate in dry and rainy environments.

3.2.3.4. Internal Combustion Engines – Diesel Engines

3.2.3.4.1. Diesel engines used with flood mitigation pumps are generally long-coupled to the pump shaft via a power transmission coupling or drive-shaft. Smaller diesel engines (1 or 2 cylinders) however can be supplied as close-coupled to the flood mitigation pump.

3.2.3.4.2. Diesel engines may be supplied as naturally aspirated, turbocharged, or twin turbocharged, and those fitted with after coolers.

3.2.3.4.3. This document does not address the National or Local Codes which require specific emission levels to be met by diesel engines.

3.2.3.4.4. Diesel engines shall be provided with electric starting as the primary means of cranking engines for all engines 3 cylinders and larger. All diesel engines with electric start shall be provided with starter motor, solenoid, storage battery provided to crank the engine, and means to recharge the battery when the engine is running. Single and dual cylinder close-coupled diesel engines may be provided with manual recoil starting as primary means of cranking the engine. Electric start is permitted on single and dual cylinder engines, but only with manual recoil as back-up means for starting the equipment.

3.2.3.4.5. Diesel engines shall be provided as liquid cooled or radiator cooled for all engines 3 cylinders and larger. All liquid cooled and radiator cooled diesel engines shall be provided with a fill port and expansion reservoir in order to reduce the loss of primary coolant due to thermal expansion. Any integral fans used to draw cooling air over the engine, across air heat exchanger, or through a radiator shall be guarded to provide protection for personnel operating the equipment. Single and dual cylinder close-coupled diesel engines may also be provided as air cooled.

3.2.3.4.6. Diesel engines shall be provided with an adjustable throttle for all engines 3 cylinders and larger. Markings shall be provided to indicate the direction for increase and decrease of engine speed in proximity to the point of adjustment. It shall be designed to provide positive locking for any setting. Single and dual cylinder close-coupled diesel engines may be provided as single speed, or with a manually adjustable throttle. Diesel engines shall not be designed to operate above 3600 rpm.

3.2.3.4.7. All diesel engines shall be internally lubricated with engine oil that is mechanically circulated throughout the engine. Oil fill and drain ports shall be readily identified either by color, marking, or symbol. The engine oil lubrication path shall pass through a readily replaceable engine oil filter that is readily identifiable, and requires no specialized tools to access or change during maintenance.

3.2.3.4.8. Diesel engines with 3 cylinders or more shall draw their fuel from a fuel tank provided as part of the entire flood mitigation pump assembly. For assemblies that do not rely on gravity feed of fuel to the engine, a fuel pump shall be provided. The fuel pickup shall not be at the lowest point within the fuel tank in order to reduce the chances of debris from entering into the combustion chamber. As an additional means of protection, fuel will be passed through a minimum of one filter prior to entering the engine. The fuel level shall be indicated either by mechanical fuel gauge or by electrical fuel gauge in the case of pump assemblies fitted with a control panel.

3.2.3.4.9. Diesel engines shall draw their combustion air through a readily replaceable filter media in order to prevent air borne debris from entering the combustion chamber.

3.2.3.4.10. Diesel engines with 3 cylinders or more shall be either provided with a muffler to reduce the sound generated, or shall state the requirements for a silencer if supplied by others. The exhaust and muffler shall be guarded to provide protection from operators of the equipment.

3.2.3.4.11. Diesel engines shall be designed for use in outdoor environments. Therefore, the electrical connections, air intake, and fuel system shall be designed to operate in dry and rainy environments.

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3.2.3.4.12. Diesel engines with 3 or more cylinders shall be provided with an engine controller as part of the pump assembly. The engine controller shall provide the operator with the following minimum information and have the following construction features:

- A tachometer shall be provided to indicate the engine speed. The tachometer shall read zero when the engine is not running (or have no reading in the tachometer is digital) and engine battery power is supplied to the controller. If the tachometer is not of the totalizing type, a separate hour meter shall be provided to indicate total time of operation.
- An oil pressure gauge shall be provided to indicate the engine oil pressure.
- A temperature gauge shall be provided to indicate temperature of primary coolant loop for radiator cooled engines. An additional temperature sensor or switch shall be provided to signal an alarm if the primary coolant temperature exceeds manufacturers' predetermined limits.
- All control devices, starting and shutdown switches, and indicator lamps shall be located on the control panel.
- The control panel shall not be allowed to be used as a junction box or conduit for any wiring that is not part of the flood mitigation pump package.
- The control panel shall be located in an area that does not subject the operator to unreasonable hazards from hot surfaces, moving parts, or noise.
- The mounting of the control panel shall be able to withstand the forces associated with equipment transportation, operation, heat, and mechanical damage.
- The control panel shall have, as a minimum, a NEMA Type 2 dripproof enclosure or an enclosure with an ingress protection (IP) rating of IP X1.
- The wiring outside the control panel shall be harnessed, attached, protected and/or enclosed to minimize mechanical, thermal, or engine fluid damage. All electrical connections shall have positive locking mechanisms or screw terminals.
- A speed sensitive switch shall be provided to indicate the engine is running and to terminate the need to crank the engine.
- If the adjustable throttle is electronic, then it shall be either mounted within the engine control panel, or otherwise protected against unauthorized re-adjustment of the speed setting.
- If the engine operation parameters can be changed at the engine control panel, then it shall be either mounted inside the control panel, or be password protected to limit un-authorized changes.
- Engine control panels that contain microprocessors shall be capable of starting manually in the event of failure of any of the microprocessors.

3.2.3.4.13. All diesel driven flood mitigation pump models shall be marked with the allowable fuel specification on /near the fill port. While fuel storage size may vary by assembly design, the anticipated continuous run time for a given full tank of fuel at maximum flow shall be clearly marked on the unit. In addition, fuel level shall be indicated either by mechanical fuel gauge or by electrical fuel gauge in the case of assemblies fitted with control panel.

3.2.3.5. Electric Motors

3.2.3.5.1. Electric motors used in flood mitigation pump packages shall be designed per NEMA MG 1, IEC 60034-1, or equivalent. Functionally equivalent motors designed per other standards will be considered on a case-by-case basis. The manufacturer shall specify which standard is to be referenced, and certify that the motor used is in compliance with said standard, providing any supporting documentation requested to verify compliance.

3.2.3.5.2. The motor shall be sized (in horsepower or kilowatts) such that the maximum motor current in any phase under any anticipated condition of pump load and voltage unbalance does not exceed the motor rated full-load current multiplied by the motor service factor.

3.2.3.5.3. To protect against water ingress, electric motors for flood mitigation pump packages require a minimum rating equivalent to a NEMA open drip proof type or have a minimum IEC rating of IP22.

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3.2.3.5.4. If applicable, eyebolts or equivalent lifting points shall be provided on the electric motor to lift the motor safely.

3.2.3.5.5. Electric motors used with flood mitigation pumps shall be provided with a protection device that will prevent damage to the electric motor in case of elevated temperature due to loss of cooling for the enclosure, or temperature rise due to locked rotor current draw. Activation of the device will open the input power circuit directly as a means to prevent damage from continued operation. The electric motor shall be able to be restarted only after the temperature has returned to within pre-determined range and the protection device closes, thus completing the power circuit.

3.2.3.6. Liquid Level Sensors

3.2.3.6.1. Liquid level sensors and switches used to provide ON/OFF signals for automatic operation of flood mitigation pumps may be the float type, mechanical float type, or transducers which react to static water pressure.

3.2.3.6.2. Liquid level sensors and/or switches may be directly assembled, or tethered, to the flood mitigation pump, or located within the water collection area.

3.2.3.6.3. Due to the environments where these devices are intended to operate, the liquid level sensor or switch may also need to be evaluated for ordinary locations, hazardous (classified) locations, or explosionproof as discussed in Section 3.2.3.2.9.

3.2.4. Penetration Sealing Devices

3.2.4.1. Penetration sealing devices shall be rated for a maximum nominal size of penetration (i.e. nominal pipe diameter).

3.2.4.2. Penetration sealing devices designed to seal the area around flexible cable shall have sufficient retention of the cable to prevent significant slippage. The design shall be such that applied forces to the cable do not affect the sealing capabilities.

3.2.4.3. All non-metallic materials used in penetration sealing device construction shall be resistant to deterioration or loss of sealing function under adverse conditions of temperature extremes, long term aging, and, if applicable, UV light exposure.

3.2.4.4. Penetration sealing devices may be permanent or contingent. Permanent or pre-installed metallic components (i.e. frames, structural components) shall be corrosion resistant, having resistance to corrosion equal to or exceeding that of bronze alloy having a minimum copper content of 80 percent, or constructed of Series 300 stainless steel.

3.2.4.5. Penetration sealing devices utilizing inflatable membrane materials shall be provided with a means for measuring fill pressure.

3.2.4.6. Permanently installed penetration sealing devices are susceptible to rodent damage over time, which may impact the product's sealing ability. The manufacturer shall detail periodic maintenance inspections which provide guidelines for assessment of rodent damage and whether the product needs to be replaced.

3.3. POST-INSTALLATION CHECKLIST

3.3.1. As it relates to all flood mitigation products with pre-installed components (permanent or contingent), the manufacturer shall be required to submit a post-installation checklist. This is to ensure proper installation of the product (or pre-installed components) by any installer, whether it be the manufacturer or a 3rd party contractor. Improper installation issues, such as gaps between the barrier and gaskets, gaps between the barrier and the structure, improper installation of frames, and others, may render the flood mitigation product completely ineffective or cause significantly higher leakage than is expected.

3.3.2. The post-installation checklist shall contain all critical aspects of the installation. The installer is to inspect and confirm all items on the checklist have been met after installation is complete in order to ensure proper operation and function of the product. The installer is to complete and sign off on the checklist, leave a copy on site, and send a copy back to the manufacturer to keep on file.

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3.3.3. Review and acceptance of the post-installation checklist is to be considered a part of the examination. The test engineer shall review the checklist for accuracy and to ensure that all critical installation aspects are adequately represented.

3.4. COMPONENTS

At a minimum, components required for the flood mitigation equipment shall be designed for proper system functionality, and maximum long term reliability. Flood mitigation equipment designs should take into account the possibility of component failure and the potential for that failure to impair the effectiveness of the system. Such impairments shall be minimized through failsafe, redundant component, over-design, de-rating, or other means demonstrating equivalent reliability.

3.5. MARKINGS

3.5.1. A permanently-marked, legible, corrosion-resistant nameplate shall be securely attached to the equipment where practical and it shall be easily visible. The nameplate shall include the following information, at a minimum:

- Manufacturer's name or trademark
- Model identification

Additional marking requirements for flood barriers include:

- Maximum design water depth
- Approved application (opening or perimeter barrier applications)
- Fill pressure range (as applicable for products with inflatable seals)

Additional marking requirements for flood mitigation valves include;

- Maximum working pressure
- Maximum backpressure
- For plastic valves, the letters "ABS" or "PVC" (as applicable to the material of the valve body)
- Nominal size
- Direction of flow

Additional marking requirements for flood mitigation pump packages, permanently marked on a suitable data plate on the pump, shall include;

- Rated flow
- Rated head
- Speed
- Hertz
- Horsepower
- Voltage
- Amperage
- Phase
- Approximate continuous run time
- Maximum rated suction lift (if applicable)

Note: Pump performance shall be de-rated if it is paired with a driver that is not able to produce the speed and/or power required to operate the pump at full rated capacity.

Additional marking requirements for penetration sealing devices include:

- Maximum design water depth
- Maximum leakage rate
- Fill pressure range (as applicable for products with inflatable seals)

When a penetration sealing device design is such that permanently marking the product is impossible, all information included in the marking requirements shall be represented on a suitable label applied to the product container.

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3.5.2. An automatic barrier shall be permanently marked with manual deployment instructions. Alternatively, the barrier's "Design, Installation, Operation, and Maintenance Manual" shall include instructions for manual deployment. The instruction manual must be permanently stored in an easily accessible location within close proximity to the barrier.

3.5.3. The marking for flood mitigation valves shall be located on the cover plate so that it is visible after the valve has been installed.

3.5.4. Any other pertinent marking information required by the referenced standards or other national or international standard to which the system is manufactured shall be permanently marked on a suitable data plate.

3.5.5. The model identification shall correspond with the manufacturer's catalog designation. The manufacturer shall not place this model identification on any other product.

3.6. MANUFACTURER'S DESIGN, INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

The manufacturer shall provide complete instructions required to properly design, install, operate, and maintain a flood mitigation product or system. Such documentation shall be furnished by the manufacturer and submitted to the testing laboratory as a part of the examination.

At a minimum, the manufacturer's Design, Installation, Operation, and Maintenance Manual shall include the following:

- A description of the product and the parts/components needed for installation and/or operation/ deployment
- A procedure for installation of the product (as applicable), including pre-installed components

  The installation manual and operation manual may be separate documents
- A procedure for operation/deployment of the product (as applicable)
- Details regarding periodic maintenance required to ensure product function/performance
- Details regarding trouble shooting/repairs during deployment or flood conditions
- Guidelines for storage of barrier and/or components when not in use (as applicable)
- Reference Sections 4.2.1, 4.3.1, and 4.3.2 for additional details regarding requirements for deployment procedures related to flood barriers.

3.7. CALIBRATION

All examinations and tests performed in evaluation to this standard shall use calibrated measuring instruments traceable and certified to acceptable national standards.

The calibration of recently purchased new equipment is also required. Documentation indicating either the date of purchase or date of shipment, equipment description, model and serial number is required for identification. The period from the time the equipment was put into service to the date of testing must be within an interval that does not require the equipment to be calibrated as determined on the basis of the parameters mentioned above.

3.8. TEST FACILITIES

If review of all required information indicates suitability for testing, representative samples of the flood mitigation equipment for specific application will be scheduled. The range of component, material and performance tests shall be specified by the testing laboratory. If testing cannot be completed at the testing laboratory, the manufacturer shall provide facilities and all properly calibrated instrumentation required to perform these tests. The manufacturer shall also provide personnel to install, operate, and maintain the flood mitigation equipment. For testing not conducted at a testing laboratory, a representative of the testing laboratory shall witness all the tests and shall receive copies of the data and calibration certificates.

3.9. TOLERANCES

Tolerances on units of measure shall be as described in Appendix A, unless otherwise specified.

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4. PERFORMANCE REQUIREMENTS

The performance requirements for flood mitigation equipment are composed of two different categories; General Component and Material Testing (Section 4.1) and Performance Testing (Sections 4.2 – 4.6). All flood mitigation equipment, and their applicable components, is subject to the General Component and Material Testing described in Section 4.1. In addition to this component testing, performance testing of the system/assembly is required as described in the performance test section (Sections 4.2 - 4.6) specific to the product category, as shown below in Table 4.

Table 4 – Applicable Performance Requirements

Product Category	**Applicable Test Sections**
Flood Barriers for Opening Barrier Applications	4.1, 4.3
Flood Barriers for Perimeter Barrier Applications	4.1, 4.2
Flood Mitigation Valves	4.1, 4.4
Penetration Sealing Devices	4.1, 4.5
Flood Mitigation Pumps	4.1, 4.6

4.1. GENERAL COMPONENTS AND MATERIALS TESTING - FLOOD MITIGATION EQUIPMENT

The components and materials of a flood mitigation product shall be examined and tested in accordance with this standard. However, not all tests within this section of the standard are applicable to every product design. In addition, if the design of a component or assembly cannot be adequately examined with the tests listed in this standard, additional testing may be necessary. Applicable tests will be determined at the sole discretion of the testing laboratory.

Component testing may be conducted on an individual component, component assembly, or as part of an entire flood mitigation system as deemed appropriate.

Material related testing may be waived at the discretion of the testing laboratory if prior testing has been completed by an OSHA Directorate of Science, Technology and Medicine certified NRTL (National Research and Testing Laboratory). Documentation shall be submitted demonstrating compliance to the requirements and confirmation that these tests have been carried out as described in the applicable ASTM Standard and completed with ISO 17025 calibrated equipment.

4.1.1. Examination

4.1.1.1. Requirements

Flood mitigation equipment shall conform to the manufacturer's drawings and specifications, and to the physical and structural requirements described in Section 3, General Requirements.

4.1.1.2. Test/Verification

Flood mitigation equipment and all its individual components shall be examined and compared to the manufacturer's production drawings and engineering specifications. All test samples shall be consistent with the drawings/specifications.

In addition, it shall be verified that the representative test samples conform to the physical and structural requirements described in Section 3, General Requirements.

4.1.2. Hydrostatic Test Strength

4.1.2.1. Requirements

Pressure retaining components or barriers, such as bladders, tubes, or inflatable seals shall withstand 150 percent of the maximum system operating pressure without rupture, cracking or permanent distortion and shall remain fully functional.

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4.1.2.2. Test/Verification

Components or barriers shall be subjected to a hydrostatic test pressure of 150 percent of the maximum system operating pressure, for five minutes. Components or barriers subject to external stresses while pressurized (i.e. inflatable seals, inflatable pipe plugs or penetration seals) shall be pressurized while installed as intended. No rupture, cracking, or permanent distortion of the component is allowed. After the pressure test, the components or barrier shall be checked for proper functionality.

4.1.3. System Leakage Test

4.1.3.1. Requirements

Pressure retaining components susceptible to leakage such as caps, fill ports, and valves shall not leak when subjected to a hydrostatic test pressure of 120 percent of the maximum system operating pressure.

4.1.3.2. Test/Verification

Pressure retaining components shall be subjected to a hydrostatic test pressure of 120 percent of the maximum system operating pressure, while installed as intended in the flood mitigation system. Any observation of visible leakage shall be recorded.

4.1.4. Component Durability - Cycling

4.1.4.1. Requirements

Components with moving parts shall not show excessive wear or damage after 500 cycles of operations.

Permanent flood barriers with moving parts (i.e. flood doors and automatic flood barriers) shall be fully deployed and redeployed 500 times through their full range of operation. For automatic flood barriers which operate via subjecting the barrier to flood water, this cycle testing may be conducted by mechanical means.

4.1.4.2. Tests/Verification

The sample component or system shall be cycled 500 times through its full operational range; through its full open to close and close to open positions, or its full range of travel, etc. After cycle testing, the components or system shall be visually inspected for any signs of excessive wear or damage which would impair proper operation or function. If deemed necessary, the component or system shall be subjected to any of the appropriate tests outlined in this standard.

4.1.5. Vibration Resistance

4.1.5.1. Requirements

Components or assemblies containing moving parts susceptible to vibration shall withstand vibration without cracking, loosening, separation, or excessive wear, or other damage that would impair its proper operation or function. This test applies to permanently installed components including those in pre-installation assemblies.

4.1.5.2. Tests/Verification

One of each type of component assembly shall be installed and secured on a vibration table as it would be in its intended installation configuration. The orientation of the sample shall be so that the plane of vibration occurs along the plane that is deemed to be the most susceptible to vibration damage. If no such determination can be made, the sample shall be subjected to the vibration test conditions in all 3 planes.

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The test samples shall be subjected to the vibration conditions outlined in Table 4.1.5. The frequency shall be continuously variable with a cycle period of 25±5 seconds. After one (1) hour If one or more resonant point(s) is detected, the component or component assemblies shall be vibrated for the remainder of the duration at such frequency(ies) for a period of time proportionate to the number of resonant frequencies. Otherwise the component or component assemblies shall be subjected to the variable frequency condition for the full 5 hour period.

Table 4.15 Vibration Conditions

Total Displacement/Stroke Inch	*(mm)*	*Frequency Hz*	*Time Hours*
0.020	(0.51)	18 to 37 (variable)	5

4.1.6. Impact and Wear Resistance

4.1.6.1. Requirement

Plastic securement components which are susceptible to stress, and/ or an outside force during installation, construction, and or during the life span of the flood mitigation product shall not crack or show signs of degradation when subjected to applied stress and/or impact.

4.1.6.2. Test/Verification

A. Each plastic component susceptible to an applied force or torque shall be placed in a refrigeration chamber and exposed to a temperature of 10°F (-12°C) for a 24 hour period. The component(s) shall then be removed from the chamber and the maximum force or torque specified by the manufacturer shall be applied. The sample shall be visually inspected for any damage.

B. Each plastic component shall be placed in a refrigeration chamber and exposed to a temperature of 10°F (-12°C) for a 24 hour period. The component(s) shall then be removed from the chamber and impacted with a spherical steel weight dropped from a height necessary to produce an impact energy of 68 Joules (50 ft-lbf). Impact energy is calculated using the formula W*H, where "W" is the weight of the impact object and "H" is the drop height. The weight shall be dropped three separate times in three different locations and shall be prevented from impacting the test sample more than once for each drop. The sample shall be visually inspected for any damage.

4.1.7. Salt Spray Corrosion – Residue Build-Up

4.1.7.1. Requirements

Components or component assemblies with dissimilar metals shall not deteriorate, crack, fail, or lose functionality due to galvanic corrosion.

4.1.7.2. Test/Verification

Each component or component assembly shall be supported and oriented in its intended installation position. The sample(s) shall be exposed to salt spray (fog) as specified by ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus with the exception of the salt solution. The salt solution shall consist of 20 percent (by weight) of common salt (sodium chloride) dissolved in deionized water with a pH between 6.5 and 7.2 and specific gravity from 1.126 to 1.157.The sample shall be exposed for a period of 240 hours.

Following the exposure, the sample shall be removed from the test chamber and permitted to air dry for a two- to four-day drying period. Subsequently, the component shall be visually inspected to meet the stated requirements and, if deemed necessary, shall be subjected to any of the appropriate tests outlined in this standard.

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4.1.8. Tensile Strength, Ultimate Elongation, and Tensile Set Tests

4.1.8.1. Requirements

Elastomeric components which are subjected to tensile type loading shall have a;

- Tensile strength of not less than 1500 psi (103.4 bar)
- Ultimate elongation of not less than 200 percent
- Tensile set of not more than 19 percent

Elastomeric parts constructed of silicone rubber material shall have a tensile strength of not less than 500 psi (34.5 bar) and at least 100 percent ultimate elongation.

Elastomeric parts constructed of open or closed cell expanded foam/cellular rubber materials are not applicable to this test.

4.1.8.2. Tests/Verification

Tensile strength, ultimate elongation, and tensile set shall be determined in accordance with ASTM D 412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension, Method A, with the following exceptions:

For tensile strength and ultimate elongation:

- If a test sample breaks outside the benchmarks or if the measured tensile strength or ultimate elongation is less than the required value; an additional test sample shall be tested and those results shall be considered final.
- It shall be acceptable for a test sample to break in the curved portion just outside the benchmarks if the measured strength and elongation values are within the minimum requirements.

For tensile set:

- The spacing of the benchmark shall be 3 in. (76 mm)
- The elongation shall be maintained for 3 minutes
- The tensile set shall be measured 3 minutes after the release of the specimen

4.1.9. Accelerated Aging Test

4.1.9.1. Requirements

A. Elastomer components other than open or closed cell expanded foam/cellular rubber materials shall not have less than 80 percent of the as-received tensile strength and 50 percent of the as-received ultimate elongation after accelerating the age of the material.

B. Elastomeric components constructed of open or closed cell expanded foam/cellular rubber materials which are subjected to compression type loading shall not have a compression deflection change of greater than ± 20% for open cell sponge type materials and ± 30% for closed cell expanded type materials, when comparing as-received and air-oven aged results.

4.1.9.2. Tests/Verification

A. Elastomeric Components (other than sponge or expanded rubber material):

Test samples shall be prepared in the same manner as for tensile strength and ultimate elongation tests outlined in Section 4.1.8, except that benchmarks spaced 1 in. (25 mm) apart shall be stamped on the specimens after the air oven exposure.

Test samples shall be exposed to 212°F (100°C) for 70 hours in accordance with ASTM D 573, Standard Test Method for Rubber - Deterioration in an Air Oven. After exposure, samples shall be tested in accordance with ASTM D 412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers C Tension. The results shall be compared to those obtained on the non-air oven aged samples for comparison and verification of the requirement.

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B. Sponge or Expanded Rubber Material Subjected to Compression Type Loading:

Test samples shall be prepared in accordance with ASTM D1056, Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.

Test samples shall be exposed to 212°F (100°C) for 70 hours in accordance with ASTM D573, Standard Test Method for Rubber - Deterioration in an Air Oven. After exposure, samples shall be tested in accordance with ASTM D1056, Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber. Compression deflection results shall also be obtained for non-air oven aged samples for comparison

4.1.10. Compression Set Test

4.1.10.1. Requirements

For elastomer components which are subjected to compression type loading, a compression set of the material in the as-received condition shall not be more than 20 percent.

For materials constructed of open or closed cell expanded foam/cellular rubber materials, the compression set shall not be more than 50 percent. Materials of this type exceeding this requirement shall be designated as one-time use only.

4.1.10.2. Tests/Verification

Testing shall be conducted in accordance with ASTM D 395, Standard Test Methods for Rubber Property C Compression Set, Method B. Type I specimens of the material shall be prepared and then exposed for 22 hours at 70°F ± 2°F (21°C ± 1°C).

In the case of open cell sponge type materials, testing shall be conducted in accordance with ASTM D1056, Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber. ASTM D1056 makes reference to ASTM D395 but includes minor changes to the test specimen and test procedure.

4.1.11. Ultraviolet Light and Water Test

4.1.11.1. Requirements

Non-metallic components or sealant materials, exposed to outdoor environmental conditions either during standby or during deployment shall be exposed to ultraviolet light and water for 720 hours in accordance with Table X3.1, Condition 1, of ASTM G 155-05a, Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials. At the conclusion of the test, there shall be no cracking or crazing of the component. Following exposure, all functions such as securement, adjustment, etc., shall operate properly.

4.1.11.2. Tests/Verification

A sample of each non-metallic component shall be exposed to ultraviolet light and water for 720 hours in accordance with Table X3.1, condition 1 of ASTM G155, Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials. During each operating cycle, each sample shall be exposed to light and water spray for 18 minutes and to only light for 102 minutes (total 120 minutes). The air temperature within the apparatus during operations shall be 109 ± 4.5°F (43 ± 2.5°C) and the relative humidity 30 ± 5 percent. The component shall be inspected for cracking and crazing after 360 hours. If no cracking or crazing is apparent, the exposure shall continue for the full 720 hours. After testing, the barrier and/or components shall be visually inspected to meet the stated requirements and, if deemed necessary, shall be subjected to any of the appropriate tests outlined in this standard.

4.1.12. Air-Oven Aging Tests of Nonmetallic Components and Gasket Adhesives

4.1.12.1. Requirements

A. Non-metallic components, other than rubber gaskets, shall not deteriorate, crack or craze following air-oven aging exposure for 180 days 158°F (70°C).

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B. All gasket adhesives used in barrier construction shall not deteriorate and lose their adhesive function, following air-oven aging exposure for 180 days at 158°F (70°C). The force required to separate the gasket from a representative sample of barrier material shall not decrease by more than 50%.

4.1.12.2. Test/Verification

A. Samples shall be subjected to an air-oven aging test for 180 days at 158°F (70°C), and then allowed to cool at least 24 hours in air at 74°F (23°C) at 50 percent relative humidity. After the test, the samples shall be inspected to meet the stated requirements and, if deemed necessary, shall be subjected to any of the appropriate tests outlined in this standard.

4.1.13. Environmental Corrosion Resistance (Barriers/Components which are Exposed to Environmental Conditions when Stored or Not in Use)

4.1.13.1. Requirement

Securement components or component assemblies shall be resistant to corrosion resulting from exposures to a moist carbon dioxide-sulfur dioxide-air mixture. Following the exposure period, the samples shall be examined for deterioration or failure to their functionality.

4.1.13.2. Test/Verification

Each component or component assembly shall be supported and oriented in its intended installation position. Each test sample shall be exposed to a moist carbon dioxide-sulfur dioxide-air mixture for a period of 10 days.

Sulfur dioxide and carbon dioxide are to be supplied to the test chamber from commercial cylinders. An amount of sulfur dioxide equivalent to one percent of the volume of the test chamber, and an equal volume of carbon dioxide shall be introduced into the chamber each day after the chamber has been purged. Approximately 0.53 gallons (2.0 liters) of deionized water shall be maintained in the bottom of the chamber.

Following the exposure, the samples shall be removed from the test chamber and permitted to air dry for a two to four-day drying period. Following this drying period, the component or component assembly shall meet the stated requirements and, if deemed, necessary, shall be subjected to any of the appropriate tests outlined in this standard.

4.1.14. Extreme Temperatures Operation (Barriers/Components which are Exposed to Environmental Conditions when Stored or Not in Use)

4.1.14.1. Requirements

A flood barrier or barrier component(s) that requires unfolding, unrolling, etc. to deploy shall operate properly after being exposed to extreme high and low temperatures. In addition, barrier gaskets under tension or compression shall not show signs of cracking or degradation.

4.1.14.2. Test/Verification

The test sample shall be submerged in water for 30 minutes. The sample shall then be conditioned in an environmental chamber set at -40 °F (-40 °C) for a period of 24 hours. Immediately upon removal from the chamber the test sample shall be tested for proper function.

The same test sample shall then be conditioned in an environmental chamber set at 130 °F (54.4 °C) for a period of 24 hours. Immediately upon removal from the conditioning chamber, the barrier and/or components shall be tested for proper function. Subsequently, the barrier and/or components shall be visually inspected to meet the stated requirements and, if deemed necessary, shall be subjected to any of the appropriate tests outlined in this standard.

4.1.15. Abrasion Resistance (Flood Barriers for Perimeter Barrier Applications)

4.1.15.1. Requirement

Membranes, shells, etc. shall be capable of resisting normal wear from anchoring components.

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4.1.15.2. Tests/Verification

The test sample shall be orientated and set-up in the same manner as the end-use application. A Norton standard 5 x 2 x 1/2 in. (130 x 50 x 15 mm) nominal size abrasion wheel with the designation 37C36-KVK or equivalent shall be moved to and fro for 3000 cycles along the sample. The wheel shall be prevented from rotating and shall exert its full weight plus the weight of the moving arm, 1/2 lb (0.5 kg), on to the sample. The frequency of cycles shall not exceed 30 per minute. After the 3000 cycles, the sample shall be visually examined for any signs of wear or damage that would cause failure to the flood barrier.

4.1.16. Hail Resistance (Flood Barriers for Perimeter Barrier Applications)

4.1.16.1. Requirement

Membranes, shells, etc., including joints and seams of the membrane, shall show no signs of cracking, crazing, peeling, puncture, rupture or splitting when impacted from potentially damaging hail.

4.1.16.2. Test/Verification

A 2 ft × 4 ft (0.6 m × 1.2 m) test sample is placed on a panel support. The panel support is a 2 ft × 4 ft (0.6 × 1.2 m), outside dimension, box that is open on the top and bottom. The box is comprised of 1- 1/2 in. (38 mm) wide × 3-1/2 in. (89 mm) high wooden panels which are nailed together at its corners. The sample is secured to the box with self-drilling fasteners spaced 12 in. (305 mm) on center along its perimeter. A 1- 3/4 in. (45 mm) diameter steel ball is dropped onto the sample from a height of 17 ft 9- 1/2 in. (5.4 m). A minimum of ten drops of the steel ball is required, five of which shall be conducted on a fabricated seam. Subsequently, the sample shall be visually inspected to meet the stated requirements and, if deemed necessary, shall be subjected to any of the appropriate tests outlined in this standard.

4.1.17. Tear and Puncture Resistance Test (Flood Barriers for Perimeter Barrier Applications)

4.1.17.1. Requirements

An impermeable portion of a barrier (i.e. barrier membrane and any other non-metallic construction material that may come into contact with debris) shall be capable of withstanding the impacts from potentially damaging objects.

4.1.17.2. Tests/Verification

Testing shall be conducted in accordance with ASTM D5602 - Standard Test Method for Static Puncture Resistance of Roofing Membrane Specimens, with the following exceptions;

- The applied weight shall be 35 lbs (16 kg)
- The sample material shall be secured to each side of the test fixture using C-clamps or a similar device

After the test, the sample shall be examined for tears and/or punctures. Any damage that could result in a catastrophic failure of the barrier shall constitute a failure.

4.2. PERFORMANCE TESTING FOR PERIMETER BARRIER APPLICATIONS

The performance testing of flood barriers for perimeter barrier applications has been designed to simulate quasi-static as well as riverine flooding conditions including hydrostatic load, large waves, multiple debris impacts, strong currents, and overtopping conditions.

All tests in this section replicate events that can be anticipated during a single flood occurrence. As a result, all tests listed in Table 4.2 must be completed in sequence with the same barrier assembly.

Performance testing is typically conducted at a facility similar to the US Army Corps of Engineers, Engineering Research and Development Center (ERDC) Coastal and Hydraulics Laboratory, located in Vicksburg, Mississippi.

The design, description, and capabilities of the facility are described in Appendix B. Construction of the barrier must comply with the test set-up and constraints of the facility. Note: A special construction may be required to connect a barrier to the wing walls of the test basin. Leakage from this construction will be included in the test results. However, the construction is not required to be part of the design of the flood barrier. Additionally, special construction may be required for any pre-installed foundation components. Alternative test facilities may be accepted for testing at the sole discretion of the testing laboratory.

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Major and minor repairs to the flood barrier during any portion of the performance test series are only allowed at the discretion of the testing laboratory. A major repair may require re-testing of the entire performance test series and/or additional testing. A maximum of three minor repairs shall be allowed, but may require adjustments to the barrier's Design, Installation, Operation, and Maintenance Manual. No repairs shall be allowed that can put facility personnel into harm's way.

Table 4.2 *Test Series – Flood Barriers for Perimeter Barrier Applications*

Test Description	Water Condition(s)		Duration
	Water Depth*	Other	
Deployment	N/A	N/A	Per Manufacturer's Specification
Hydrostatic Load	1.0 ft (0.30 m)	N/A	22 hr
	2.0 ft (0.61 m)	N/A	22 hr
	100 percent x h	N/A	22 hr
Wave-Induced Hydrodynamic Load	66.7 percent x h	low waves 2-3 in (51-76 mm)	7 hr
	66.7 percent x h	medium waves 6-8 in (152-203 mm)	10 min (3 times)
	66.7 percent x h	high waves 10-12 in (254-305 mm)	10 min
	80 percent x h	low waves 2-3 in (51-76 mm)	1 hr (min) - 7 hr (max)
	80 percent x h	medium waves 6-8 in (152-203 mm)	10 min (3 times)
	80 percent x h	high waves 10-12 in (254-305 mm)	10 min
Overtopping	≥1 in (25 mm) overflow	N/A	1 hr
Debris Impact	66.7 percent x h	12 in (30 cm) diameter log 610 lb (277 kg) weight at 7 ft/s (2.13 m/s)	N/A
	66.7 percent x h	17 in (43 cm) diameter log 790 lb (358 kg) weight 7 ft/s (2.13 m/s)	N/A
Current	66.7 percent x h	7 ft/s (2.13 m/s) current	1 hr
Post Hydrostatic Load	100 percent x h	N/A	1 hr (min) - 22 hr (max)

* The manufacturer's specified maximum design water depth for the barrier is defined as "*h*".

At the discretion of the testing laboratory, the maximum deflection requirement, included as part of each test in the test series, may be waived for certain barrier designs where distortion beyond the requirement is expected and does not affect overall barrier stability or function. Deflection measurements may be taken at the conclusion of the series, after the water has been drained from the basin, to demonstrate no permanent distortion or displacement.

4.2.1. Deployment

4.2.1.1. Requirements

The barrier system shall be deployed within the construction base area as described in Appendix B. The barrier's Design, Installation, Operation, and Maintenance Manual shall be verified for accuracy and completeness of the deployment process. The following items related to the barrier's deployment shall be confirmed:

4.2.1.1.1. Barrier Packaging

No cracks, tears, or other damage that may have occurred during shipping shall be visible. At the discretion of the testing laboratory, minor repairs maybe allowed (i.e. repositioning of a seal). If minor repairs are required, the manual shall include details on how to identify and repair the damage prior to deployment.

4.2.1.1.2. Material, Tools, and Equipment Required

The manual shall include a list of all the materials, tools, and equipment used during the unpacking and deployment of the barrier. In addition, the manual shall indicate if the materials, tools, and/or equipment are supplied or not supplied with the barrier.

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4.2.1.1.3. Person-Power Requirements

The manual shall include the number and skill level of the personnel required to deploy the barrier as described below:

- Skilled personnel; a person with specific knowledge of the deployment method of the barrier
- Unskilled personnel: a person that has no knowledge of the barrier design or deployment
- Heavy machine operator

4.2.1.1.4. Deployment Time

The deployment time shall be equal to or less than the time listed in the manual. The deployment time shall be measured in terms of personnel requirements, total man-hours, and length of the barrier.

4.2.1.1.5. Deployment Procedure

The manual shall clearly detail all steps for the deployment of the barrier. The procedure shall be written in such a way so that it can be readily understood by a person with no prior knowledge of the barrier design or deployment.

4.2.1.1.6. Additional Deployment Requirements

The manual shall adequately detail any of the following deployment requirements if identified by the manufacturer and/or preformed during the deployment test process:

- Special construction considerations
- Application limitations
- Foundation requirements
- What to do if damage should occur during deployment

4.2.1.1.7. Barrier Reusability

The manual shall indicate if that barrier is suitable for multiple uses. If multiple use is indicated then the manual shall contain a procedure for how the barrier shall be disassembled and restored to a similar pre-test condition.

4.2.1.2. Tests/Verification

Document the unpacking and deployment of the barrier with a video camera while simultaneously reviewing the Design, Installation, Operations, and Maintenance Manual. At the completion of the deployment, compare the video recording to the manual to assure that all of the requirements listed in Section 4.2.1.1 have been properly documented. The manual must be corrected of any inaccuracies and/or missing information.

If the barrier is reusable, document and verify the disassembling procedure at the completion of the performance testing in the same manner as the deployment, Section 4.2.1.

4.2.2. Hydrostatic Load

4.2.2.1. Requirements

Flood barriers for perimeter barrier applications barrier shall be capable of withstanding the hydrostatic loads created by floodwaters of various heights. The leakage rate shall not exceed 15 gallons per hour per foot length (186 liters per hour per meter length), where the barrier's length is measured along the center point of the barrier's seal to the ground.

In addition, the permanent deflection of the barrier shall be less than or equal to 6 in. (15 cm), as measured from the horizontal and vertical center of each wall.

4.2.2.2. Tests/Verification

Conduct three different hydrostatic load tests at the following water heights;

- 1 ft ± 0.5 in (0.30 m ± 13 mm)
- 2 ft ± 0.5 in (0.61 m ± 13 mm)
- 100 percent x h ± 0.5 in (13 mm)

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Where "h" is the manufacturer's specified maximum design water depth of the barrier. If this water depth is less than or equal to 2.0 ft, the tested water depths may be changed as deemed appropriate by the testing laboratory.

Fill the wet-side of the basin to the desired water level at a maximum rate of 2/3 ft (10.0 cm) per hour. The desired water level shall be held for a minimum of 22 hours at each water depth specified above.

The leakage rate shall be calculated in intervals no greater than 15 minutes at the following times (at a minimum);

- During the filling process
- During the first hour
- During the last two hours

Measure the barrier's deflection from the horizontal and vertical center of each wall (three locations) at the completion of each test. Additional locations (up to 6 total) shall be required if deemed appropriate for the design of the barrier.

The Hydrostatic Load Test at a water depth of 100 percent x "h" shall be repeated subsequent to the Current Test, as a post test to the Overtopping, Debris Impact, and Current Tests. The test duration for the post test shall be 1 hour, at a minimum. If negative effects (i.e. increased leakage rates or deflection measurements) are observed during the first hour of the post test, then the post test shall be conducted for a maximum of 22 hours.

4.2.3. Wave-Induced Hydrodynamic Load

4.2.3.1. Requirements

Flood barriers for perimeter barrier applications shall be capable of withstanding wave-induced hydrodynamic load conditions from various water depths and wave heights. The permanent deflection of the barrier shall be less than or equal to 6 in. (15 cm), as measured from the horizontal and vertical center of each wall.

In addition, during low wave conditions, the leakage rate shall not exceed 15 gallons per hour per foot length (186 liters per hour per meter length), where the barrier's length is measured along the center point of the barrier's seal to the ground.

There is no leakage rate requirement for medium and high wave conditions. However, during these wave conditions the barrier shall not fatigue, experience fill-loss, wall sliding, overturning, or other permanent deflection in excess of the requirement.

4.2.3.2. Tests/Verification

Six tests shall be conducted; consisting of three different size wave heights (low, medium, and high) at each of the following two still water depths:

- 66.7 percent x h
- 80 percent x h

Where "h" is the manufacturer's specified maximum design water depth of the barrier. If this water depth is less than or equal to 2.0 ft, the tested water depths may be changed as deemed appropriate by the testing laboratory.

Drain the wet-side of the basin to the desired water level, or fill the wet-side of the basin at a maximum rate of 2/3 ft (10.0 cm) per hour, as applicable.

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Impact the barrier with waves generated perpendicular to the face of the center wall of the barrier as detailed in Table 4.2.3.2.

At the end of each test condition, allow the waves to dissipate before starting the next test.

Table 4.2.3.2 Wave Spectrums

Wave Description	*Wave Height (Measured from trough to crest)*	*Mean Wave Period*	*Test Duration*
Low Waves	2-3 in (51-76 mm)	2 seconds	7 hr*
Medium Waves	6-8 in (152-203 mm)	2 seconds	10 min (3 times)
High Waves	10-12 in (254-305 mm)	2 seconds	10 min

*For a water depth of 80 percent x h, if no negative effects are observed during the first hour of testing (i.e. increased leakage rates or deflection measurements), the test duration may be reduced to 1 hour.

Measure the leakage rate for the duration of each low wave test at intervals no greater than 15 minutes.

Measure the barrier's deflection at the completion of each test from the horizontal and vertical center of each wall (three locations). Additional locations (up to 6 total) shall be required if deemed appropriate for the design of the barrier.

4.2.4. Overtopping

4.2.4.1. Requirements

Flood barriers for perimeter barrier applications shall not float, overturn, or experience catastrophic failure if the water level of a flood exceeds the height of the barrier.

In addition, the permanent deflection of the barrier shall be less than or equal to 6 in. (15 cm), as measured from the horizontal and vertical center of each wall.

4.2.4.2. Tests/Verification

Fill the river-side of the basin at a maximum rate of 2/3 ft (10.0 cm) per hour until the water level equals 100 percent of structure height plus one inch. Maintain the water level for one hour.

At the completion of the test, measure the barrier's deflection from the horizontal and vertical center of each wall (three locations). Additional locations (up to 6 total) shall be required if deemed appropriate for the design of the barrier.

4.2.5. Debris Impact Test

4.2.5.1. Requirements

Flood barriers for perimeter barrier applications barrier shall be capable of withstanding multiple impacts from floating debris. The leakage rate shall not exceed 15 gallons per hour per foot length (186 liters per hour per meter length), where the barrier's length is measured along the center point of the barrier's seal to the ground.

In addition, the permanent deflection of the barrier shall be less than or equal to 6 in. (15 cm), as measured from the horizontal and vertical center of each wall.

4.2.5.2. Tests/Verification

Drain the wet-side of the barrier until the water level equals 66.7 percent x h ± 0.5 in (13 mm), where *h* is the manufacturer's specified maximum design water depth.

Two tests shall be conducted with two different size logs; 12 in. (30 cm) and 17 in. (43 cm) in diameter, 610 lb (277 kg) and 790 lb (358 kg) in weight respectively. The logs shall be southern pine or similar density and conditioned by submerging in water for a minimum of 2 weeks prior to testing. The cut edges of the logs shall be perpendicular saw-cut with no round edges.

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Each floating log shall be pulled into the center wall of the barrier with a velocity of 7.0 ft/s (2.1 m/s) [~5.0 mph (8.0 km/h)] at a trajectory angle of approximately 70 degrees, see Figure 4.2.5.2. The pulling action shall be shut-off immediately prior to the log's impact to the barrier.

Measure the leakage rate during each test at intervals no greater than 15 minutes.

At the completion of each test, measure the barrier's deflection from the horizontal and vertical center of each wall (three locations). Additional locations (up to 6 total) shall be required if deemed appropriate for the design of the barrier.

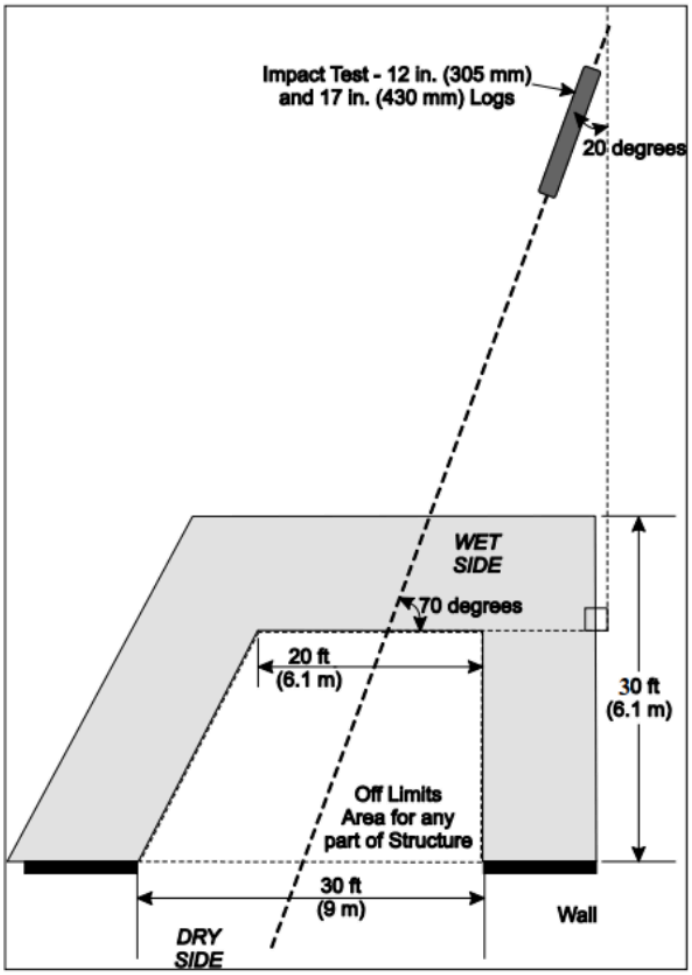


Figure 4.2.5.2 Debris Impact Test Layout

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4.2.6. Current Test

4.2.6.1. Requirements

Flood barriers for perimeter barrier applications shall be capable of withstanding forces created by a 7.0 ft/s (2.1 m/s) current. The leakage rate shall not exceed 15 gallons per hour per foot length (186 liters per hour per meter length), where the barrier's length is measured along the center point of the barrier's seal to the ground.

In addition, the permanent deflection of the barrier shall be less than or equal to 6 in. (15 cm), as measured from the horizontal and vertical center of each wall.

4.2.6.2. Tests/Verification

Testing shall be conducted at a water height of 66.7 percent h ± 0.5 in (13 mm), where h is the manufacturer's specified maximum design water depth. A minimum channel width of 6 in. (15 cm) should be created for the water flow. Current shall be applied parallel to the face of the barrier. The water velocity shall be slowly increased to 7.0 ft/s (2.1 m/s) [~5.0 mph (8.0 km/h)] and then maintained steady for a duration of 1 hour.

The water velocity shall be measured at 50 percent of the water depth approximately 6 in. (15 cm) from the front face of the barrier, and the horizontal midpoint of the section of barrier exposed to the current; or 1/2 the distance from the barrier to the wall, which ever is less.

Measure the leakage rate for the duration of the test at intervals no greater than 15 minutes.

At the completion of the test, measure the barrier's deflection from the horizontal and vertical center of each wall (three locations). Additional locations (up to 6 total) shall be required if deemed appropriate for the design of the barrier.

4.3. PERFORMANCE TESTING – FLOOD BARRIERS FOR OPENING APPLICATIONS

The performance testing of flood barriers for opening barrier applications has been designed to simulate quasi-static flood conditions. All tests in this section must be completed in sequence as shown in Table 4.3, with the same flood barrier system.

If the product under evaluation is available in a range of sizes, a worst case system representing the maximum protected opening width shall be tested to the manufacturer's maximum design water depth. Depending on design consistency across size ranges, testing of the worst case may allow for smaller sizes to be considered for certification with little or no further testing.

If a barrier is submitted for modular configurations having intermediate support mullions (or similar) between multiple barrier sections, a minimum of two sections with one intermediate support shall be performance tested. Approval will be restricted to the maximum width measured between each section (between one edge and the intermediate support). Single-span configurations shall also be tested if the maximum width of the single-span configuration exceeds the maximum section width of the modular configuration

Table 4.3 *Performance Test Series – Flood Barriers for Opening Barrier Applications*

Test Description	***Condition****	***Duration***
Deployment	N/A	Per Manufacturer's Specifications
Hydrostatic Load	10 percent x h ± 0.25 in (0.6 cm)**	2 hr
Hydrostatic Load	100 percent x *h* ± 0.25 in (0.6 cm) **	20 hr
Redeploy	Disassemble and redeploy	Per Manufacturer's Specifications
Dynamic Impact Load	Water drained, two 600J impacts (minimum)	N/A
Post Hydrostatic Load	10 percent x h ± 0.25 in (0.6 cm)**	1 hr
Post Hydrostatic Load	100 percent x h ± 0.25 in (0.6 cm)	1 hr

*The manufacturer's specified maximum design water depth for the barrier is defined as "h."

** Hydrostatic load testing may be required at additional water depths, at the discretion of the testing laboratory, if the design of the barrier is such that increased leakage may occur at other depths besides those prescribed above. Additional water depths shall be tested for a minimum duration of 1 hr. Hydrostatic Load testing at 10 percent x h may be waived if the design of the barrier is such that compression forces applied by the water column do not influence the barrier's sealing capabilities.

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The tests shall be conducted with a test enclosure that is capable of withstanding the maximum design water depth without significant leakage. A method to maintain the water level at the required depths within the specified degree of accuracy throughout the specified durations shall be established. Some leakage through the test enclosure is permitted provided that the tested water depth is able to be maintained. The test enclosure must be of sufficient size to accommodate the requirements for each test procedure outlined in this performance test series.

Major and minor repairs to the flood barrier during the performance test series are only allowed at the discretion of the testing laboratory. Up to a maximum of three minor repairs are allowed. In addition, each minor repair may require adjustments to the barrier's Design, Installation, Operation, and Maintenance Manual. Any major repair may require retesting of the entire performance test series and/or additional testing. No repairs shall be allowed that can put facility personnel into harm's way.

4.3.1. Pre Deployment Installation Configurations

4.3.1.1. Requirements

The installation of barrier components which are designed to be permanently installed in the protected opening prior to barrier deployment (i.e. frames, tracks, etc.) does not require to be witnessed by FM Approvals. However, the barrier's Design, Installation, Operation, and Maintenance Manual shall include reference to each possible installation configuration and shall be verified for accuracy and completeness (see Section 3.3). These documents shall be furnished prior to the commencing of the test series.

When multiple installation configurations exist, (i.e. externally mounted to a structure, internally mounted to a structure, door jamb mounting, etc.), the performance test series shall be conducted on all configurations desired for certification.

4.3.1.2. Tests/Verification

Verify that the barrier's manual and post-installation checklist accurately details all applicable installations of the barrier components to the test enclosure(s). All installation configuration options shall be represented during testing.

4.3.2. Deployment

4.3.2.1. Requirements

The barrier shall be deployed within the test enclosure as it would be deployed during a flood event to protect the simulated structure opening.

The barrier's Design, Installation, Operation, and Maintenance Manual shall be verified for accuracy and completeness of the deployment process. The manual shall include at a minimum;

4.3.2.1.1. Material, Tools, and Equipment Required

The manual shall include a list of all the materials, tools, and equipment used during the deployment of the barrier. In addition, the manual shall indicate if the materials, tools and/or

4.3.2.1.2. Person-Power Requirements

The manual shall include the number of personal used to deploy the barrier. The same number of personnel shall be used for the deployment process.

4.3.2.1.3. Deployment Time

The measured deployment time shall be equal to or less than the time listed in the manual. The deployment time shall be measured in terms of personnel requirements and total deployment time.

4.3.2.1.4. Deployment Procedure

The manual shall clearly detail the steps for how to deploy the barrier. The procedure shall comply with all of the requirements of Section 4.3.2.1.

4.3.2.1.5. Additional Deployment Requirements

The manual shall adequately detail any of the following deployment requirements if identified by the manufacturer and/or preformed during the deployment test process:

- Foundation requirements

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- Special construction considerations
- Application limitations
- What to do if damage should occur during deployment

4.3.2.1.6. Barrier Reusability

For contingent barriers, the manual shall include a procedure for proper disassembly and storage of barrier components to restore the system to a similar pre-test condition.

4.3.2.2. Tests/Verification

Document the deployment of the barrier with a video camera while simultaneously reviewing the Design, Installation, and Operation, and Maintenance Manual. At the completion of the deployment, compare the video recording to the manual to assure that all of the requirements listed in Section 4.3.2.1 have been properly documented. If the disassembly process differs from the inverse of the deployment process, the disassembly process shall also be documented. The manual must be corrected of any inaccuracies and/or missing information.

In addition, the barrier shall be removed or opened (as applicable) and evaluated for wear or damage after each of the Hydrostatic Loads tests, as shown in Table 4.3. The barrier shall then be re-deployed in accordance with Section 4.3.2 before the start of the next test in the sequence. For automatic type barriers, the deployment test shall be conducted at the beginning of the Hydrostatic Load Tests during the filling process of the test apparatus.

4.3.3. Hydrostatic Load Test

4.3.3.1. Requirements

Flood barriers for opening barrier applications shall be capable of withstanding the hydrostatic loads created by quasi-static floodwaters. The leakage rate shall not exceed 0.08 gallons per hour per linear foot (1 L/h/m) of seal over any 15-minute period, where the linear length of seal is the opening width (measured from barrier seal-to-seal) plus two times the water depth. For barriers with a maximum design water height greater than the barrier height (i.e. fully submerged window), the linear length of seal is considered to be the opening width plus two times the water height, or the barrier perimeter, whichever is less. For barriers which are parallel to the ground surface (i.e. subway stair barriers, subway grate barriers, etc.) the linear length of seal is considered to be the perimeter.

4.3.3.2. Tests/Verification

Fill the wet-side of the test apparatus to 10 percent x *h* ± 0.25 in (0.6 cm), where "*h*" is the manufacturer's specified maximum design water depth. Measure the leakage rate over 15 minute intervals until the leakage rate has either stopped or stabilized. Maintain the desired water level for a minimum duration of 2 hrs. Measure the leakage rate during the final 15 minutes. If leakage rate continues to increase, additional time shall be added until stabilization is reached

Increase the water height to 100 percent x h ± 0.25 in (0.6 cm), where h is the maximum design water depth.

Maintain the desired water level for a minimum of 22 hours. Measure the leakage rate over 15 minute intervals until the leakage rate has either stopped or stabilized. Measure the leakage rate during the final 15 minutes. If leakage rate does not stabilize, then measure the leakage rate for 15 minute intervals elapsing at the following time increments, at a minimum:

- 15 min
- 30 min
- 45 min
- 1 hour
- 20 hours

If leakage rate continues to increase, additional time shall be added until stabilization is reached.

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The Hydrostatic Load Test shall be repeated as a post test to Dynamic Impact Load testing as shown in Table 4.3. The duration of the post tests shall be a minimum of 1 hour at each water level. If leakage rate is increasing, additional time may be added at the discretion of testing laboratory.

Hydrostatic Load Testing at 10 percent x h water depths may be waived if the design of the flood barrier is such that the compression force applied by the water column does not increase the barrier's sealing capability.

4.3.4. Dynamic Impact Load Tests

4.3.4.1. Requirements

Flood barriers for opening barrier applications shall be capable of withstanding a minimum of two impacts of 600J each from a rigid falling object simulating floating debris. Any damage sustained as a result of the impacts shall not impair functionality/performance of the barrier.

4.3.4.2. Tests/Verification

Drain the wet-side of the test apparatus before conducting the test.

The impact object shall be a piece of saw-cut log with a diameter of 12 in (30.5 cm) and a density similar to wet southern pine [30 lb/ft^3 (48 kg/m^3)]. One end of the log shall have a straight perpendicular cut and the other shall be cut at an angle of 15 degrees off-center with no round edges. The straight cut end of the log shall be attached to a steel block so that the total mass of object is 110 lbs (50 kg). A similar impact object can be substituted at the discretion of the testing laboratory as long as the trajectory of impact and impact energy criteria are met.

The first impact location shall be the predetermined weak point of the barrier structure, or at the horizontal center point of the barrier at 80 percent *x h,* where *h* is the manufacturer's specified maximum water depth of the barrier.

The second location shall be as close to the barrier perimeter as possible, at roughly the same height as the first impact. This location is intended to evaluate the barrier connection to the supporting structure. Additional impact locations on the barrier may be required at the discretion of the testing laboratory (e.g. hinges, plastic parts, etc.).

The impact to the barrier shall be such that the leading edge of the impacting object hits the predetermined location on the barrier. Figure 4.3.4 contains a suggested layout for this test.

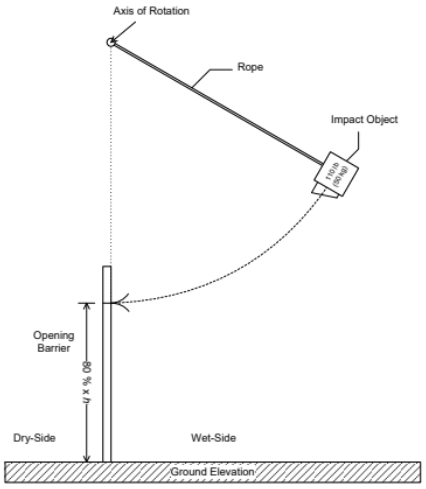


Figure 4.3.4 Impact Test Layout

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Impact the barrier by lifting the object to a height of 4 ft (1.22 m) above the point of impact. Then drop the object so that it falls under gravitational acceleration, through a circular trajectory, and impacts the barrier in the horizontal position. The impact force *E* (600J), calculated as potential energy, is determined by the length of trajectory and weight of the impacting object:

$$E = mgh$$

where, *m* is the mass of the impacting object (50 kg), g is gravitational acceleration (9.81 m/s2), and *h* is the height through which the impacting object falls (1.22 m).

After each impact, make observations of any damage sustained and any possible detriments to the barrier functionality and ability to hold back water. Post-hydrostatic load testing shall be conducted as specified in Section 4.3.3.

4.4. PERFORMANCE TESTING FLOOD MITIGATION VALVES

4.4.1. Examination

4.4.1.1. Requirements

Flood mitigation valves shall conform to the manufacturer's drawings and specifications.

4.4.1.2. Test/Verification

A flood mitigation valve shall be representative of the manufacturer's final production equipment shall be examined and compared to drawings and engineering specifications. It shall be verified that the representative sample conforms to the physical and structural requirements described in Section 3, General Requirements.

4.4.2. Debris Passage

4.4.2.1. Requirements

The opening through a flood mitigation valve shall permit the passage of a cylinder 12 in. (305 mm) long and a diameter as follows:

Nominal Size, Inches	*Diameter of Cylinder, Inches (mm)*
1.5	0.75 (19)
2	1.00 (25)
2.5	1.25 (32)
3	1.50 (38)
4	2.00 (51)
6	3.00 (76)
8	4.00 (102)
10	5.00 (127)
12	6.00 (152)

4.4.2.2. Tests/Verification

The test cylinder as indicated in section 4.4.2.1 shall be passed through the flood mitigation valve in the direction of flow.

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4.4.3. Watertightness

4.4.3.1. Requirements

When exposed to a range of backflow pressures, the leakage through a flood mitigation valve shall not exceed the values in the following table.

Nominal Size, Inches	***Maximum Leakage Volume, Fl oz (mL)***
1.5	5.5 (163)
2	9.5 (281)
2.5	15.0 (444)
3	21.5 (636)
4	38.5 (1,139)
6	87.0 (2,573)
8	153.0 (4,525)
10	240.0 (7,098)
12	345.0 (10,202)

4.4.3.2. Tests/Verification

The valve shall be positioned in its normal operating position as prescribed by the manufacturer. A water source capable of maintaining the maximum rated backpressure shall be affixed to the outlet of the flood mitigation valve. The water pressure shall be increased in the following steps:

Water Pressure, psi (kPa)
0.25 (1.7)
0.50 (3.4)
1.0 (6.9)
5.0 (34.5)
Maximum Rated Backpressure

At each step, the pressure shall be maintained for 10 min. ±15 sec. During each test period, any water that is emitted from the entrance side of the fitting shall be collected, measured, and recorded. The total leakage volume over any given 10-minute step period shall be less than the maximum limitation requirement specified above.

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4.4.4. Pressure Loss

4.4.4.1. Requirements

For flood mitigation valves designed for in-line applications, the pressure loss through the valve shall be determined throughout the manufacturer's rated flow range and shall be included in the manufacturer's design/maintenance manual. Pressure loss shall be determined at a minimum of four different flow rates to allow for the development of a pressure loss vs. flow curve.

4.4.4.2. Tests/Verification

Each sample shall be installed between two test pipes equipped with a means for attaching a pressure gauge. The test pipes shall be of the same nominal diameters as the sample. Using water as a test medium, the pressure loss between the inlet and outlet shall be measured at a minimum of four flow rates. The test sample shall be removed from the test configuration, and the pressure losses at the same flow rates determined. The pressure loss of the sample is determined by subtracting the loss of the pipe from the loss of the pipe/test sample combination.

4.4.5. Aging

4.4.5.1. Requirements

For resilient seated flood mitigation valves (non-metallic seal), aging of the seat material shall not promote any cracking when tested in accordance with Section 4.4.6.2.

For flood mitigation valve designs constructed of non-metallic material (i.e. flexible rubber type valves), the valve assembly shall be subjected to the 180 day air-oven aging test as described in Section 4.1.12. Following the aging exposure period, the valve shall be subjected to 500 cycles of normal operation, as described in Section 4.1.4, using water as the test medium. The valve shall then undergo the watertightness test described in Section 4.4.3.

4.4.5.2. Tests/Verification

For resilient seated flood mitigation valves (non-metallic seal), a specimen of the valve rubber seat material, approximately 1 x 3 in. (25 x 75 mm) by 1/8 in. thick, supplied by the manufacturer, shall be subjected to an accelerated aging test in accordance with ASTM D572, "Standard Test Method for Rubber – Deterioration by Heat and Oxygen". The test duration shall be 96 hours. After the test, the specimen shall be examined for resilience by being bent double (i.e. bend radius of 180°). Observations of any cracking or deterioration shall be made.

4.5. PERFORMANCE TESTING – PENETRATION SEALING DEVICES

4.5.1. Examination

4.5.1.1. Requirements

Penetration sealing devices shall conform to the manufacturer's drawings and specifications and to the Approval requirements.

4.5.1.2. Test/Verification

A penetration sealing device assembly representative of the manufacturer's final production equipment shall be examined and compared to drawings and engineering specifications. It shall be verified that the representative sample conforms to the physical and structural requirements described in Section 3, General Requirements.

4.5.2. Hydrostatic Pressure Leakage Test

4.5.2.1. Requirements

Penetration sealing devices shall be capable of withstanding the hydrostatic loads created by floodwaters without significant leakage. The leakage rate shall not exceed 0.08 gallons per hour per linear foot (1 L/h/m) of protected opening, where the linear foot of protected opening is the perimeter of the penetration. If the sample being tested accommodates multiple penetrations, the sum of the perimeter of each penetration shall be used. For modular products that include additional sealing surfaces between modular sections, the length of these

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additional sealing surfaces shall not be included in calculation for linear length of protected opening. For pipe plugs or similar devices used to seal the entire area within a penetration, the perimeter of the maximum protected area shall be represented.

4.5.2.2. Test/Verification

Each sample penetration sealing device shall be installed in the wall of a test enclosure having a penetration of the size specified by the manufacturer. The test enclosure shall be capable of hydrostatically pressurizing the sample to a pressure equivalent to that exerted by a water column at the manufacturer's specified maximum design water depth, plus 10%, and maintaining that pressure throughout the stated duration. A means for collecting leakage through the penetration throughout the duration shall be established.

All pre-installed frame components, if applicable, shall be included in the tested assembly. If the product is designed to seal the area around a penetrating object (i.e. pipe, flexible wire cables), a representative penetrating object of the size specified by the manufacturer shall also be included in the tested assembly. Schedule 40 steel pipe shall be considered representative of piping and standard, round, smooth, PVC cable shall be considered representative of flexible wire cables. Assemblies designed for both pipe and flexible cable type penetrating objects shall be tested with both objects. If Approval for armored type corrugated cables is desired, an additional assembly including armored cable shall be tested.

The test enclosure shall be hydrostatically pressurized to the pressure equivalent to that exerted by a water column at the manufacturer's specified maximum design water depth, plus 10%. The pressure shall be maintained for 72 hours. Leakage through the penetration shall be collected throughout the duration. After each 24 hours, the leakage shall be measured and recorded.

4.5.3. Low Temperature and Impact Resistance

4.5.3.1. Requirements

Penetration sealing devices shall not show any evidence of cracking or deterioration as a result of low temperature conditioning. While at the low temperature, there shall be no damage following impact testing that would impair product function, performance, or installation.

4.5.3.2. Test/Verification

Each sample penetration sealing device shall be immersed in a water bath at 70 ± 10°F (21 ± 5.5°C) for 24 hours. The sample shall then be conditioned to a temperature of 10°F (-12°C) for an additional 24 hours. The sample shall then be removed and inspected for any cracking or other deterioration. While still at that temperature, a 2.2 lb. (1 kg) steel sphere shall be dropped from a height of 3.3 ft. (1 m) onto the sample so that the impact occurs at a predetermined worst case location. Tubing may be used as a guide for the sphere to ensure the impact occurs at the intended location. A minimum of three drops shall be performed at three different locations. Additional drops may be required at the discretion of the testing laboratory.

4.5.4. Aging

4.5.4.1. Requirements

After a penetration sealing device is subjected to the Air-Oven Aging Test for Nonmetallic Components and Gasket Adhesives, as described in Section 4.1.12, the sample shall meet the requirements of the Hydrostatic Pressure Leakage Test, as detailed in Section 4.5.2.

4.5.4.2. Test/Verification

Penetration sealing devices shall be subjected to the Air-Oven Aging Test for Nonmetallic Components and Gasket Adhesives, as described in Section 4.1.12, except the conditioning temperature shall be at the manufacturer's maximum rating. Subsequently, the sample shall be subjected to the Hydrostatic Pressure Leakage Test, as detailed in Section 4.5.2, for verification that leakage remains within the requirement.

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4.5.5. Cable Retention Test

4.5.5.1. Requirements

Penetration sealing devices designed to seal around flexible cables shall sufficiently retain the cable during applied forces. When the force is applied along the same axis of the cable, the cable slippage shall be less than .25 in. (6.4 mm). Subsequently, the sample shall meet the requirements of the Hydrostatic Pressure Leakage Test, as detailed in Section 4.5.2.

4.5.5.2. Test/Verification

Each sample penetration sealing device shall be installed as described in Section 4.5.2 - Hydrostatic Pressure Leakage Test. After installation is complete, a marked line shall be made on the cable along the interface between the cable and the penetration sealing device. A static force of 40 lbf (178 N) shall be applied to the cable, along the same axis of the cable, in a direction moving away from the penetration. The force shall be applied for a duration of 5 minutes before being released. Determine the cable slippage by measuring the distance between the inside of the marked line and the penetration sealing device.

Apply a static pull or push force of 40 lbf (178 N) to the cable, at an approximate distance of 6 in. (15cm) from the penetration sealing device, along the axis perpendicular to the cable, in a direction moving vertically upward. The force shall be applied for a duration of 1 minute before being released. Similarly, the same force shall be applied in the vertically downward, right, and left directions.

Subsequently, the sample shall be subjected to the Hydrostatic Pressure Leakage Test, as detailed in Section 4.5.2, for verification that leakage remains within the requirement.

4.6. PERFORMANCE TESTING - FLOOD MITIGATION PUMPS

4.6.1. Examination

4.6.1.1. Requirements

Flood mitigation pumps shall conform to the manufacturer's drawings and specifications.

4.6.1.2. Test/Verification

A pump representative of the manufacturer's final production equipment shall be examined and compared to drawings and engineering specifications. It shall be verified that the representative sample conforms to the physical and structural requirements described in Section 3, General Requirements.

4.6.2. Debris Clearance/ Solid Handling Capability

4.6.2.1. Requirements

A pump shall conform to the manufacturer's maximum rated solids handling capability, expressed as diameter of solid. Compliance shall be verified by the passage of a rigid sphere through the waterway of the pump.

4.6.2.2. Tests/Verification

A sample pump, with no power, shall be capable of passing a rigid sphere from the discharge of the pump to the water inlet. The size of the sphere must be equal to, or greater then, the clearance specifications listed by the manufacturer. The pump shall be rotated from its intended installation position to pass the sphere though the pump but only if the rotation of the pump does not increase the clearance of any opening or passageway.

4.6.3. Pump Performance Testing

4.6.3.1. Requirements

The pump shall develop its rated pressure when delivering its rated capacity as specified by the manufacturer. Pump characteristic curves shall be confirmed for accuracy.

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4.6.3.2. Tests/Verification

A sample pump of each rated capacity shall be operated at various flow rates, from shut-off, all the way to full open downstream valve, to verify the manufacturer's characteristic curve. The pump shall be tested at each rated speed (if applicable). A minimum of four flow readings (min, max, and two intermediate points) shall be taken to generate discharge pressure (total dynamic head) vs. capacity curves. At each flow rate, the total discharge head and total suction head, or total suction lift shall be measured. Power measurements may also be measured for the purpose of qualifying additional pump drivers, as described in Section 4.6.5. All test speeds must be within ± 4 percent of the rated speed. Test data shall be corrected to rated speed to develop the characteristic curves.

For self-priming pumps with suction lift capabilities, characteristic curves shall be developed for various degrees of suction lift. Characteristic curves for a minimum of four suction lift values shall be generated, including zero suction lift, maximum suction lift, and two evenly spaced intermediate values.

For submersible pumps, characteristic curves shall be developed at the minimum suction pressure, or the minimum submergence required for operation.

4.6.4. Endurance Test

4.6.4.1. Requirements

A pump assembly shall be capable of continuous operation for 336 hours at its maximum rated capacity without excessive vibration, loosening of parts (fasteners, etc.), visible distortion of the baseplate, excessive generation of heat in the bearings, or rubbing of the rotor.

4.6.4.2. Tests/Verification

A sample pump shall be operated continuously for 336 hours at its maximum rated capacity. No loose parts, distortion, overheating, or degradation of performance shall be allowed. During this test, measurements for flow and discharge pressure shall be recorded at 15 minute intervals. Depending on the construction of the overall pump assembly, additional measurements for rotational speed, fuel consumption rate, lubricant temperature, and power, as applicable, will also be recorded.

Ideally, the pump is to be operated with a driver and coupling that will be included in the submitted pump package(s) (see Appendix C). Each driver and coupling design that is included in the submitted pump package(s) and which is not subjected to this endurance test, shall be subjected to the pump package endurance test described in Section 4.6.5.

Once the test is started, it shall be left to run as near continuous as practical. Stopping for refueling, end of business day, or to make adjustments to the test equipment (not the pump assembly) is allowed. Other than the normal starting / priming procedures, no adjustments are permitted to be made to the pump assembly. Stopping the test for reasons other than indicated above shall be considered a failure. No loose parts, distortion, overheating, or degradation of performance shall be allowed. Following the test, the pump shall be disassembled and examined for signs of rubbing.

4.6.5. Endurance Test – Pump Package

4.6.5.1. Requirements

A minimum of 1 of each pump driver, whether it be a diesel engine or electric motor, shall be endurance tested as part of a flood mitigation pump package. Each coupling design shall also be represented and tested. Drivers and couplings shall be tested with the pump requiring the greatest amount of power for which it is specified to be used. Whenever possible, representative testing may be justified, at the discretion of the testing laboratory, for drivers or couplings having similar designs.

There shall be no excessive vibration, loosening of parts (fasteners, etc.), visible distortion of the baseplate, excessive generation of heat, or loss of pump performance.

Alternative to performing the endurance test on each pump driver, rated power levels obtained as part of the US EPA emission certification or other third party certification process may be considered, at the discretion of the testing laboratory. Power measurements are required to be recorded during the pump performance testing

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described in Section 4.6.3 to allow for comparison. The rated power shall be greater than the maximum power required by the pump, plus an additional safety factor of 1.1.

4.6.5.2. Tests/Verification

Flood mitigation pump drivers and couplings which were not tested as part of Section 4.6.4 shall be installed in pump packages and run continuously at maximum rated capacity for a duration of 4 hours. During this test, measurements for flow and discharge pressure shall be recorded at 15 minute intervals. Depending on the construction of the overall pump assembly, additional measurements for rotational speed, fuel consumption rate, lubricant temperature, and power, as applicable, will also be recorded.

Throughout the endurance test, observations shall be made for excessive vibration, loosening of parts (fasteners, etc.), distortion of the baseplate, or excessive generation of heat. No loss of pump performance shall also be verified.

4.6.6. Hydrostatic Strength

4.6.6.1. Requirements

A flood mitigation pump shall withstand an exposure to hydrostatic pressure without rupturing, cracking, or exhibiting permanent distortion of any component of the pump. For pumps with mechanical seals, no leakage shall be detected. For pumps with stuffing box packing, no leakage shall be detected with the exception of the stuffing box packaging.

4.6.6.2. Tests/Verification

A sample pump shall be hydrostatically tested for 5 minutes at a pressure equal to, or greater than, twice the maximum shutoff pressure ($2 \times P_{max}$), where P_{max} is the maximum shutoff pressure specified by the pump manufacturer. No rupture, cracking or permanent distortion shall be observed.

4.6.7. On/Off Switch Durability - Cycling

4.6.7.1. Requirements

The on/off switch of a flood mitigation pump, under full electrical load, shall not show excessive wear or damage after 1000 cycles of operations.

4.6.7.2. Tests/Verification

The on/off switch assembly of a flood mitigation pump shall be cycled 1000 times through its full range of travel while under full electrical load. After testing, all parts of the assembly shall be visually inspected. No excessive wear or damage shall be observed.

4.6.8. Voltage Variation and Temperature Extremes

4.6.8.1. Requirements

Electrically operated motors or components used in a flood mitigation pump shall operate at ±85 and 110 percent of the rated voltage specified by the manufacturer, while conditioned to the maximum and minimum rated installation temperatures. The motor/component shall display no hesitation, partial operation, or other failures to operate properly.

4.6.8.2. Tests/Verification

The electrically operated motor or component shall be conditioned at the maximum rated installation temperature for a minimum of 16 hours. Immediately upon removal from the chamber, the motor/component shall be supplied with minus 15 percent of the rated voltage for a period of 2 minutes. The motor/component shall then be supplied with plus 15 percent of the rated voltage for a period of 2 minutes. The motor/component shall display no hesitation, partial operation, or other failures to operate properly. The test shall be repeated with the motor/component conditioned to the minimum rated installation temperature.

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4.6.9. Dielectric Withstand

4.6.9.1. Requirements

Electrically operated motors or components used in a flood mitigation pump shall withstand an applied voltage between all terminals provided for external connections and ground, as well as between all combinations of individual connections. There shall be no breakdown of the insulation between the test points. The motor and pump shall continue to function normally subsequent to this test.

4.6.9.2. Tests/Verification

For a motor/component with a rated voltage not exceeding 90 V, the test voltage shall be equal to 500 V. For all other devices, the test voltage shall be calculated as 1000 V plus two times the rated voltage of the circuit. The required voltage shall be applied between each terminal and ground, and between all individual terminals. The voltage shall be increased steadily to the specified value in a period of not less the 10 seconds, and maintained for a minimum of 60 seconds.

4.6.10. Maximum Suction Lift Capability

4.6.10.1. Requirements

Self-priming flood mitigation pumps designed for suction lift applications shall be operated to verify maximum suction lift capability. The priming mechanism shall produce a vacuum pressure equivalent to or exceeding the maximum rated suction lift.

4.6.10.2. Tests/Verification

The pump suction shall be suitably sealed by closing the suction valve or other means used to plug the suction end of the pump and shall be fitted with a vacuum pressure gauge. While the pump suction is sealed, the pump shall be operated, as directed in the manufacturer's priming instructions. The maximum vacuum pressure developed by the priming mechanism shall be recorded. A conversion factor of 2.3 ft. (0.7m) of water per 1.0 psi (2.04 mmHg) vacuum pressure shall be used to determine the equivalent suction lift capability in feet (meters).

4.7. ADDITIONAL TESTS

Additional tests may be required, depending on design features, results of any tests, material application, or to verify the integrity and reliability of the flood mitigation equipment barriers, at the discretion of the testing laboratory.

Unexplainable failures shall not be permitted. A re-test shall only be acceptable at the discretion of the testing laboratory and with adequate technical justification of the conditions and reasons for failure.

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5. BIBLIOGRAPHY

ASCE/SEI 24-14, Flood Resistant Design and Construction

ASME A112.14.1, Backwater Valves

ASTM D471, Standard Test Method for Rubber Property Effect of Liquids

ASTM D1242, Standard Test Method for Resistance of Plastic Materials to Abrasion

ASTM D6382, Standard Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material

ASTM E290, Standard Test Methods for Bend Testing of Material For Ductility

ASTM G154, Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

ASTM SI10 - American National Standard for Use of The International System of Units (SI): The Modern Metric System

United States Army Corps of Engineers (USACE), Engineering Research and Development Center (ERDC), Standardized Testing Protocol for Evaluation of Expedient Floodfight Structures

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APPENDIX A: Tolerances

Unless otherwise stated, the following tolerances shall apply:

Angle:	± 2°
Flow	± 3 percent of value
Frequency (Hz):	± 5 percent of value
Length:	± 5 percent of value
Volume:	± 5 percent of value
Rotation:	± 1 RPM
Pressure:	± 5 percent of value
Temperature:	± 5 percent of value
Time:	+ 5/- 0 seconds + 0.1/- 0 minutes + 0.1/- 0 hours + 0.25/- 0 days

Unless stated otherwise, all tests shall be carried out at a room (ambient) temperature of 68°F ± 18°F (20°C ± 10°C).

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APPENDIX B: USACE Coastal and Hydraulics Laboratory Test Facility Description

Performance testing of flood barrier for perimeter barrier applications is typically conducted at a facility similar to the wave basin at the ERDC Coastal and Hydraulics Laboratory, located in Vicksburg, Mississippi. The research facility consists of a 100 ft. (30.48 m) wide by 150 ft. (45.72 m) long basin. One end of the facility contains three electric-driven piston-type wave generators, each driving a 25 ft. (7.62 m) wide wave paddle. The three wave generators are synchronized so that they all run together as a 75 ft. (22.86 m) wide generator. Guide vanes contain the wave train for the first 50 ft. (15.24 m) in front of the wave generators. The generators are computer controlled and capable of producing monochromatic or spectral wave fields.

Two wing walls, 30 ft. (9.14 m) apart, are centered at the end of the basin away from the wave generators. The wing walls are each 30 ft. (9.14 m) long then turn towards the sides of the basin for 10 ft. (3.05 m) Between the wing walls is an 8 ft. (2.44 m) diameter by 8 ft. (2.44 m) deep sump. The sump is equipped with two 4 in. (10.2 cm) diameter pipes with float-controlled submersible pumps and flow meters, and also two external diesel-powered pumps with 15 in. (0.38 cm) diameter intakes and 12 in. (0.31 m) diameter outfalls.

During testing of a flood-fighting product, seepage through the structure shall be collected in the sump and pumped back into the basin via the sump pumps and 4-in diameter pipes. The diesel pumps are used during the overtopping tests to return the water to the basin and during the current test to provide water flow.

Seepage rates through the test structures are measured by the flow meters in the 4 in. (10.2 cm) diameter pipes and also by a laser pointing at a float in a standpipe in the sump measuring changes in water surface elevation. Several capacitance-type wave gauges measure the changes in water surface elevation within the basin to determine the incident wave fields. Eight lasers record any movement of the structure during testing.

A cable take-up reel has been modified to tow a log into the structure at a calibrated 5 mph (7 ft/s) (for a debris impact test. The log trips a wire set a few in. in front of the test structure which turns off the drive motor on the take-up reel prior to impact. Two web cams with 360-degree pan and telephoto zoom capabilities are used to record construction, testing, and disassembly of each product. The web cams may also be used to broadcast so that the tests may be viewed in real time by anyone with web access.

Due to the restrictive height of the research basin walls, the height of each structure shall be limited to 4 ft (1.2 m). The layout of the base of the barrier construction area is shown in Figure A-1. The ground surface of the wave basin is a smooth, flat, and impervious concrete slab with little elevation changes. The water supply for performance testing shall be the available non-potable (e.g. city water) water supply to the test facility. No purposely contaminated water shall be allowed into the facility.

The wet-side, or river-side, of the wave basin refers to the side of the basin that imposes the flood water. The dry-side of the wave basin refers to the side protected by the flood barrier.

Two web cams with 360-degree pan and telephoto zoom capabilities are used to record construction, testing, and disassembly of each product. The web cams may also be used to broadcast so that the tests may be viewed in real time by anyone with web access.

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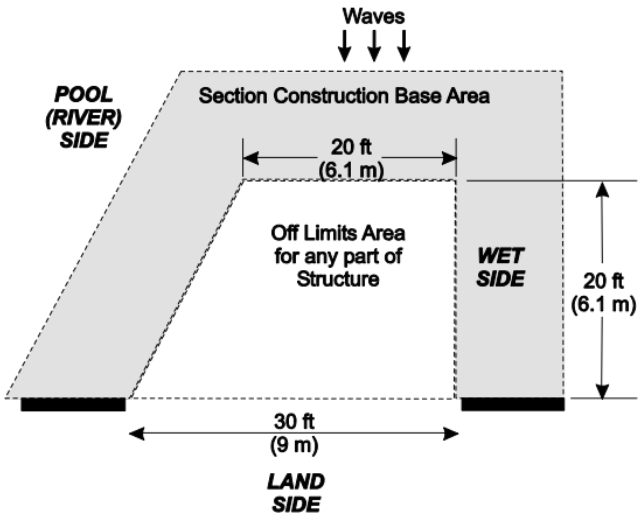


Figure B-1. Layout and Barrier Construction

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APPENDIX C: FLOOD MITIGATION PUMP PACKAGE COMPONENTS

The flood mitigation pump package shall consist of the following components which are furnished by the flood mitigation pump manufacturer:

1. Flood mitigation pump
2. Driver – diesel engine or electric motor
3. Pump controller (if applicable)
4. Flexible coupling or drive shaft (if applicable)
5. Suction and discharge pressure gauges (if applicable)
6. Substantial bedplate for pump and driver (if applicable)
7. Diesel engine accessories (if applicable):
    a. starting batteries
    b. rigid cooling water and fuel lines for stationary installations (may have short flexible elements in close proximity to engine to minimize vibration)
    c. exhaust piping and muffler
    d. fuel tank
8. Liquid level sensor (if applicable)
9. Instruction, operation, and maintenance manual in local language

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APPENDIX D : MAXIMUM SEEPAGE RATE ALLOWANCE - FLOOD BARRIERS FOR OPENING BARRIER APPLICATIONS

The following table was developed based on the maximum leakage rate criteria and calculation methods described in Section 4.3.3. This table does not apply to flood barriers which have a maximum design water depth greater than the barrier height (i.e. fully submerged windows), if the barrier perimeter is less than the opening width plus two times the water depth. This table also does not apply to flood barriers which are parallel to the ground surface.

Note: To determine maximum seepage flow rate allowances for flood barriers for perimeter barrier applications, simply multiply the barrier length by the maximum leakage rate requirement specified in Section 4.2. Water height is not factored into the calculation.

Maximum Seepage Rate Allowance, (gal/hr)

	Opening Width, (ft.)											
Maximum Design Water Depth, (ft.)	1	2	3	4	5	6	8	10	12	15	20	25
0.5	0.16	0.24	0.32	0.4	0.48	0.56	0.72	0.88	1.04	1.28	1.68	2.08
1	0.24	0.32	0.4	0.48	0.56	0.64	0.8	0.96	1.12	1.36	1.76	2.16
1.5	0.32	0.4	0.48	0.56	0.64	0.72	0.88	1.04	1.2	1.44	1.84	2.24
2	0.4	0.48	0.56	0.64	0.72	0.8	0.96	1.12	1.28	1.52	1.92	2.32
2.5	0.48	0.56	0.64	0.72	0.8	0.88	1.04	1.2	1.36	1.6	2	2.4
3	0.56	0.64	0.72	0.8	0.88	0.96	1.12	1.28	1.44	1.68	2.08	2.48
3.5	0.64	0.72	0.8	0.88	0.96	1.04	1.2	1.36	1.52	1.76	2.16	2.56
4	0.72	0.8	0.88	0.96	1.04	1.12	1.28	1.44	1.6	1.84	2.24	2.64
4.5	0.8	0.88	0.96	1.04	1.12	1.2	1.36	1.52	1.68	1.92	2.32	2.72
5	0.88	0.96	1.04	1.12	1.2	1.28	1.44	1.6	1.76	2	2.4	2.8
5.5	0.96	1.04	1.12	1.2	1.28	1.36	1.52	1.68	1.84	2.08	2.48	2.88
6	1.04	1.12	1.2	1.28	1.36	1.44	1.6	1.76	1.92	2.16	2.56	2.96
7	1.2	1.28	1.36	1.44	1.52	1.6	1.76	1.92	2.08	2.32	2.72	3.12
8	1.36	1.44	1.52	1.6	1.68	1.76	1.92	2.08	2.24	2.48	2.88	3.28
9	1.52	1.6	1.68	1.76	1.84	1.92	2.08	2.24	2.4	2.64	3.04	3.44
10	1.68	1.76	1.84	1.92	2	2.08	2.24	2.4	2.56	2.8	3.2	3.6
11	1.84	1.92	2	2.08	2.16	2.24	2.4	2.56	2.72	2.96	3.36	3.76
12	2	2.08	2.16	2.24	2.32	2.4	2.56	2.72	2.88	3.12	3.52	3.92
13	2.16	2.24	2.32	2.4	2.48	2.56	2.72	2.88	3.04	3.28	3.68	4.08
14	2.32	2.4	2.48	2.56	2.64	2.72	2.88	3.04	3.2	3.44	3.84	4.24
15	2.48	2.56	2.64	2.72	2.8	2.88	3.04	3.2	3.36	3.6	4	4.4
16	2.64	2.72	2.8	2.88	2.96	3.04	3.2	3.36	3.52	3.76	4.16	4.56
17	2.8	2.88	2.96	3.04	3.12	3.2	3.36	3.52	3.68	3.92	4.32	4.72
18	2.96	3.04	3.12	3.2	3.28	3.36	3.52	3.68	3.84	4.08	4.48	4.88
19	3.12	3.2	3.28	3.36	3.44	3.52	3.68	3.84	4	4.24	4.64	5.04
20	3.28	3.36	3.44	3.52	3.6	3.68	3.84	4	4.16	4.4	4.8	5.2

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SP12034-A1Text Modification

1612.4 Design and construction.

The design and construction of buildings and structures located in flood hazard areas, including coastal high hazard areas and Coastal A Zones, shall be in accordance with Chapter 5 of ASCE 7 and with ASCE 24.

1612.4.1Modification of ASCE 24.

Table 6-1 and Section 6.2.1 in ASCE 24 shall be modified as follows:

1.The title of Table 6.1 shall be “Minimum Elevation of Floodproofing, Relative to Base Flood Elevation (BFE) or Design Flood Elevation (DFE), in Coastal A Zones and in Other Flood Hazard Areas that are not High Risk Flood Hazard Areas.”

2.Section 6.2.1 shall be modified to permit dry floodproofing in Coastal A Zones, as follows: “Dry floodproofing of nonresidential structures and nonresidential areas of mixed-use structures shall not be allowed unless such structures are located outside of High Risk Flood Hazard areas and Coastal High Hazard Areas. Dry floodproofing shall be permitted in Coastal A Zones provided wave loads and the potential for erosion and local scour are accounted for in the design. Dry floodproofing of residential structures or residential areas of mixed-use structures shall not be permitted.”

1612.4.2Modification of ASCE 24 9.6 Pools.

Modify Section 9.6 in ASCE 24 by adding an exception as follows:

9.6 Pools. In-ground and above-ground pools shall be designed to withstand all flood-related loads and load combinations. Mechanical equipment for pools such as pumps, heating systems and filtering systems, and their associated electrical systems, shall comply with Chapter 7.

Exception: Equipment for pools, spas and water features shall be permitted below the elevation required in Table 7-1, provided it is elevated to the extent practical, is anchored to prevent flotation and resist flood forces, and is supplied by branch circuits that have ground-fault circuit-interrupter protection.

~~**1612.4.3** Flood Resistance Materials for Dry Flood Proofing of Special Flood Hazards Areas of A-zones shall meet TAS 204 or an approved flood resistant test.~~

1612.4.3 Testing of Dry Floodproofing Measures (Passive). Flood Resistance Materials for passive Dry Flood Proofing shall meet TAS 204 or an approved flood resistance test.

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SP12034Text Modification

1612.4 Design and construction.
The design and construction of buildings and structures located in flood hazard areas, including coastal high hazard areas and Coastal A Zones, shall be in accordance with Chapter 5 of ASCE 7 and with ASCE 24.

1612.4.1Modification of ASCE 24.
Table 6-1 and Section 6.2.1 in ASCE 24 shall be modified as follows:
1.The title of Table 6.1 shall be "Minimum Elevation of Floodproofing, Relative to Base Flood Elevation (BFE) or Design Flood Elevation (DFE), in Coastal A Zones and in Other Flood Hazard Areas that are not High Risk Flood Hazard Areas."
2.Section 6.2.1 shall be modified to permit dry floodproofing in Coastal A Zones, as follows: "Dry floodproofing of nonresidential structures and nonresidential areas of mixed-use structures shall not be allowed unless such structures are located outside of High Risk Flood Hazard areas and Coastal High Hazard Areas. Dry floodproofing shall be permitted in Coastal A Zones provided wave loads and the potential for erosion and local scour are accounted for in the design. Dry floodproofing of residential structures or residential areas of mixed-use structures shall not be permitted."

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Exception: Equipment for pools, spas and water features shall be permitted below the elevation required in Table 7-1, provided it is elevated to the extent practical, is anchored to prevent flotation and resist flood forces, and is supplied by branch circuits that have ground-fault circuit-interrupter protection.

1612.4.3 Flood Resistance Materials for Dry Flood Proofing of Special Flood Hazards Areas of A-zones shall meet TAS 204 or an approved flood resistant test.

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SP12034-A2Rationale

SUBMITTED: Rebecca Quinn, obo FDEM Office of Floodplain Management

ALTERNATE LANGUAGE for SP12034

Text of Modification:

1612.4.3 Testing of Dry Floodproofing Measures. Where dry floodproofing is permitted by this code, materials, products and assemblies specified by registered design professionals as part of dry floodproofing measures shall meet the following, as applicable:

1. Where human intervention is not required (passive), meet the test requirements of ANSI/FM 2510, TAS 204 or an approved test standard, unless otherwise approved by the building official.
2. Where human intervention is required (active), meet the test requirements of ANSI/FM 2510 or an approved test standard, unless otherwise approved by the building official.

ADD to Chapter 35:

ANSI/FM 2510—20. American National Standard for Flood Mitigation Equipment.

Rationale:

ANSI/FM Approvals 2510-2020, a standard for "flood mitigation equipment," was published in 2020. This standard applies to "flood barriers for opening barrier and perimeter barrier applications" (passive and active) and mitigation valves and pumps. ANSI/FM 2510 is cited in the 2024 edition of ASCE 24, Flood Resistant Design and Construction.

This Alternate Language proposal adds the ANSI/FM standard to the Miami-Dade proposal. It also provides for use of measures, both passive and active, with approval of the building officials – this is a necessary clarification. Some manufacturers have not yet completed testing and ANSI/FM 2510 certification, and likely even fewer have satisfied TAS 204. Plus, there are instances where a design professional might develop individually designed measures for unique situations that manufactured and certified products cannot address.

Miami-Dade County proposes to require all dry floodproofing passive measures ("flood resistance materials") used in every jurisdiction in the State to meet Testing Application Standard (TAS), 204-26, that was developed by the County. Other Miami-Dade TASs cited in the FBC are related to High-Velocity Hurricane Zone and wind-borne debris regions. See separate comment submitted for SP12040, which is the TAS. It is also notable that:

- TAS 204 is not applicable in Coastal A Zones, yet the FBC allows dry floodproofing in those areas. The Alternate Language addresses this by stating it applies "where dry floodproofing is permitted by this code."
- TAS 204 is explicitly only for "passive" measures. The obvious question is what about measures that require people to take action? Requiring passive measures only if tested by TAS 204 or another resistance test would end the standard of practice for +50 years by

Commented [RQ1]: Reminder, FBC defines: **DRY FLOODPROOFING.** A combination of design modifications that results in a building or structure, including the attendant utilities and equipment and sanitary facilities, being water tight with walls substantially impermeable to the passage of water and with structural components having the capacity to resist loads as identified in ASCE 7.

Commented [RQ2]: This captures 1612.4.1 that allows dry FP in CAZ

Commented [RQ3]: Reminder, ASCE 24 defines: **Human Intervention**—Required presence and active involvement of people to implement a *floodproofing* measure prior to the onset of *flooding*.

Commented [RQ4]: This phrase allows acceptance of untested things, with BO approval. From what I can tell, there aren't yet a lot of things tested to meet ANSI/FM 2510

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precluding individual certification. The Alternate Language addresses this by providing for approval by the building official as an option.

The FBC defines the term "dry floodproofing" and Sec. 1612.4 refers to ASCE 24 for design and construction requirements. Dry floodproofing measures fall into two categories – those that are passive and do not rely on people to take action (e.g., solid walls, special flood glass, special doors that seal every time closed), and those that require human intervention (e.g., to install panels and barriers).

As spelled out in ASCE 24, Sec. 6.2, performance of all measures used to achieve dry floodproofing must result in the structure being substantially impermeable to the passage of floodwater, and the walls, floors, and flood shields must be designed and constructed to resist hydrostatic, hydrodynamic, and other flood-related loads, including buoyancy. FBC Sec. 1612.5 requires construction documents to include a "statement that the dry floodproofing is designed in accordance with ASCE 24." This is required when buildings are proposed to be dry floodproofed, whether with active or passive measures, or as is most common, a combination.

Fiscal Impact Statement:

Impact to local entity relative to enforcement of code (553.73(9)(b),F.S.):
Saves time and increases confidence when certified products are specified in designs.

Impact to building and property owners relative to cost of compliance with code (553.73(9)(b),F.S.):
Saves some costs when design professionals specify use of certified products.

Impact to industry relative to the cost of compliance with code (553.73(9)(b),F.S.):
Design industry will save time and costs when they can specify certified products. Manufacturing industry incurs costs for testing, but whether to seek certification is a choice.

Requirements:

Has a reasonable and substantial connection with the health, safety, and welfare of the general public (553.73(9)(a)2,F.S.):
Improves reliability of dry floodproofed buildings when certified products are used.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction (553.73(9)(a)3,F.S.):
Improves reliability of dry floodproofed buildings when certified products are used.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities (553.73(9)(a)4,F.S.):
In addition to offering two testing standards, allows continuation of standard practice over last +50 years by relying on design professional certification.

Does not degrade the effectiveness of the code (553.73(9)(a)5,F.S.):
Improves effectiveness when certified products are specified.

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

19

S12046

Date Submitted	02/12/2025	**Section**	1607	**Proponent**	Jeanne Clarke
Chapter	16	**Affects HVHZ**	No	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Summary of Modification

Changes live load requirements in parking garages from 40 psf to 55 psf to account for increased weight of electric vehicles

Rationale

There is an ongoing concern about the design live loads for elevated parking garages with respect to the increased loads due to the presence of electric vehicles (EVs). Current design loads are established at 40 pounds-per-square foot (psf) per Table 4.3-1 of the American Society of Civil Engineers (ASCE) design standard 7-22 ‘Minimum Design Loads for Buildings and Other Structures’. Considering that EV are about 30% heavier than cars powered by internal combustion engines, and charging stations can weigh several thousand pounds, the 40 psf design load is not adequate. European and Canadian Building Codes use nearly 53 psf for the design of these structures with Great Britian increasing the loads to nearly 60 psf for ‘car parks’ or parking garages. Adoption of this modification will require that any new construction of elevated parking garages use 55 pounds-per-square foot for live loads to account for the growing use of these heavier electric vehicles and placing Florida more in line with European and Canadian design standards.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
None
Impact to building and property owners relative to cost of compliance with code
Minimal
Impact to industry relative to the cost of compliance with code
None
Impact to small business relative to the cost of compliance with code
None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Provides additional capacity to accommodate electric vehicles

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Provides additional capacity to accommodate electric vehicles

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
this modification is for design load only and does not require a specific material

Does not degrade the effectiveness of the code
Provides additional capacity to accommodate electric vehicles

Alternate Language

2nd Comment Period

S12046-A1

Proponent Jeanne Clarke **Submitted** 8/13/2025 12:06:30 PM **Attachments** Yes

Rationale:

Based on information provided by the Builder's Association of Florida, the discrepancy in weight amounts to EVs being about 20% heavier. The proposed modification is therefore reduced to 50 psf (approximately 20% greater than 40 psf). Attached is the table provided by the Builder's Association of Florida providing data on the increased loads of EVs.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Impact to small business relative to the cost of compliance with code

None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Increases load bearing capacity of parking structures

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This change provides increased capacity for these parking structures

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This is a change in design, not to specific materials

Does not degrade the effectiveness of the code

It adjusts the design values to account for current loading due to heavier electric vehicles

S12046-A1Text Modification

TABLE 1607.1

MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_0, AND MINIMUM CONCENTRATED LIVE LOADS

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (pounds)	ALSO SEE SECTION
* * *			
15. Garages			—
Passenger vehicles only	50~~40~~[c]	See Section 1607.7	-
Trucks and buses	See Section 1607.8		
* * *			

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm^2, 1 square foot = 0.0929 m^2, 1 pound per square foot = 0.0479 kN/m^2, 1 pound = 0.004448 kN, 1 pound per cubic foot = 16 kg/m^3.

a. Live load reduction is not permitted.

b. Live load reduction is only permitted in accordance with Section 1607.11.1.2 or Item 1 of Section 1607.11.2.

c. Live load reduction is only permitted in accordance with Section 1607.11.1.3 or Item 2 of Section 1607.11.2.

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S12046Text Modification

TABLE 1607.1

MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_0, AND MINIMUM CONCENTRATED LIVE LOADS

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (pounds)	ALSO SEE SECTION
*	*	*	
15. Garages			—
Passenger vehicles only	5540[c]	See Section 1607.7	
Trucks and buses	See Section 1607.8		
*	*	*	

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm^2, 1 square foot = 0.0929 m^2, 1 pound per square foot = 0.0479 kN/m^2, 1 pound = 0.004448 kN, 1 pound per cubic foot = 16 kg/m^3.

a. Live load reduction is not permitted.

b. Live load reduction is only permitted in accordance with Section 1607.11.1.2 or Item 1 of Section 1607.11.2.

c. Live load reduction is only permitted in accordance with Section 1607.11.1.3 or Item 2 of Section 1607.11.2.

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S12046-A1Rationale

Segment	Gasoline Vehicle (Trim & Curb Weight)	Electric Vehicle (Trim & Curb Weight)	Weight Difference (lbs)	% Difference
Compact Car	Toyota Corolla LE: 2,955 lbs	Chevrolet Bolt EV 1LT: 3,589 lbs	634	21.5%
Midsize Sedan	Honda Accord LX: 3,239 lbs	Tesla Model 3 Long Range RWD: 3,891 lbs	652	20.1%
Compact SUV	Hyundai Kona SEL (Gas): 3,241 lbs	Hyundai Kona Electric SEL: 3,759 lbs	518	16.0%
Midsize SUV	Ford Explorer XLT: 4,345 lbs	Tesla Model X Dual Motor: 5,148 lbs	803	18.5%
Full-Size SUV	Chevrolet Suburban LS: 5,680 lbs	Rivian R1S: 7,148 lbs	1,468	25.8%
Pickup Truck	Ford F-150 XL: 4,687 lbs	Ford F-150 Lightning Pro: 6,015 lbs	1,328	28.3%
Luxury SUV	BMW X5 xDrive40i: 4,919 lbs	Mercedes-Benz EQE 500 4MATIC SUV: 5,681 lbs	762	15.5%
			AVERAGE	**20.8%**

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TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

20

S12298

Date Submitted	02/18/2025	**Section**	1604.5.3	**Proponent**	Douglas Armstrong
Chapter	16	**Affects HVHZ**	No	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

Summary of Modification

This specialized code language will provide a systematic, accurate, and consistent approach to evaluating lightning risk for these essential uses and recommend protective measures.

Rationale

There is a lack of a standardized, detailed methodology within the IBC to assess and mitigate lightning risks specifically for Risk Category IV buildings and other structures. These buildings contain essential facilities (e.g., hospitals, emergency shelters) and also those buildings where the loss of function is a real hazard to the occupants/users. The assignment in Risk Category IV is to help ensure these buildings maintain functionality and safety during natural hazards; in this case severe weather events. This specialized code language will provide a systematic, accurate, and consistent approach to evaluating lightning risk for these essential uses and recommend protective measures. Lightning strikes can significantly disrupt hospital operations, affecting both infrastructure and patient care. Key impacts include: Electrical and Electronic System Failures: a. Power Supply Disruptions: Lightning can cause power outages, compromising critical systems. b. Equipment Damage: Sensitive medical devices are vulnerable to voltage spikes from lightning, potentially leading to malfunctions or complete failure. This can impede patient monitoring and treatment. Communication System Interruptions: a. Lightning-induced surges can disrupt hospital communication networks, including telephones, intercoms, and internet services, hindering coordination among medical staff and with external emergency services. Structural Damage: a. Direct lightning strikes can cause fires or physical damage to hospital buildings, posing safety risks to patients and staff and potentially leading to evacuations. To safeguard against these risks, hospitals can implement comprehensive lightning protection systems. Implementing these measures can enhance hospital resilience against lightning-related incidents, ensuring continuity of critical healthcare services. Please see uploaded Support File for more information.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

The Cost per Square Foot of such systems for Low-Rise Buildings is approximately $2.10 to $2.70 per square foot of roof area and Five-Story Buildings is approximately $1.50 to $1.90 per square foot of roof area for the installation of such protective systems based on industry studies.

Impact to industry relative to the cost of compliance with code

The cost impacts are based on industry studies. It is a simple cost of system over roof area provided. The new language should help streamline assessments to integrate seamlessly into design and approval phases, avoiding delays in the construction timeline.

Impact to small business relative to the cost of compliance with code

None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

The code modification will help to ensure the continued functionality of essential uses and others designated as Risk Category IV. This includes hospitals, fire stations, police stations, etc.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This specialized code language will provide a systematic, accurate, and consistent approach to evaluating lightning risk for these essential uses and recommend protective measures.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This code modification does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

This improves the effectiveness of the code by clarifying the lightning risk analysis of Category IV buildings

2nd Comment Period

s12298-G6

Proponent Michael Dillon Submitted 8/22/2025 10:41:45 AM Attachments No

Comment:

The Electrical TAC approved this proposal, even though the Structural TAC did not. This proposal is simply requiring a risk assessment be done for Category IV buildings. There is no requirement to add a LP system.

2nd Comment Period

s12298-G7

Proponent David Allen Submitted 8/24/2025 12:57:02 PM Attachments No

Comment:

The proposal does not simply require a risk assessment be conducted, it mandates that the risk assessment be done "in accordance with NFPA 780 or IEC 62305-2." The reliance on NFPA 780 as a code is misguided and its inclusion is simply in pursuit of corporate protectionism.

1st Comment Period History

S12298-G1

Proponent Dillon Mike Submitted 4/10/2025 11:39:20 AM Attachments No

Comment:

My name is Michael Dillon, with Bonded Lightning Protection Systems. I represent the Lightning protection industry as an installer in Florida. I support this proposal because it gives the project developer, building owner, contractors, and building officials industry recognized methods for performing a lightning risk assessment. It also recognizes that risk category IV buildings and structures are especially vulnerable to the hazards of lightning.

1st Comment Period History

S12298-G2

Proponent Tyler Baumert Submitted 4/14/2025 2:47:48 PM Attachments No

Comment:

My name is Tyler Baumert, and I represent the Lightning Protection Coalition. I am writing to express strong support for Proposals S12298.Proposal S12298 promotes resilience in Risk Category IV buildings—those crucial to public safety during emergencies—by requiring lightning risk assessments based on recognized national and international standards. This ensures objective, data-driven decisions while avoiding unnecessary system mandates. It's a smart, balanced approach that enhances life safety, supports business continuity, and bolsters community resilience during Florida's frequent storm events.

1st Comment Period History

S12298-G3

Proponent harger Tim Submitted 4/15/2025 4:24:34 PM Attachments No

Comment:

My name is Tim Harger from the Lightning Protection Institute. I support S12298, which promotes safer, more resilient Risk Category IV buildings—facilities critical to public safety during emergencies. By requiring a lightning risk assessment based on recognized national and international standards, this proposal ensures informed, objective decisions without mandating unnecessary systems. It enhances life safety, supports business continuity, and strengthens community resilience during Florida's frequent storm events.

1st Comment Period History

S12298-G4

Proponent George Po Submitted 4/16/2025 3:59:33 PM Attachments Yes

Comment:

Support of S12298

1st Comment Period History

S12298-G5

Proponent George Po Submitted 4/16/2025 4:06:42 PM Attachments Yes

Comment:

Support of S12298

S12298Text Modification

Add a new Section 1604.5.3 as follows:

1604.5.3 Lightning protection assessment. Those buildings or structures assigned to Risk Category IV shall have a lightning risk assessment in accordance with NFPA 780 or IEC 62305-2.

Chapter 35

Add the following standard:

IEC

IEC 62305-2 2024-9 Protection against lightning, Part 2: Risk Management 2703.1.1

International Electrotechnical Commission

3, rue de Varembe

CH-1211 Geneva 20

Switzerland

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IEC 62305-2

Edition 3.0 2024-09

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Protection against lightning – Part 2: Risk management

Protection contre la foudre – Partie 2: Évaluation des risques



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IEC 62305-2

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Protection against lightning – Part 2: Risk management

Protection contre la foudre – Partie 2: Évaluation des risques

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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ISBN 978-2-8322-9549-6

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PROTECTION AGAINST LIGHTNING –

Part 2: Risk management

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1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 62305-2 has been prepared by IEC technical committee 81: Lightning protection. It is an International Standard.

This third edition cancels and replaces the second edition, published in 2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) The concept of a single risk, to combine loss of human life and loss due to fire, has been introduced.
b) The concept of frequency of damage that can impair the availability of the internal systems within the structure has been introduced.

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c) The lightning ground strike-point density N_{SG} has been introduced replacing the lightning flash density N_G in the evaluation of expected average annual number of dangerous events.

d) Reduction of a few risk components can be achieved by the use of preventive temporary measures activated by means of a thunderstorm warning system (TWS) compliant with IEC 62793. The risk of direct strike to people in open areas has been introduced, considering the reduction of that risk using a TWS.

The text of this International Standard is based on the following documents:

Draft	Report on voting
81/769/FDIS	81/772/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62305 series, published under the general title *Protection against lightning*, can be found on the IEC website.

The following differing practices of a less permanent nature exist in the countries indicated below.

In Germany, the value of r_p = 1 applies for all cases. For the risk components R_B, R_C, R_M, R_V, R_W and R_Z P_{TWS} = 1 is assumed. For LF1 and LF2 the highest values given in Table C.2 should be used.

In Greece, the value of P_{TWS} = 1 for all cases is assumed.

In Italy, calculating both the risk of loss of human life, RL1 in Equation (7), and the risk of loss due to physical damages, RL2 in Equation (8), and comparing each risk with the tolerable risk is required. Protection is achieved when both risks, RL1 and RL2, are less than the tolerable value.

In the Netherlands and South Africa, Annex D and Annex E should not be applied for usual studies.

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The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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INTRODUCTION

Lightning flashes to earth can be hazardous to structures and to lines supplying the structure.

These hazards can result in:

– damage to the structure and to its contents,
– failure of associated electrical and electronic systems,
– injury to living beings in or close to the structure.

Consequential effects of the damage and failures can be extended to the surroundings of the structure or can involve its environment. Moreover, regardless of the extent of loss, the availability of the structure and its internal systems can be unacceptably impaired if the frequency of damage is high.

To reduce the frequency of damage and the loss due to lightning, protection measures can be required. Whether they are necessary, and to what extent, should be determined by frequency of damage and risk assessment.

NOTE 1 The decision to provide lightning protection can be taken regardless of the outcome of frequency of damage or risk assessment where there is a desire that there be no avoidable damages.

NOTE 2 IEC 60364-4-44 [1][1] always requires the installation of a surge protective device (SPD) at the power line entrance in the structure when the consequence caused by overvoltages affects:

– care of human life, e.g. safety services, medical care facilities,
– public services and cultural heritage, e.g. loss of public services, IT centres, museums,
– commercial or industrial activity, e.g. hotels, banks, industries, commercial markets, farms.

The frequency of damage, defined in this document as the annual number of damages in a structure due to lightning flashes, depends on:

– the annual number of lightning flashes influencing the structure;
– the probability of damaging events by one of the influencing lightning flashes.

The risk, defined in this document as the probable average annual loss in a structure due to lightning flashes, depends on:

– the frequency of damage;
– the mean extent of consequential loss.

Lightning flashes influencing the structure can be divided into

– flashes terminating on the structure,
– flashes terminating near the structure, directly to connected lines (power, telecommunication lines) or near the lines.

Flashes to the structure or a connected line can cause physical damage and life hazards. Flashes near the structure or line as well as flashes to the structure or line can cause failure of electrical and electronic systems due to overvoltages resulting from resistive and inductive coupling of these systems with the lightning current.

Moreover, failures caused by lightning overvoltages in users' installations and in power supply lines can also generate voltage switching overvoltages in the installations.

NOTE 3 Malfunctioning of electrical and electronic systems is not covered by the IEC 62305 series. Reference is made to IEC 61000-4-5 [2].

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The number of lightning flashes influencing the structure depends on the dimensions, the characteristics of the structure and the connected lines, on the environmental characteristics of the structure and the lines, as well as on lightning ground strike-point density in the region where the structure and the lines are located. Guidance on the assessment of the number of lightning flashes influencing the structure is given in Annex A.

The probability of damage depends on the structure, the resistibility of equipment located on the structure, the connected lines, and the lightning current characteristics, as well as on the type and efficiency of the protection measures applied. Guidance on the assessment of probability of damage is given in Annex B.

The annual mean extent of the consequential loss depends on the extent of damage and the consequential effects which can occur as a result of a lightning flash. Guidance on the assessment of consequential loss is given in Annex C.

The effect of protection measures results from the characteristics of each protection measure and can reduce the damage probabilities.

NOTE 4 It is assumed that protective provisions are realized in the necessary quality.

The protection measures are intended to comply with the IEC 62305 series, the IEC 61643 series and IEC 62793, as applicable.

NOTE 5 For complex structures (such as petrochemical plants, large industrial plants) the factors reported in the annexes of this document can require more detailed evaluation of the characteristics of the structure.

National or local regulations can provide guidance or minimum requirements on the application of this document. This includes fixing the values for the tolerable risk R_T and the tolerable frequency of damage F_T, and the calculation rules and parameter values given in Annex A, Annex B, Annex C and Annex E.

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PROTECTION AGAINST LIGHTNING –

Part 2: Risk management

1 Scope

This part of IEC 62305 is applicable to the risk management of a structure due to lightning flashes to earth.

Its purpose is to provide a procedure for the evaluation of such a risk. Once an upper tolerable limit for the risk has been selected, this procedure provides a means for the selection of appropriate protection measures to be adopted to reduce the risk to or below the tolerable limit.

Risk management also includes the evaluation of frequency of damage of internal systems caused by surges due to lightning flashes to earth. Once an upper tolerable limit for the frequency of damage has been selected, this procedure provides a means for the selection of appropriate protection measures to be adopted to reduce the frequency of damage to or below the tolerable limit.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61643 (all parts), *Low-voltage surge protective devices*

IEC 62305-1:2024 , *Protection against lightning – Part 1: General principles*

IEC 62305-3:2024, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

IEC 62305-4:2024, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

IEC 62793, *Thunderstorm warning systems – Protection against lightning*

IEC 62858, *Lightning density based on lightning location systems (LLS) – General principles*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

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3.1
structure to be protected
any place, facility or building suitable to contain persons, animals, materials or systems

Note 1 to entry: A structure to be protected can be part of a larger structure.

3.2
structure with a risk of explosion
structures associated with hazardous areas as determined in accordance with IEC 60079-10-1 [3] and IEC 60079-10-2 [4] or solid explosive materials

Note 1 to entry: IEC 60079-10-1 and IEC 60079-10-2 do not deal with the hazards from solid explosives.

3.3
structure dangerous to the environment
structure which can cause biological, chemical or radioactive emission as a consequence of lightning

EXAMPLE Chemical, petrochemical plants.

3.4
urban environment
area with a high density of buildings or densely populated communities with tall buildings

EXAMPLE Town centre.

3.5
suburban environment
area with a medium density of buildings

EXAMPLE Town outskirts, residential communities.

3.6
rural environment
area with a low density of buildings

EXAMPLE Countryside.

3.7
rated impulse withstand voltage
U_W
value of the impulse withstand voltage assigned by the manufacturer to the equipment or to a part of it, characterizing the specified withstand capability of its insulation against overvoltages

Note 1 to entry: For the purposes of this document, only the withstand voltage between live conductors and earth is considered.

[SOURCE: IEC 60664-1:2020, 3.1.18 [5], modified – The symbol U_{imp} has been replaced with U_w, in the definition "transient overvoltages" has been replaced with "voltages" and the Note to entry has been added.]

3.8
electrical system
system incorporating low voltage power supply components

3.9
electronic system
system incorporating sensitive electronic components such as telecommunication equipment, computer, control and instrumentation systems, radio systems, power electronic installations

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3.10
internal systems
electrical and electronic systems of a structure

3.11
line
power line or telecommunication line connected to the structure to be protected

3.12
telecommunication line
line intended for communication between equipment that can be located in separate structures

EXAMPLE Phones lines, data lines.

3.13
power line
distribution line feeding electrical energy into a structure to power electrical and electronic equipment located there

EXAMPLE Low voltage (LV) or high voltage (HV) electric mains.

3.14
dangerous event
lightning flash to or near the structure to be protected, or to or near a line connected to the structure to be protected that can cause damage

3.15
lightning flash to a structure
lightning flash striking a structure to be protected

3.16
lightning flash near a structure
lightning flash striking close enough to a structure to be protected that can cause dangerous overvoltages

3.17
lightning flash to a line
lightning flash striking a line connected to the structure to be protected

3.18
lightning flash near a line
lightning flash striking close enough to a line connected to the structure to be protected that can cause dangerous overvoltages

3.19
ground flash density
N_G
mean number of cloud-to-ground flashes per unit of area per unit of time (flashes × km^{-2} × $year^{-1}$)

Note 1 to entry: Lightning flashes to ground can have more than one striking point to ground.

3.20
lightning ground strike-point density
N_{SG}
mean number of strike-points to ground or to ground based objects per unit of area per unit of time (strike-points × km^{-2} × $year^{-1}$)

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3.21
number of dangerous events due to flashes to a structure
N_D
expected average annual number of dangerous events due to lightning flashes to a structure

3.22
number of dangerous events due to flashes to a line
N_L
expected average annual number of dangerous events due to lightning flashes to a line

3.23
number of dangerous events due to flashes near a structure
N_M
expected average annual number of dangerous events due to lightning flashes near a structure

3.24
number of dangerous events due to flashes near a line
N_I
expected average annual number of dangerous events due to lightning flashes near a line

3.25
lightning electromagnetic pulse
LEMP
Fast time-varying electromagnetic field emitted by lightning and creating surges via resistive, inductive, capacitive and electromagnetic coupling to circuits

3.26
surge
transient created by lightning electromagnetic pulse (LEMP) coupled onto lines and equipment, that appears as an overvoltage or overcurrent

3.27
node
point on a line from which onward surge propagation can be assumed to be neglected

EXAMPLE A power HV substation for a power line, a telecommunication exchange for a telecommunication line.

3.28
physical damage
damage to a structure (or to its contents) due to mechanical, thermal, chemical or explosive effects of lightning

3.29
injury to human beings
injuries, including loss of life, to people resulting from lightning

Note 1 to entry: Animals are addressed by frequency of damage or loss L2.

3.30
failure of internal systems
damage of electrical and electronic systems due to LEMP

3.31
probability of damage
P
probability that a dangerous event will cause damage in the considered zone or to internal system of the structure to be protected

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3.32
frequency of damage
F
value of the annual number of damaging events which can occur to internal systems of the structure to be protected

3.33
frequency of damage component
F_X
partial frequency of damage depending on the source of damage

3.34
tolerable frequency of damage
F_T
maximum value of the frequency of damage which can be tolerated by equipment inside the structure or a zone to be protected

3.35
loss
L_X
mean extent of a specified type of damage consequent to a dangerous event, in the considered zone of a structure

3.36
service
function performed by the internal systems of the structure to supply a specific need

3.37
risk
R
probable average annual loss due to lightning in a structure or in a considered zone of the structure

3.38
risk component
R_X
partial risk depending on the source and the type of damage

3.39
tolerable risk
R_T
maximum value of the risk which can be tolerated for the structure to be protected

3.40
risk zone
Z_X
<of a structure> part of a structure with homogeneous characteristics where a single set of parameters is applicable to the risk assessment

Note 1 to entry: A structure can contain one or more zones.

3.41
section of a line
S_L
part of a line with homogeneous characteristics where a single set of parameters is involved for that part of the line in the assessment of a risk or frequency of damage component

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3.42
lightning protection zone
LPZ
zone where the lightning electromagnetic environment is defined

Note 1 to entry: The zone boundaries of an LPZ are not necessarily physical boundaries.

3.43
lightning protection level
LPL
number related to a set of lightning current parameters values relevant to the probability that the associated maximum and minimum design values will not be exceeded in naturally occurring lightning

Note 1 to entry: Lightning protection level is used to design protection measures according to the relevant set of lightning current parameters.

3.44
protection measures
measures adopted in the structure to be protected, in order to reduce the risk or frequency of damage

3.45
lightning protection
LP
measures taken for protection of structures against lightning, including their internal systems and contents, as well as persons, in general consisting of an LPS and SPM

Note 1 to entry: Ancillary protection measures such as a TWS can also be used.

3.46
lightning protection system
LPS
complete system used to reduce injury to living beings and physical damage due to lightning flashes to a structure

Note 1 to entry: A lightning protection system consists of both external and internal lightning protection systems.

3.47
surge protection measures
SPM
measures taken to protect internal systems against the effects of LEMP

Note 1 to entry: Surge protection measures are part of an overall lightning protection.

3.48
electromagnetic shield
screen of conductive material intended to reduce the penetration of a time-varying electromagnetic field into the structure or part of the structure to be protected, used to reduce failures of internal systems

3.49
lightning protective cable
special cable with a rated impulse withstand voltage greater than U_w of the connected equipment and a metallic sheath in continuous contact with the soil, either directly or by use of conductive plastic covering

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3.50
lightning protective cable-duct
cable-duct of low resistivity in contact with the soil

EXAMPLE Concrete with interconnected structural steel reinforcements, metallic duct.

3.51
surge protective device
SPD
device that contains at least one non-linear component and that is intended to limit transient overvoltages and divert surge currents

[SOURCE: IEC 61643-11:2011, 3.1.1 [6], modified – "surge voltages" has been replaced with "transient overvoltages and the Note has been deleted.]

3.52
coordinated SPD system
system composed of SPDs properly selected, coordinated and installed to form a system intended to reduce the failures of electrical and electronic systems

3.53
isolating interface
device which is capable of reducing conducted surges on a line entering the lightning protection zone (LPZ)

Note 1 to entry: The isolating interface includes isolation transformers with earthed screen between windings, metal-free fibre optic cables and opto-isolators.

Note 2 to entry: The insulation withstand characteristics of a device suitable for this application is provided either intrinsically or via an SPD.

3.54
lightning equipotential bonding
EB
bonding to an LPS of separated metallic parts, by direct conductive connections or via surge protective devices, to reduce potential differences caused by lightning current

3.55
thunderstorm warning system
TWS
system composed of thunderstorm detector(s) able to monitor the lightning or upcoming lightning activity in the monitoring area (MA) and tools for processing the acquired data to provide a valid alarm (warning) related to the lightning-related events (LREs) or conditions (LRC) for a defined surrounding area (SA)

Note 1 to entry: Some countries refer to TWS as 'lightning warning systems'.

[SOURCE: IEC 62793:2020, 3.1.23]

3.56
lightning-related event
LRE
event where one or more cloud-to-ground lightning (CG) occurs inside the surrounding area (SA)

[SOURCE: IEC 62793:2020, 3.1.15]

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3.57
lightning-related conditions
LRC
static electric field that has reached a level high enough so that lightning is expected to occur at any time in the surrounding area (SA)

[SOURCE: IEC 62793:2020, 3.1.16]

3.58
monitoring area
MA
geographic area where the lightning or upcoming lightning (lightning is expected to occur at any time) activity is monitored in order to provide a valid warning for the surrounding area (SA)

Note 1 to entry: The monitoring area is smaller or equal to the coverage area.

[SOURCE: IEC 62793:2020, 3.1.18]

3.59
surrounding area
SA
geographic area in which a lightning-related event (LRE) causes a potential danger and which surrounds and includes the target (TA) to be protected

Note 1 to entry: Any lightning-related event (LRE) occurring in the surrounding area (SA) is potentially dangerous for the target. This area is used when evaluating a thunderstorm warning system (TWS) to determine the performance parameters such as failure to warn ratio (FTWR).

[SOURCE: IEC 62793:2020, 3.1.20]

3.60
Zone 0
area in which an explosive gas atmosphere is present continuously, or for long periods, or frequently

Note 1 to entry: Both “long” and “frequently” are the terms which are intended to describe a very high likelihood of a potentially explosive atmosphere in the area. In that respect, those terms do not necessarily need to be quantified.

[SOURCE: IEC 60079-10-1:2020, 3.3.4 [3]]

3.61
Zone 1
area in which an explosive gas atmosphere is likely to occur occasionally in normal operation

[SOURCE: IEC 60079-10-1:2020, 3.3.5 [3]]

3.62
Zone 2
area in which an explosive gas atmosphere is not likely to occur in normal operation, but, if it does occur, will exist for a short period only

[SOURCE: IEC 60079-10-1:2020, 3.3.6 [3]]

3.63
Zone 20
a place in which an explosive dust atmosphere, in the form of a cloud of dust in air, is present continuously, or for long periods, or frequently

[SOURCE: IEC 60079-10-2:2015, 3.25.1 [4]]

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3.64
Zone 21
a place in which an explosive dust atmosphere, in the form of a cloud of dust in air, is likely to occur in normal operation occasionally

[SOURCE: IEC 60079-10-2:2015, 3.25.2 [4]]

3.65
Zone 22
area in which an explosive dust atmosphere, in the form of a cloud of combustible dust in air, is not likely to occur in normal operation but, if it does occur, will persist for a short period only

Note 1 to entry: The potential of creating an explosive dust cloud from a dust layer also needs to be considered.

[SOURCE: IEC 60079-10-2:2015, 3.25.3 [4]]

3.66
adjacent structure
structure connected to the structure under review by at least one line

4 Symbols and abbreviated terms

A_D	Equivalent collection area for flashes to an isolated structure	A.2.1.2
A_D'	Collection area attributed to an elevated roof protrusion	A.2.1.3
A_{DJ}	Equivalent collection area for flashes to an adjacent structure	A.2.5
A_I	Equivalent collection area for flashes near a line	Clause A.5
A_L	Equivalent collection area for flashes to a line	Clause A.4
A_M	Equivalent collection area for flashes striking near the structure	Clause A.3
B	Building	A.2.2
C_D	Location factor	Table A.1
C_{DJ}	Location factor of an adjacent structure	A.2.5, Table A.1
C_E	Environmental factor	Table A.4
C_I	Installation factor of the line	Table A.2
C_{LD}	Factor depending on shielding, grounding and isolation conditions of the line for flashes to a line	Table B.9
C_{LI}	Factor depending on shielding, grounding and isolation conditions of the line for flashes near a line	Table B.9
C_T	Line type factor for a HV/LV transformer on the line	Table A.3
D_{1D}	Electric shock resulting from direct strike to human beings	5.2
D_{1T}	Electric shock to human beings resulting from resistive and inductive coupling	5.2
D_2	Dangerous sparking triggering fire or explosion.	5.2
D_3	Surges due to all sources of damage	5.2
F	Frequency of damage	9.1
F_C	Frequency of damage due to flashes to the structure (source S_1)	9.1
F_M	Frequency of damage due to flashes near the structure (source S_2)	9.1
F_T	Tolerable frequency of damage	9.3

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F_W Frequency of damage due to flashes to the line (source S_3) 9.1

F_Z Frequency of damage due to flashes near the line (source S_4) 9.1

H Height of the structure A.2.1.2

k Factor relating N_G to N_{SG} ..... Clause A.1

K_{S1} Factor relevant to the screening effectiveness of the structure ..... Clause B.6

K_{S2} Factor relevant to the screening effectiveness of shields internal to the structure ..... Clause B.6

K_{S3} Factor relevant to the characteristics of internal wiring ..... Clause B.6

L Length of structure A.2.1.2

L_1 Loss due to injury to human beings 5.3

L_2 Loss due to physical damage to the structure and its content 5.3

L_3 Loss due to failure of electrical and electronic systems 5.3

L_{AD} Loss related to injury to human beings by electric shock resulting from direct strike to those human beings (flashes to a structure) ..... Table 3, Clause C.2

L_{AT} Loss related to injury to human beings by electric shock resulting from resistive and inductive coupling (flashes to a structure) ..... Table 3, Clause C.2

L_{B1} Loss related to injury to human beings caused by physical damage to a structure (flashes to a structure) ..... Table 3, Clause C.2

L_{B2} Loss related physical damage to a structure (flashes to a structure) Table 3, Clause C.2

L_{BT} Total loss related to physical damage of the structure including environmental damage (flashes to a structure) ..... Clause C.2

L_{C1} Loss related to injury to human beings, caused by failure of internal systems (flashes to a structure) ..... Table 3, Clause C.2

L_{C2} Loss related to failure of internal systems (flashes to a structure) ..... Table 3, Clause C.2

L_D Typical mean ratio of persons injured by direct lightning stroke related to the total number of persons exposed in the zone, due to one dangerous event .... Clause C.2

L_E Typical mean ratio of loss outside the structure related to the maximum amount of loss in the zone, due to one dangerous event ..... Clause C.2

L_{F1} Typical mean ratio of persons injured by fire or explosion related to the total number of persons in the zone, due to one dangerous event ..... Clause C.2

L_{F2} Typical mean ratio of physical damage by fire or explosion related to the maximum amount of damage in the zone, due to one dangerous event ..... Clause C.2

L_L Length of line section ..... Clause A.4

L_{M1} Loss related to injury to human beings, caused by failure of internal systems (flashes near a structure) ..... Table 3, Clause C.2

L_{M2} Loss related to failure of internal systems (flashes near a structure) . Table 3, Clause C.2

L_{O1} Typical mean ratio of persons injured by failure of internal systems related to the total number of persons in the zone, due to one dangerous event ..... Clause C.2

L_{O2} Typical mean ratio of physical damage by failure of internal systems related to the maximum amount of damage in the zone, due to one dangerous event .... Clause C.2

L_T Typical mean ratio of persons injured by touch and step voltages related to the total number of persons in the zone, due to one dangerous event ..... Clause C.2

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L_{UT} Loss related to injury to human beings by electric shock resulting from resistive and inductive coupling (flashes to a line)..... Clause C.2

L_{V1} Loss related to injury to human beings, caused by physical damage to a structure (flashes to a line) ..... Clause C.2

L_{V2} Loss related to physical damage to a structure (flashes to a line) ..... Clause C.2

L_{VT} Total loss related to physical damage of the structure including environmental damage (flashes to a line)..... Clause C.2

L_{W1} Loss related to injury to human beings caused by failure of internal systems (flashes to a line)..... Clause C.2

L_{W2} Loss related to failure of internal systems (flashes to a line) ..... Clause C.2

L_X Loss consequent to damages.....8.1

L_{Z1} Loss related to injury to human beings, caused by failure of internal systems (flashes near a line)..... Clause C.2

L_{Z2} Loss related to failure of internal systems (flashes near a line) ..... Clause C.2

n' Number of conductors in a cable.....Table B.7

n Total number of cable conductors and external conducting paths.....Table B.7

N_D Number of dangerous events per year due to flashes to structure..... ..... A.2.4

N_{DJ} Number of dangerous events due to flashes to adjacent structure..... A.2.5

N_G Annual lightning ground flash density.....Clause A.1

N_I Number of dangerous events due to flashes near a line ..... Clause A.5

N_L Number of dangerous events due to flashes to a line ..... Clause A.4

N_M Number of dangerous events due to flashes near a structure.....Clause A.3

N_{SG} Annual lightning ground strike-point density .....Clause A.1

N_X Number of dangerous events per annum.....8.1, 9.2

P_{AD} Probability that a flash to a structure will strike a person.....Clause B.3

P_{am} Probability that a flash to a structure will cause injury to human beings due to touch and step voltages .....Clause B.2

P_{AT} Probability that a flash to a structure will cause dangerous touch and step voltages .....Clause B.2

P_B Probability of physical damage to a structure (flashes to a structure).....Clause B.4

P_C Probability of failure of internal systems (flashes to a structure).....Clause B.5

P_e Probability that an equipment will be exposed to a damaging event .....Clause B.12

P_{EB} Probability that a spark between electrically-isolated conductive sections could appear in spite of protection by EB .....Clause B.7, Table B.13

P_{LD} Probability reducing P_U, P_V and P_W depending on-line characteristics and withstand voltage of equipment (flashes to connected line) .....Clause B.7

P_{LPS} Probability depending on LPL of lightning protection system (LPS) .....Clause B.3

P_M Probability of failure of internal systems (flashes near a structure).....Clause B.6

P_{MS} Probability reducing P_M depending on shielding, wiring and withstand voltage of equipment.....Clause B.6

P_O Probability factor according to the position of a person in the exposed area ...Clause B.3

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P_P Probability that a person will be in a dangerous place ..... Clause B.11

P_Q Probability that the value of the charge associated with the current flowing through the SPD is exceeding the value tolerated by the SPD ..... Annex D

P_S Probability that a flash to a structure will cause dangerous sparking ..... Clause B.4

P_{SPD} Probability that an apparatus will be damaged, in spite of protection by a coordinated SPD system..... ..... Table B.8, Table B.9

P_{TWS} Probability that a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area ..... Clause B.1

P_U Probability of injury to human beings by electric shock (flashes to a connected line) ..... Clause B.7

P_{Up} Probability that the value of residual voltage at the SPD exceeds the required protection level U_p, relevant to the current flowing through the SPD..... ..... Annex D

P_V Probability of physical damage to a structure (flashes to a connected line) .... Clause B.8

P_W Probability of failure of internal systems (flashes to connected line) ..... Clause B.9

P_X Probability of damage 8.1, 9.2

P_Z Probability of failure of internal systems (flashes near a connected line) ..... Clause B.10

r_f Factor reducing loss depending on risk of fire ..... Clause B.4

r_M Conventional distance ..... Clause A.3, Clause A.5

r_p Factor reducing the loss due to provisions against fire ..... Clause B.4

r_t Reduction factor associated with the type of surface ..... Clause B.2

R Risk 6.1, 6.3.1, 6.3.2

R_{AD} Risk component (injury caused by a flash to human beings exposed on a structure – flashes to a structure)..... 6.2.1, Table 2, Table 3

R_{AT} Risk component (injury to human beings caused by electric shock due to touch and step voltages – flashes to a structure) ..... 6.2.1, Table 2, Table 3

R_B Risk component (physical damage to a structure – flashes to a structure) ..... 6.2.1, Table 2, Table 3

R_C Risk component (failure of internal systems – flashes to a structure) ..... 6.2.1, Table 2, Table 3

R_M Risk component (failure of internal systems – flashes near a structure) ..... 6.2.2, Table 2, Table 3

R_S Shield resistance per unit length of a cable ..... Table B.12, Table B.13

R_T Tolerable risk 7.3

R_U Risk component (injury to human being – flashes to a connected line) ..... 6.2.3, Table 2, Table 3

R_V Risk component (physical damage to a structure – flashes to a connected line) ..... 6.2.3, Table 2, Table 3

R_W Risk component (failure of internal systems – flashes to a connected line) ..... 6.2.3, Table 2, Table 3

R_X Risk component for a structure 8.1

R_Z Risk component (failure of internal systems – flashes near a line) 6.2.4, Table 2, Table 3

S Structure A.2.2

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S2 Source of damage – Flashes near a structure ..... 5.1, Table 3
S3 Source of damage – Flashes to a line ..... 5.1, Table 3
S4 Source of damage – Flashes near a line ..... 5.1, Table 3
S_L Section of a line 8.4
t_z Time in hours per year that persons are present in a dangerous place ..... Clause B.11
U_W Rated impulse voltage of a system ..... Clause A.3, Clause A.5, Clause B.7
w_m Mesh width ..... Clause B.6
W Width of structure A.2.1.2
X Generic subscript for risk component, number of dangerous events, probability and loss 8.1, 9.2
Z_S Zones of a structure 8.3

5 Damage and loss

5.1 Source of damage

The lightning current is the primary source of damage. Details relating to lightning currents and lightning properties shall be taken into consideration, in accordance with IEC 62305-1:2024. The following sources are distinguished by the point of strike:

S1: flashes to the structure,

S2: flashes near the structure,

S3: flashes to a line connected to the structure,

S4: flashes near a line connected to the structure.

5.2 Cause of damage

A lightning flash can cause damage in different ways depending on the characteristics of the structure being assessed. Some of the most important characteristics are: type of construction, contents and application, type of service and protection measures provided. Physical damage to structures and life hazards shall be taken into consideration, in accordance with IEC 62305-3:2024.

As a result, four causes of damage can be distinguished:

– D_{1D}: electric shock to human beings resulting from direct strike to those beings;

– D_{1T}: electric shock to human beings resulting from resistive and inductive coupling;

– D_2: dangerous sparking inside the structure either triggering fire or explosion or leading to mechanical and chemical effects, or both, which can also endanger the environment;

– D_3: surges due to all sources of damage causing failures of internal systems.

The damage to a structure due to lightning can be limited to a part of the structure or can extend to the entire structure. It can also involve surrounding structures or the environment (structures dangerous to the environment).

5.3 Type of loss

Each cause of damage relevant to a structure to be protected, alone or in combination with others, can produce different types of loss. The type of loss that can appear depends on the characteristics of the structure itself.

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For the purposes of this document, the following types of loss, which can appear as a consequence of lightning flashes, are considered:

L_1: loss due to injury to human beings. It is a consequence of causes D_{1D}, D_{1T}, D_2 and even D_3 in structures where failure of internal systems endangers human life for example in structures with a risk of explosion and hospitals;

L_2: loss due to physical damage of the structure and its contents. It is a consequence of causes D_2 and D_3 (D_3 generally for structures with a risk of explosion);

L_3: loss due to failure of internal systems. It is a consequence of cause D_3.

NOTE 1 L_3 does not address physical damage to an internal system. It is focused on surges affecting the function provided by the internal system.

The risk calculation is applicable to all structures when types of loss L_1 or L_2 are involved.

The type of loss L_3 can unacceptably impair the services provided by internal systems of the structure. In this case the frequency of damage calculation is performed in addition to the risk calculation. Frequency of damages can cover pure economic losses or loss of service. When damage to internal systems implies consequences for the environment or involves safety related critical equipment, consequence of losses should be addressed by risk calculation and not frequency of damage. Protection against lightning for electrical and electronic systems within structures shall be taken into consideration, in accordance with IEC 62305-4:2024 and the IEC 61643 series.

NOTE 2 Loss of national heritage is covered by loss L_2, loss of service to the public is covered by F and L_2/L_3.

6 Risk and risk components

6.1 Risk

The risk R shall be evaluated with reference to the safety of persons (type of loss L_1) and of the structure and its content (type of loss L_2).

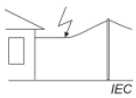
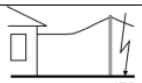
To evaluate risk R, the risk components (partial risks depending on the source of damage and type of loss) shall be defined and calculated (see Table 1).

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Table 1 – Sources of damage, causes of damage, types of loss and risk components according to the point of strike

Point of strike		Source of damage	Cause of damage	Type of loss	Risk component
The structure		S1	D_{1T}	L_1	R_{AT}
			D_{1D} [c]	L_1	R_{AD}
			D_2	L_1, L_2	R_{B1}, R_{B2}
			D_3	L_1 [a], L_2 [b]	R_{C1}, R_{C2}
Near the structure		S2	D_3	L_1 [a], L_2 [b]	R_{M1}, R_{M2}
The lines connected to the structure		S3	D_{1T}	L_1	R_U
			D_2	L_1, L_2	R_{V1}, R_{V2}
			D_3	L_1 [a], L_2 [b]	R_{W1}, R_{W2}
Near the lines connected to the structure		S4	D_3	L_1 [a], L_2 [b]	R_{Z1}, R_{Z2}

Risk components in the last column are calculated based on the type of losses considered (see column Type of loss).

[a] Generally for structures where failure of internal systems endangers human life for example in structures with risk of explosion and hospitals.

[b] Generally for structures with a risk of explosion.

[c] This is only for people exposed on a structure such as parking on a roof or terrace, balconies.

Some examples of risk calculations are reported in Annex F.

6.2 Risk components

6.2.1 Risk components for a structure due to source S1

R_{AT}: Component related to type of loss L_1, caused by electric shock to human beings due to touch and step voltages inside the structure and outside in zones up to 3 m around down conductors.

R_{AD}: Component related to type of loss L_1, caused by a flash to human beings exposed on a structure.

R_B: Component related to type of loss L_1 (R_{B1}) and L_2 (R_{B2}), caused by dangerous sparking inside the structure triggering fire or explosion, or leading to mechanical or chemical effects, which can also endanger the environment.

R_C: Component related to type of loss L_1 (R_{C1}) and L_2 (R_{C2}), caused by failure of internal systems because of LEMP. Loss can occur generally in the case of structures with a risk of explosion and of hospitals or other structures where failure of internal systems involve injury to human beings or danger to the environment.

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6.2.2 Risk component for a structure due to source S2

R_M: Component related to type of loss L_1 (R_{M1}) and L_2 (R_{M2}), caused by failure of internal systems due to LEMP. Loss can occur in the case of structures with a risk of explosion and of hospitals or other structures where failure of internal systems involve injury to human beings or danger to the environment.

6.2.3 Risk components for a structure due to source S3

R_U: Component related to type of loss L_1, caused by electric shock to human beings due to touch voltages inside the structure.

R_V: Component related to type of loss L_1 (R_{V1}) and L_2 (R_{V2}), caused by fire or explosion (triggered by dangerous sparking between an external installation and metallic parts generally at the entrance point of the line into the structure) or leading to mechanical or chemical effects, due to lightning current transmitted through or along incoming lines.

R_W: Component related to type of loss L_1 (R_{W1}) and L_2 (R_{W2}), caused by failure of internal systems by overvoltages induced on incoming lines and transmitted to the structure. Loss can occur generally in the case of structures with a risk of explosion and of hospitals or other structures where failure of internal systems involve injury to human beings or danger to the environment.

NOTE 1 All lines which are connected to the structure are considered in the assessment.

NOTE 2 Lightning flashes to or near metallic pipes are considered as a source of damage unless the pipes are bonded to an equipotential bonding bar or the LPS earthing system at the entrance of the structure.

6.2.4 Risk component for a structure due to source S4

R_Z: Component related to type of loss L_1 (R_{Z1}) and L_2 (R_{Z2}), caused by failure of internal systems by overvoltages induced on incoming lines and transmitted to the structure. Loss can occur generally in the case of structures with a risk of explosion and of hospitals or other structures where failure of internal systems involve injury to human beings or danger to the environment.

NOTE 1 All lines which are connected to the structure are considered in the assessment.

NOTE 2 Lightning flashes to or near metallic pipes are considered as a source of damage unless the pipes are bonded to an equipotential bonding bar or the LPS earthing system at the entrance of the structure.

6.2.5 Factors affecting risk components for a structure

Characteristics of the structure, possible protection measures and provisions taken when a thunderstorm occurs are factors affecting risk components for a structure. The main factors are given in Table 2.

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Table 2 – Factors influencing the risk components

Characteristics of structure or of internal systems – Protection measures	R_{AT} [h]	R_{AD} [h]	R_B [h]	R_C [h]	R_M	R_U	R_V	R_W	R_Z
Collection area	X	X	X	X	X	X	X	X	X
Surface soil resistivity	X								
Floor resistivity	X					X			
Physical restrictions, insulation, warning notice, soil equipotentialization	X					X			
Construction characteristics of structure	X		X						
LPS	X	X	X	X	X[a]	X[b]	X[b]		
Equipotential bonding SPD	X		X			X	X		
Isolating interfaces				X[c]	X[c]	X	X	X	X
Coordinated SPD system[f]				X	X			X	X
Spatial shield				X	X				
Shielding external lines						X	X	X	X
Shielding internal lines				X	X				
Routing precautions				X	X				
Bonding network				X					
Fire precautions			X				X		
Fire sensitivity			X				X		
Impulse withstand voltage				X	X	X	X	X	X
Thunderstorm warning systems[g]	X[d]	X[e]		X	X	X[e]	X[e]	X[e]	X[e]
Presence of people	X	X	X	X	X	X	X	X	X

NOTE Equipment is usually connected to two different services e.g. power line and data line. In case of equipment connected only to one service, the result can overestimate the risk.

[a] Only for grid-like external LPS acting as a shield (see KS1 factor in Annex B).

[b] Due to equipotential bonding.

[c] Only if they belong to equipment.

[d] Only for external risk zones according to provisions activated by means of a thunderstorm warning system (TWS) compliant with IEC 62793. A TWS shall always be active and running and should send a message in case of fault.

[e] According to provisions activated by means of a thunderstorm warning system (TWS) compliant with IEC 62793.

[f] Mainly for structures where failure of internal systems endangers human life for example in structures with a risk of explosion and hospitals.

[g] The provisions taken shall be appropriate for the case investigated.

[h] When source of damage S1 is considered, protection measures are effective only in structures protected by an LPS or structures with continuous metal or reinforced concrete framework acting as a natural LPS.

6.3 Composition of risk components

6.3.1 Composition of risk components according to source of damage

The risk R is the sum of its risk components according to the source of damage or type of loss.

$$R = R_{S1} + R_{S2} + R_{S3} + R_{S4} \quad (1)$$

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where

$$R_{S1} = R_{AT} + R_{AD} + R_{B1} + R_{B2} + R_{C1} + R_{C2} \quad (2)$$

$$R_{S2} = R_{M1} + R_{M2} \quad (3)$$

$$R_{S3} = R_{U} + R_{V1} + R_{V2} + R_{W1} + R_{W2} \quad (4)$$

$$R_{S4} = R_{Z1} + R_{Z2} \quad (5)$$

R_{C1}, R_{M1}, R_{W1} and R_{Z1} generally apply for structures with a risk of explosion and for hospitals with life-saving electrical equipment or other structures when failure of internal systems involve injury to human beings or danger to the environment.

R_{C2}, R_{M2}, R_{W2} and R_{Z2} generally apply for structures with a risk of explosion.

NOTE 1 An analysis can justify that an equipment damaged by an overvoltage can create a fire or explosion inside the building. In this case, the relevant risk components can also be evaluated in the risk assessment.

NOTE 2 The value of risk R obtained by adding the two risk components R_M and R_Z is overestimated. In power internal systems the risk component R_M is usually negligible. A more accurate assessment of risk can be made by taking into account that a flash to ground simultaneously has influence on internal systems by direct inductive coupling and on the overvoltage induced on the connected lines. The effect is that components R_M and R_Z can overlap.

6.3.2 Composition of risk components according to type of loss

$$R = R_{L1} + R_{L2} \quad (6)$$

where

$$R_{L1} = R_{AT} + R_{AD} + R_{B1} + R_{C1} + R_{M1} + R_{U} + R_{V1} + R_{W1} + R_{Z1} \quad (7)$$

$$R_{L2} = R_{B2} + R_{C2} + R_{M2} + R_{V2} + R_{W2} + R_{Z2} \quad (8)$$

R_{C1}, R_{M1}, R_{W1} and R_{Z1} generally apply for structures with a risk of explosion and for hospitals with life-saving electrical equipment or other structures when failure of internal systems involve injury to human beings or danger to the environment.

R_{C2}, R_{M2}, R_{W2} and R_{Z2} mainly apply for structures with a risk of explosion.

NOTE 1 An analysis can justify that an equipment damaged by an overvoltage can create a fire or explosion inside the building. In this case, the relevant risk components can also be evaluated in the risk assessment.

NOTE 2 The value of risk R obtained by adding the two risk components R_M and R_Z is overestimated. In power internal systems the risk component R_M is usually negligible. A more accurate assessment of risk can be made by taking into account that a flash to ground simultaneously has influence on internal systems by direct inductive coupling and on the overvoltage induced on the connected lines. The effect is that components R_M and R_Z can

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NOTE 3 Equations (7) and (8) provide the means of separately assessing the contribution of the risk of loss of human life and of the risk of loss of goods and services to the overall risk.

7 Risk assessment

7.1 Basic procedure

The following procedure shall be applied:

– identification of the structure to be assessed and its characteristics;
– evaluation of risk R.

7.2 Structure to be considered for risk assessment

The structure to be considered includes:

– the structure itself;
– installations in the structure;
– contents of the structure;
– persons in the structure, on the roof of the structure or in the zones up to 3 m from the outside of the structure;
– environment affected by damage to the structure.

Lines outside the structure are of relevance only to the extent that they can carry damaging currents into the structure.

NOTE The structure to be considered can be subdivided into several risk zones (see 8.3).

7.3 Procedure to evaluate the need of protection for risk R

Protection against lightning is necessary if the risk R is higher than the tolerable level R_T.

$$R > R_T$$

In this case, protection measures shall be adopted in order to reduce the risk R to no more than the tolerable level R_T.

$$R \leq R_T$$

NOTE 1 A representative value of tolerable risk is $R_T = 10^{-5}$ [year]$^{-1}$. Different values can be assigned after detailed investigation, taking into account the vulnerability of human beings inside and outside the investigated structure and the criticality of the structure and its environment for the public due to physical damage.

NOTE 2 When a risk evaluation is not otherwise required, evaluating whether or not to reduce the risk R can be decided by the owner or the manager of the structure.

NOTE 3 If $R \leq R_T$, lightning protection is not necessary to reduce the risk but can be:

– useful to reduce the frequency of damage of the internal systems (see 9.4);
– appropriate if it is desired to reduce in any way the loss (or the unavailability of services).

The following steps shall be taken to determine whether the risk exceeds the tolerable level:

– identification of the components R_X which make up the risk;
– calculation of the identified risk components R_X;
– calculation of the total risk R (see 6.3);
– comparison of the risk R with the tolerable value R_T.

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If the structure is partitioned in risk zones Z_S (see 8.3), risk R shall be evaluated for each zone Z_S.

Comparison of risk R with R_T shall be performed:

– for each risk zone of the structure in a zoned structure;
– for the whole structure in a single-zoned structure.

The procedure to evaluate the need for protection for risk R is given in Figure 1.

NOTE 4 When source of damage S1 is considered, protection measures are effective only in structures protected by an LPS or structures with continuous metal or reinforced concrete framework acting as a natural LPS.

NOTE 5 The site owner is informed in cases where the risk cannot be reduced to a tolerable level in spite of having applied the most efficient protection measures proposed. If the risk can be significantly reduced by temporary preventive measures, then a TWS according to IEC 62793 can be installed.

An assessment should be made when the damage to a structure due to lightning can also involve surrounding structures or the environment (e.g. fire propagation, explosion, chemical or radioactive emissions).

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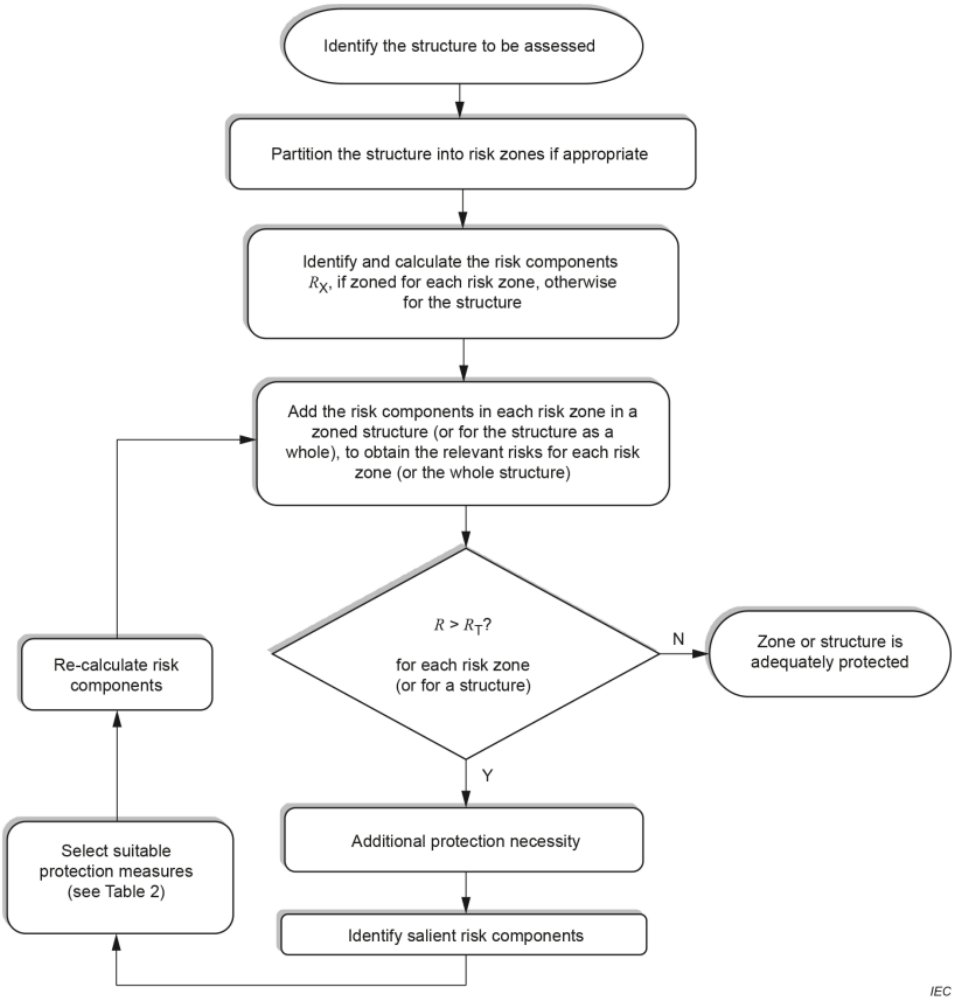


Figure 1 – Procedure for deciding the need for protection and for the selection of protection measures to reduce $R \leq R_T$

8 Assessment of risk components

8.1 Basic equation

Each risk component R_{AT}, R_{AD}, R_B, R_C, R_M, R_U, R_V, R_W and R_Z, as described in Table 3, can be expressed by the following general equation:

$$R_X = N_X \times P_X \times L_X \quad (9)$$

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where

N_X is the number of dangerous events per annum (see also Annex A);

P_X is the probability of damage (see also Annex B);

L_X is the extent of consequent loss (see also Annex C).

The number N_X of dangerous events is affected by lightning ground strike-point density (N_{SG}) and by the physical characteristics of the structure to be protected, its surroundings, connected lines and the soil. N_X shall be obtained, as explained in detail in Annex A, mainly from LLS data, where LLS shall comply with IEC 62858.

The probability of damage P_X is affected by characteristics of the structure to be protected, the connected lines, the attendance of persons and the protection measures provided.

The consequent loss L_X is affected by the use to which the structure is assigned.

If the structure is partitioned in risk zones Z_S (see 8.3), each risk component shall be evaluated for each risk zone Z_S.

NOTE When the damage to a structure due to lightning can also involve surrounding structures or the environment (e.g. chemical or radioactive emissions), the consequent loss is added to the value of L_X, or the concept described in Annex E can be used.

8.2 Assessment of risk components due to different sources of damage

Equations to calculate the risk components related to each source of damage are given in Table 3.

The values of the parameters required in making the calculation of risk components can be found in Annex A, Annex B and Annex C.

For evaluation of the risk components related to lightning flashes to an incoming line (S3), the following shall be considered:

– If the line has more than one section (see 8.4), the values of R_U, R_V and R_W are the sum of the R_U, R_V and R_W values relevant to each section of the line. The sections to be considered are those between the structure and the first node. When information of the section lengths is not available, a maximum line length of 1 km for the sum of HV power lines and LV power lines and a maximum line length of 1 km for telecom lines can be assumed.

– In the case of a structure with more than one connected line with different routing feeding the same internal system, the calculations shall be performed for each line.

– In the case of a structure with more than one connected line with the same routing feeding the same apparatus, the calculations shall be performed only for the line leading to the highest values of N_L (telecom line versus power line, unscreened line versus screened line, LV power line versus HV power line with HV/LV transformer, etc.).

NOTE In the case of lines for which there is an overlapping of the collection area, the overlapping area is considered only once.

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For evaluation of the risk component related to lightning flashes near a line connected to the structure (S4), the following shall be considered:

– If the line has more than one section (see 8.4), the value of R_Z is the sum of the R_Z components relevant to each section of the line. The sections to be considered are those between the structure and the first node. When information of the section lengths is not available, a maximum line length of 1 km for the sum of HV power lines and LV power lines and a maximum line length of 1 km for telecom lines can be assumed.
– In the case of a structure with more than one connected line with different routing feeding the same internal system, the calculations shall be performed for each line.
– In the case of a structure with more than one connected line with the same routing feeding the same internal system, the calculations shall be performed only for the line leading to the highest values of N_I (e.g. telecom line versus power line, unscreened line versus screened line, LV power line versus HV power line with HV/LV transformer, etc.).

If the structure is partitioned in risk zones Z_S (see 8.3), each risk component shall be evaluated for each risk zone Z_S.

Table 3 – Risk components for different sources of damage and types of loss

Type of loss	Source of damage			
	S1 Lightning flash to a structure	**S2 Lightning flash near a structure**	**S3 Lightning flash to an (incoming) line**	**S4 Lightning flash near a line**
L_1 Injury to living beings	$R_{AT} = N_D \times P_{AT} \times P_P \times L_{AT}$		$R_U = (N_L + N_{DJ}) \times P_U \times P_P \times L_{UT}$	
	$R_{AD} = N_D \times P_{AD} \times P_P \times L_{AD}$			
	$R_{B1} = N_D \times P_B \times P_P \times L_{B1}$		$R_{V1} = (N_L + N_{DJ}) \times P_V \times P_P \times L_{V1}$	
	$R_{C1} = N_D \times P_C \times P_P \times P_e \times L_{C1}$ See footnote "a".	$R_{M1} = N_M \times P_M \times P_P \times P_e \times L_{M1}$ See footnote "a".	$R_{W1} = (N_L + N_{DJ}) \times P_W \times P_P \times P_e \times L_{W1}$ See footnote "a".	$R_{Z1} = N_I \times P_Z \times P_P \times P_e \times L_{Z1}$ See footnote "a".
L_2 Physical damage	$R_{B2} = N_D \times P_B \times L_{B2}$		$R_{V2} = (N_L + N_{DJ}) \times P_V \times L_{V2}$	
	$R_{C2} = N_D \times P_C \times P_e \times L_{C2}$ See footnote "b".	$R_{M2} = N_M \times P_M \times P_e \times L_{M2}$ See footnote "b".	$R_{W2} = (N_L + N_{DJ}) \times P_W \times P_e \times L_{W2}$ See footnote "b".	$R_{Z2} = N_I \times P_Z \times P_e \times L_{Z2}$ See footnote "b".

[a] R_{C1}, R_{M1}, R_{W1} and R_{Z1} generally apply for structures with a risk of explosion and for hospitals or other structures where failures of internal systems immediately endanger human life.

[b] R_{C2}, R_{M2}, R_{W2} and R_{Z2} generally apply for structures with a risk of explosion.

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8.3 Partitioning of a structure in risk zones Z_S

To assess each risk component, a structure can be (or is assumed to be) a single zone or can be divided into risk zones Z_S each having their own homogeneous characteristics.

Risk zones Z_S are generally defined by:

- type of soil or of floor;
- fireproof compartments;
- spatial shields.

Further risk zones can be defined according to:

- layout of internal systems;
- protection measures existing or to be provided;
- loss L_X values.

Partitioning of the structure in risk zones Z_S should take into account the feasibility of the implementation of the most suitable protection measures.

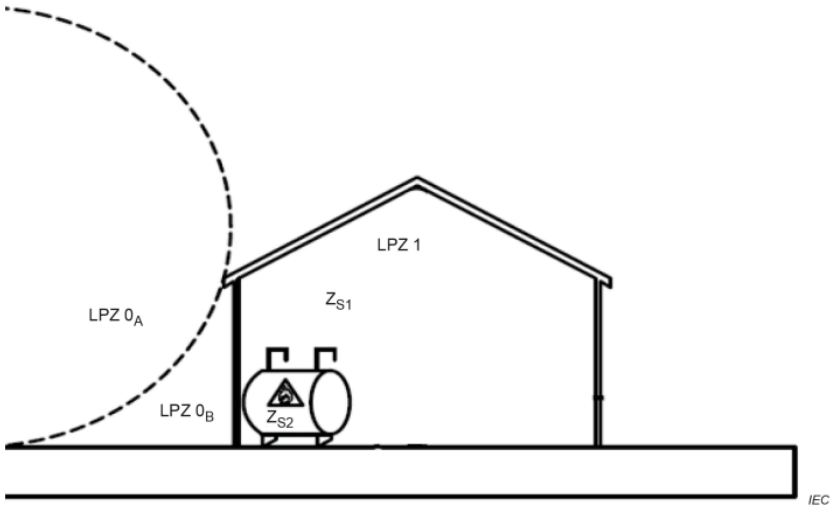
NOTE It is emphasized that the risk zones Z_S are defined by the designer to carry out the risk assessment. They are different from the zones LPZ defined in IEC 62305-1.

An example of zone partitioning is shown in Figure 2.

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Key

LPZ 0_A	direct flash, full lightning current, full electromagnetic field
LPZ 0_B	no direct flash, lightning or induced current, full electromagnetic field
LPZ 1	no direct flash, limited lightning or induced current, damped electromagnetic field H1 present (Zone where the surge current is limited by current sharing and isolating interfaces or by SPDs at the boundary. Spatial shielding can attenuate the lightning electromagnetic field.)
Z_{S1}	example of zone number 1
Z_{S2}	example of zone number 2

Figure 2 – Example of zone partitioning

8.4 Partitioning of a line into sections S_L

To assess the risk components due to a flash to or near a line, the line can be assumed to be a single section or can be divided into individual sections S_L.

For all risk components, sections S_L are primarily defined by

– the type of line (aerial or buried, C_I),

– the characteristics of the line (shielded or unshielded, shield resistance),

– other factors (C_D, C_E, C_T).

If more than one value of a parameter exists in a section, the value leading to the highest value of risk shall be assumed.

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8.5 Assessment of risk components in a zone of a structure with risk zones Z_S

8.5.1 General criteria

For the evaluation of risk components and the selection of the relevant parameters involved, the following rules apply:

– parameters relevant to the number N of dangerous events shall be evaluated according to Annex A;

– parameters relevant to the probability P of damage shall be evaluated according to Annex B.

Moreover:

– for components R_A, R_{B1}, R_{B2}, R_U, R_{V1}, R_{V2}, R_{W1}, R_{W2}, R_{Z1}, and R_{Z2}, only one value shall be fixed in each risk zone for each parameter involved. Where more than one value is applicable, the highest one shall be chosen;

– for components R_{C1}, R_{C2}, R_{M1}, and R_{M2}, if more than one internal system is involved in a risk zone, values of P_C and P_M are given by:

$$P_C = 1 - (1 - P_{C1}) \times (1 - P_{C2}) \times \ldots \times (1 - P_{Cn}) \quad (10)$$

$$P_M = 1 - (1 - P_{M1}) \times (1 - P_{M2}) \times \ldots \times (1 - P_{Mn}) \quad (11)$$

where P_{Cn} and P_{Mn} are parameters relevant to the internal system n = 1, 2, 3...;

– parameters relevant to the loss shall be evaluated according to Annex C.

With the exception made for P_C and P_M, if more than one value of any other parameter exists in a risk zone, the value of the parameter leading to the highest value of risk is to be assumed.

NOTE 1 An internal system is not necessarily connected directly to an external service. For example, it can be connected to a copper power line and to a data line connected via an isolation interface.

NOTE 2 A simpler approach is to use $P_C = P_{C1}$ and $P_M = P_{M1}$ where P_{C1} and P_{M1} refer to the worst case.

8.5.2 Single-zoned structure

In this case, only one risk zone Z_S defines the entire structure. The risk R is the sum of risk components R_X in this risk zone.

Defining the structure with a single risk-zone can lead to a greater expense than necessary if an expensive protection measure shall extend to the entire structure, even though it is not essential throughout the entire structure.

8.5.3 Multi-zoned structure

In this case, the structure is divided into multiple risk zones Z_S. In each risk zone, the risk is the sum of all relevant risk components in the risk zone.

Dividing a structure into risk zones allows the designer to take into account the characteristics of each part of the structure in the evaluation of risk components and to select the most suitable protection measures tailored to each risk zone, reducing the overall cost of protection against lightning.

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9 Frequency of damage and its components

9.1 Frequency of damage

The frequency of damage F is the value of the number of damaging events caused by sources of damage S in the systems of the structure to be protected.

In the evaluation of the need of protection against lightning, the frequency of damage F shall be considered with reference to loss of service L_3.

The frequency of damage F is the sum of partial frequencies of damage depending on the source of damage. For evaluation of the frequency of damage F the following relationship applies:

$$F = F_C + F_M + F_W + F_Z \quad (12)$$

where

F_C is the frequency of damage due to flashes to the structure (source S1);

F_M is the frequency of damage due to flashes near the structure (source S2);

F_W is the frequency of damage due to flashes to the line (source S3);

F_Z is the frequency of damage due to flashes near the line (source S4).

The frequency of damages F_C refers to the failure of internal systems caused by LEMP and earth potential rise due to flashes to the structure, F_M refers to the failure of internal systems caused by LEMP due to flashes to ground near the structure, whereas the frequency of damages F_W and F_Z refers to the failure of internal systems caused by overvoltages transmitted from incoming lines to the structure.

NOTE 1 The value of frequency of damage F obtained by adding the two partial frequencies of damage F_M and F_Z can be overestimated. A more accurate assessment of risk can be made by taking into account that a flash to ground simultaneously has influence on internal systems by direct inductive coupling and on the overvoltage induced on the connected lines. The effect is that partial frequency of damage F_M and F_Z can overlap.

NOTE 2 In power internal systems the frequency component F_M is usually negligible.

NOTE 3 The frequency of damage caused by lightning flashes associated with a structure can be assessed for a piece of equipment. The frequency of damage of an internal system or a part of an internal system is in all cases the one of its weakest equipment amongst equipment the user wants to protect (by default all of them).

9.2 Assessment of partial frequency of damage

Each partial frequency of damage F_C, F_M, F_W and F_Z, as described in 9.1, can be expressed by the following general equation:

$$F_X = N_X \times P_X \quad (13)$$

where

N_X is the number of dangerous events per annum (see also Annex A);

P_X is the probability of damage (see also Annex B);

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Equations to calculate the partial frequency of damage related to each source of damage are given in Table 4.

The values of the parameters required in making the calculation of partial frequency of damage are given in Annex A and Annex B. Where TWSs are involved, as explained in detail in Annex B, these shall comply with IEC 62793.

Table 4 – Partial frequency of damage for each source of damage

Type of loss	Source of damage			
	S1 Lightning flash to a structure	**S2** Lightning flash near a structure	**S3** Lightning flash to an (incoming) line	**S4** Lightning flash near a line
L_3 loss of service due to failure of internal systems	$F_C = N_D \times P_C \times P_e$	$F_M = N_M \times P_M \times P_e$	$F_W = (N_L + N_{DJ}) \times P_W \times P_e$	$F_Z = N_I \times P_Z \times P_e$

9.3 Procedure to evaluate the need of protection for frequency of damage F

Protection against lightning is necessary if the frequency of damage F is higher than the tolerable level F_T

$$F > F_T$$

In this case, protection measures should be adopted in order reduce the frequency of damage F to no more than the tolerable level F_T

$$F \leq F_T$$

NOTE 1 A representative value of tolerable risk F_T is F_T = 0,1 [year]$^{-1}$ for internal systems critical in performing their function in relation to the required service unavailability, and F_T = 1 [year]$^{-1}$ for non-critical internal systems. The values F_T = 0,1 and F_T = 1 proposed in this document are typical values of tolerable frequency of damage.

NOTE 2 The criticality of the internal systems to perform their function (in relation to the service unavailability that can be tolerated) is considered by the owner or manager of the structure when fixing the F_T value.

NOTE 3 If $F \leq F_T$, lightning protection is not necessary to reduce frequency of damage, but can be appropriate if it is desired to reduce in any way the loss or the unavailability of services.

The following steps shall be taken to evaluate the need of protection for frequency of damage F:

– calculation of the partial frequency of damage F_X;

– calculation of the total frequency of damage F;

– identification of the tolerable frequency of damage F_T;

– comparison of the frequency of damage F with the tolerable value F_T.

The frequency of damage F shall be evaluated for internal systems or equipment in the structure that the owner wants to protect (when the structure is divided into zones, in each zone where equipment is located and that the owner or manager wants to protect). Comparison of frequency F with F_T shall be performed for these internal systems or equipment.

The procedure to evaluate the need for protection for the frequency of damage F is given in

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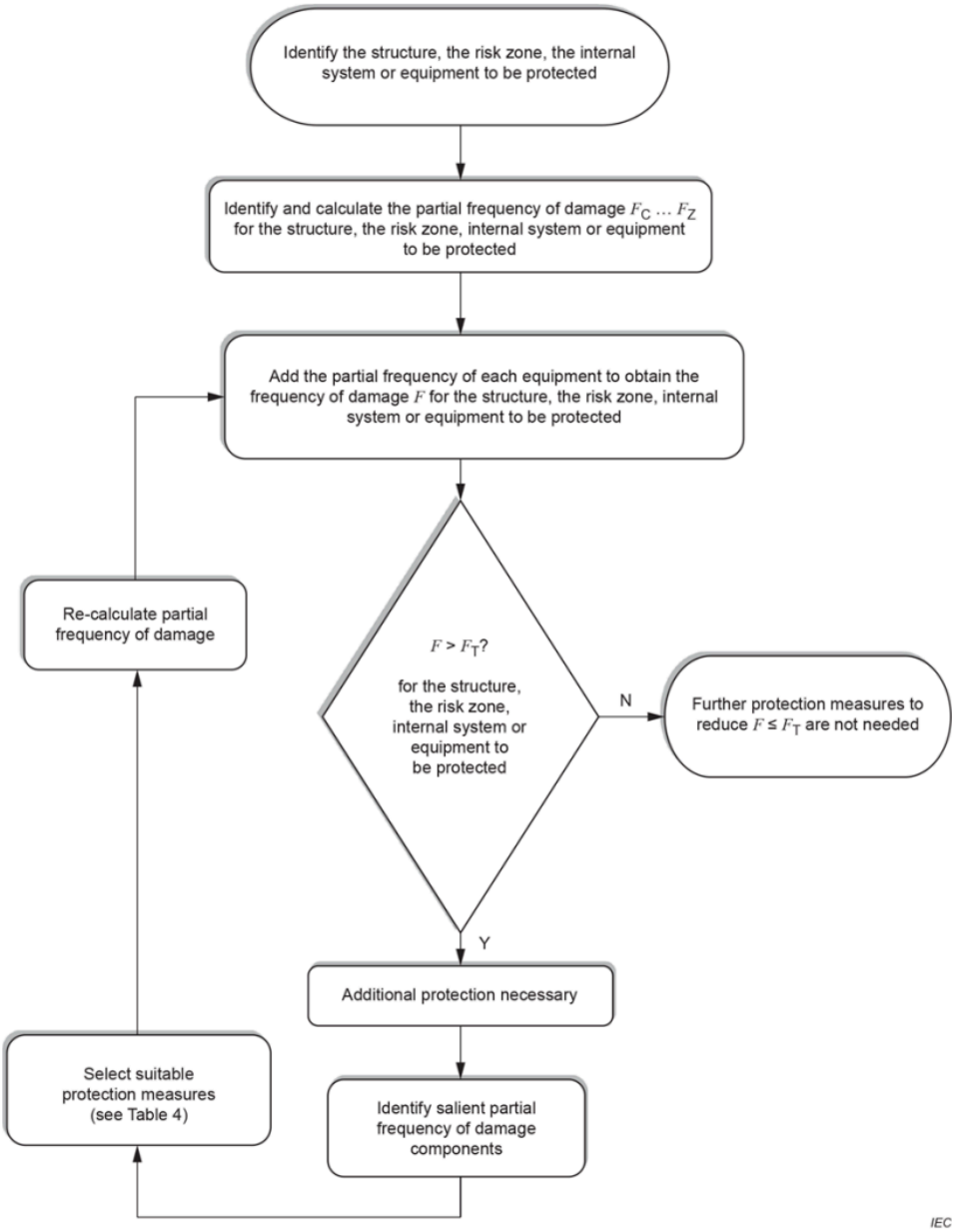


Figure 3 – Procedure for determining the need for protection and for the selection of protection measures

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9.4 Assessment of partial frequency of damage in zones

9.4.1 General criteria

For the evaluation of partial frequency of damage and the selection of the relevant parameters involved, the following rules apply:

– parameters relevant to the number N of dangerous events shall be evaluated according to Annex A;

– parameters relevant to the probability P of damage shall be evaluated according to Annex B.

Moreover:

– for partial frequency of damage F_W and F_Z, only one value is to be fixed in each risk zone for each parameter involved. Where more than one value is applicable, the highest one shall be chosen;

– for partial frequency of damage F_C and F_M, if more than one internal system is involved in a risk zone, values of P_C and P_M are given by:

$$P_C = 1 - (1 - P_{C1}) \times (1 - P_{C2}) \times \ldots \times (1 - P_{Cn}) \quad (14)$$

$$P_M = 1 - (1 - P_{M1}) \times (1 - P_{M2}) \times \ldots \times (1 - P_{Mn}) \quad (15)$$

where P_{Cn} and P_{Mn} are parameters relevant to internal system n = 1, 2, 3…

If more than one value of any other parameter exists in a risk zone, the value of the parameter leading to the highest value of partial frequency of damage shall be assumed, with the exception made for P_C and P_M.

NOTE 1 An internal system is not necessarily connected directly to an external service. For example, it can be connected to a copper power line and to a data line connected via an isolation interface.

NOTE 2 A simpler approach is to use $P_C = P_{C1}$ and $P_M = P_{M1}$ where P_{C1} and P_{M1} refer to the worst cases.

9.4.2 Single-zoned structure

In this case, only one risk zone Z_S made up of the entire structure is defined. The frequency of damage F is the sum of partial frequencies of damage F_X in this risk zone.

Defining the structure as a single risk zone can lead to expensive protection measures because each measure shall extend to the entire structure.

9.4.3 Multi-zoned structure

In this case, the structure is divided into multiple risk zones Z_S. The frequency of damage F_{zone} for the risk zone is the sum of the partial frequencies of damage $F_{zone/X}$ relevant to all sources of damage.

Dividing a structure into risk zones allows the designer to take into account the characteristics of each part of the structure in the evaluation of the partial frequency of damage and to select the most suitable protection measures tailored risk zone by risk zone, reducing the overall cost of protection against lightning.

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Annex A
(informative)

Assessment of annual number N of dangerous events

A.1 General

The average annual number N of dangerous events due to lightning flashes influencing a structure to be assessed depends on the lightning ground strike-point density of the region where the structure is located and on the structure's physical characteristics.

The lightning ground strike-point density N_{SG} is the number of lightning strike points per km^2 per year. In many areas of the world this value can be obtained from data provided by lightning location systems (LLS) complying with IEC 62858.

When N_{SG} values are not available directly, it is possible to account for flashes with multiple ground strike points. The values of lightning ground flash density N_G, can be multiplied by a factor k to estimate N_{SG} depending on many factors such as geographical location. This factor k should be obtained from the national LLS data provider.

$$N_{SG} = k\, N_G \tag{A.1}$$

where

N_{SG} is the lightning ground strike-point density (1 per km^2 per year).

NOTE 1 When the LLS data provider cannot provide this factor k or it does not exist (for example when a N_G map exists for a country), a factor 2 can be assumed.

In areas without ground-based lightning location systems, the recommended estimate of lightning ground strike-point density is

$$N_{SG} = 0{,}5\, N_T \tag{A.2}$$

where N_T is the total (ground CG + cloud IC) density of optically recorded flashes per km^2 per year, obtained through the NASA website
http://lightning.nsstc.nasa.gov/data/data_lis-otd-climatology.html [7].

NOTE 2 In most areas of the world, an indication of lightning activity can be obtained from observations of lightning optical transients. Satellite-based sensors respond to all types of lightning with relatively uniform coverage. With sufficient averaging, optical transient density data provide better estimates of ground flash density than thunder observations, which have a wide range of relations between ground flash density and thunderstorm hours or thunderstorm days. There are also regional variations in the ratio of ground flashes (CG) to total flashes (CG + IC).

NOTE 3 IEC 62858 specificies how lightning data is obtained and presented.

Events that can be considered as dangerous to a structure being considered for protection are:

– flashes to the structure,
– flashes to ground near the structure,
– flashes to a line entering the structure, including flashes to another structure to which the

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– flashes to ground near a line entering the structure.

NOTE 4 Annex A provides simplified methods to calculate the number N of dangerous events due to lightning flashes influencing a structure to be protected.

A.2 Assessment of the average annual number of dangerous events N_D due to flashes to a structure and N_{DJ} to an adjacent structure

A.2.1 Determination of the collection area A_D

A.2.1.1 General

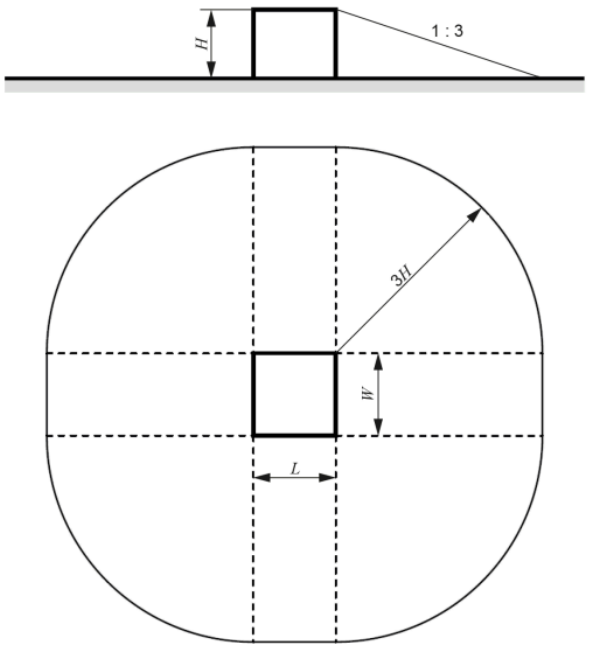
For isolated structures on flat ground, the equivalent collection area A_D is the area defined by the intersection between the ground surface and a straight line with 1/3 slope which passes from the upper parts of the structure (touching it there) and rotating around it. Determination of the value of A_D can be performed graphically or mathematically.

A.2.1.2 Rectangular structure

For an isolated rectangular structure with length L, width W, and height H on flat ground, the equivalent collection area is then equal to:

$$A_D = L \times W + 2 \times (3 \times H) \times (L + W) + \pi \times (3 \times H)^2 \quad \text{(A.3)}$$

where L, W and H are expressed in metres (see Figure A.1).



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A.2.1.3 Complex-shaped structure

If the structure has a complex shape, such as elevated roof protrusions (see Figure A.2), a graphical method should be used to evaluate A_D (see Figure A.3).

An acceptable approximate value of the collection area is the greater value between the equivalent collection area A_{DMIN} evaluated with Equation (A.3) taking the minimum height H_{MIN} of the structure, and the collection area attributed to the elevated roof protrusion A_D'. A_D' can be calculated by:

$$A_D' = \pi \times (3 \times H_P)^2 \quad \text{(A.4)}$$

where H_P is the height of protrusion.

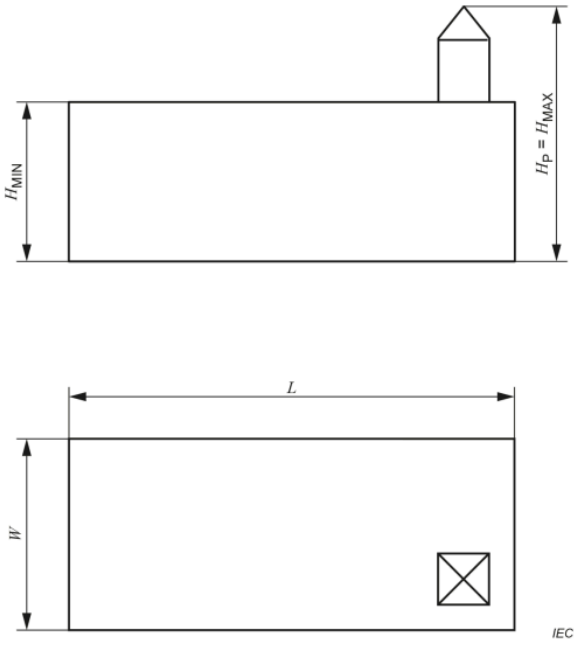


Figure A.2 – Complex-shaped structure

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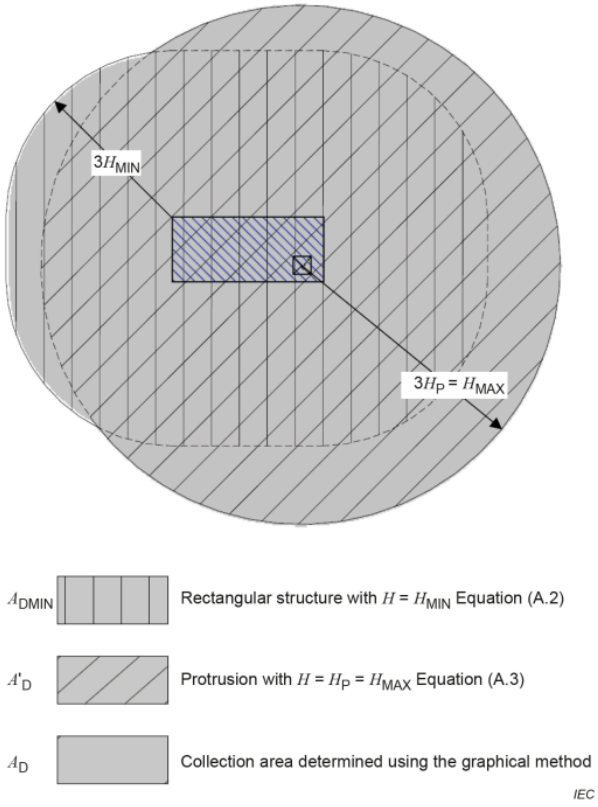


Figure A.3 – Different methods to determine the collection area for a given structure

A.2.2 Structure as a part of a building

Where the structure S to be considered consists of only a part of a building B, the dimensions of structure S can be used in evaluation of A_D provided that the following conditions are fulfilled (see Figure A.4):

– the structure S is a separated vertical part of the building B as shown in Figure A.4;

– the building B does not have a risk of explosion;

– propagation of fire between the structure S and other parts of the building B is restricted e.g. by means of walls with resistance to fire of 120 min or by means of other equivalent protection measures.

NOTE Fire regulations can fix different values for the resistance to fire. Building regulations can fix wall resistance to fire.

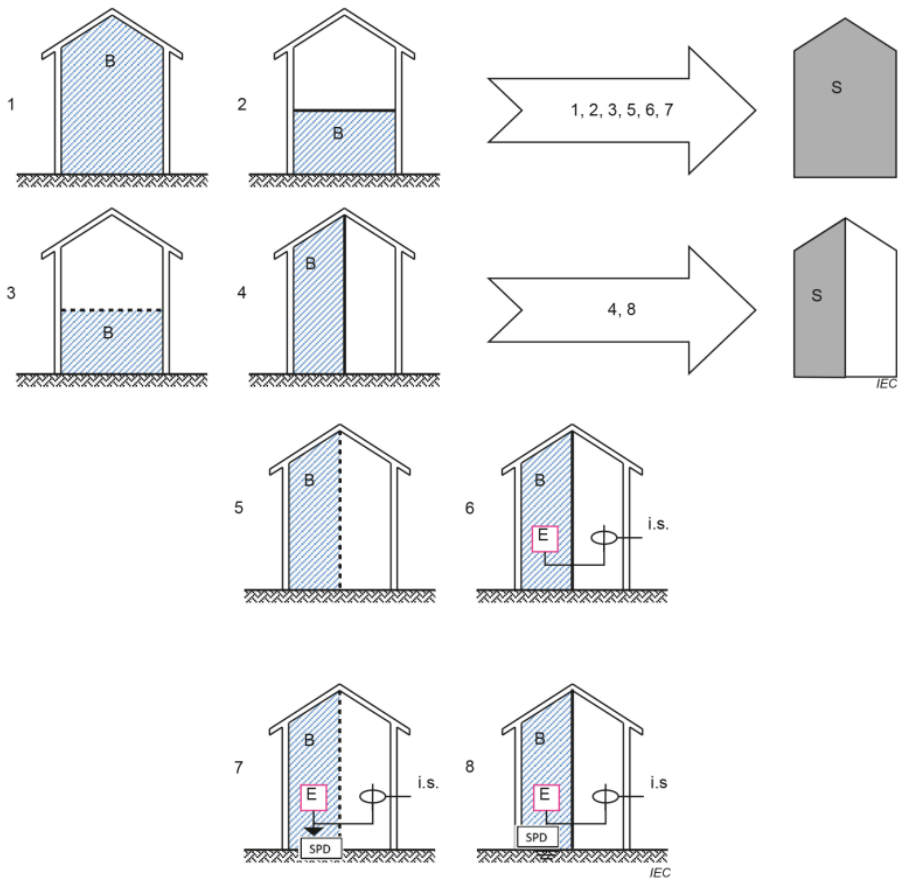
– propagation of overvoltages along common lines, if any, is avoided by means of SPDs installed at the entrance point of such lines in the structure or by means of other equivalent protection measure.

Where these conditions are not fulfilled, the dimensions of the whole building B should be used.

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Key

B building or part of it for which protection is considered (evaluation of A_D is necessary)

part of building for which protection is not considered (evaluation of A_D is not necessary)

S structure to be considered for risk assessment (dimensions of S shall be used for evaluation of A_D)

partitioning with resistance to fire ≥ 120 min

partitioning with resistance to fire < 120 min

E equipment

i.s. internal system

SPD SPD

Figure A.4 – Structure to be considered for evaluation of collection area A_D

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A.2.3 Relative location of the structure

The relative location of the structure, compensating for surrounding structures or an exposed location, will be taken into account by a location factor C_D (see Table A.1).

A more precise evaluation of the surrounding objects' influence can be obtained considering the relative height of the structure with respect to the surrounding objects or the ground within a distance of 3 × H from the structure and assuming C_D = 1.

Table A.1 – Structure location factors C_D and C_{DJ}

Relative location	C_D or C_{DJ}
Structure surrounded by higher objects	0,25
Structure surrounded by objects of the same height or smaller	0,5
Isolated structure: no other objects in the vicinity	1
Isolated structure on hilltop or a knoll	2

NOTE 1 A more complete method based on 3D models can provide detailed results, considering the impact of surrounding buildings and environment.

NOTE 2 The usual way to determine coefficient C_D or C_{DJ} is to determine the influence of objects within a distance of 3H from the considered building (overlapping of collection areas).

NOTE 3 C_D is representative of an equivalent collection area of the structure; C_D depends on the height of the nearby structures, the width and in general the collection of the nearby structures. It is not a simple geometric calculation. However, to give an indication, C_D = 0,25 can be considered for example when the collection area of the physical structure itself and the ground within a distance of 3 × H is permanently covered by the collection area of surrounding objects to 75 %. C_D = 0,5 for example when the collection area of the physical structure itself and the ground within a distance of 3 × H is permanently covered by the collection area of surrounding objects to 50 %. C_D = 1 for example when the collection area of the physical structure itself and the ground within a distance of 3 × H is marginally covered by the collection area of surrounding objects.

A.2.4 Number of dangerous events N_D for the structure

N_D can be evaluated as the product:

$$N_D = N_{SG} \times A_D \times C_D \times 10^{-6} \quad \text{(A.5)}$$

where

N_{SG} is the lightning ground strike-point density per km^2 per year;

A_D is the equivalent collection area of the structure (m^2);

C_D is the location factor of the structure (see Table A.1).

NOTE In areas with isolated tall structures a more accurate evaluation of N_D can be advisable. Further information can be provided by national committes.

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A.2.5 Number of dangerous events N_{DJ} for an adjacent structure

The average annual number of dangerous events due to flashes to a structure connected at the far end of a line, N_{DJ} can be evaluated as the product:

$$N_{DJ} = N_{SG} \times A_{DJ} \times C_{DJ} \times C_T \times 10^{-6} \quad \text{(A.6)}$$

where

N_{SG} is the lightning ground strike-point density per km^2 per year;

A_{DJ} is the equivalent collection area of the adjacent structure (m^2);

C_{DJ} is the location factor of the adjacent structure (see Table A.1);

C_T is the line type factor (see Table A.3).

A.3 Assessment of the average annual number of dangerous events N_M due to flashes near a structure

N_M can be evaluated as the product:

$$N_M = (1/k) \times N_{SG} \times A_M \times 10^{-6} \quad \text{(A.7)}$$

where

N_{SG} is the lightning ground strike-point density per km^2 per year;

A_M is the equivalent collection area of flashes striking near the structure (m^2).

NOTE 1 When N_{SG} is obtained directly by LLS, the factor k is provided by the LLS data provider. When not available, k = 2 can be assumed (see Clause A.1).

NOTE 2 In power systems the dangerous events N_M can be usually disregarded due to the use of concrete building with dense rebar mesh.

NOTE 3 Environmental factor C_E can also influence N_M, e.g. N_M can be multiplied by the environment coefficient C_E.

The equivalent collection area A_M extends to a line located at a conventional distance r_M from the perimeter of the structure:

$$A_M = 2 \times r_M \times (L + W) + \pi \times r_M{}^2 \quad \text{(A.8)}$$

where

r_M = $350/U_W$ (m);

U_W is the equipment impulse rated voltage in kV of the equipment having the lowest insulation level.

NOTE 4 Typical values for U_W can be found in Table B.11 and Table B.12.

NOTE 5 This Formula (A.8) is calculated considering a loop area of 50 m^2 considering its random position with

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A.4 Assessment of the average annual number of dangerous events N_L due to flashes to a line

A line can consist of several sections. For each section of line, the value of N_L can be evaluated by:

$$N_L = N_{SG} \times A_L \times C_I \times C_E \times C_T \times 10^{-6} \quad \text{(A.9)}$$

where

N_L is the number of overvoltages of amplitude not lower than 1 kV (1/year) on the line section;

N_{SG} is the lightning ground strike-point density per km^2 per year;

A_L is the equivalent collection area of flashes striking the line (m^2);

C_I is the installation factor of the line (see Table A.2);

C_T is the line type factor (see Table A.3);

C_E is the environmental factor (see Table A.4);

with the collection area for flashes to a line:

$$A_L = 40 \times L_L \quad \text{(A.10)}$$

where

L_L is the length of the line section (m).

When information of the section lengths is not available, a maximum line length of 1 km for the sum of HV power lines and LV power lines and a maximum line length of 1 km for telecom lines can be assumed.

NOTE 1 More information on the equivalent collection areas A_L for telecommunication lines can be found in ITU-T Recommendation K.47 [8].

NOTE 2 A realistic maximum total length to be considered for power lines is generally 2 km.

Table A.2 – Line installation factor C_I

Routing	C_I
Aerial	1
Buried	0,3
Buried cables running entirely within a meshed earth termination (IEC 62305-4:2024, 5.2).	0,01

NOTE 3 The ground resistivity affects the collection area A_L of buried sections. In general, the larger the ground resistivity, the larger the equivalent collection area. The installation factor of Table A.2 is based on ρ = 400 Ωm. For ρ > 400 Ωm, the following equation for a buried section can be used $A_L = 0{,}6 \times \sqrt{\rho} \times L_L$.

NOTE 4 Different values can be assigned to the installation factor C_I after detailed investigation.

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Table A.3 – Line type factor C_T

Installation	C_T
LV power, telecommunication or data line or HV power line with HV/LV auto-transformer	1
HV power (with HV/LV transformer with separated windings)	0,2

NOTE 5 Different values can be assigned to the line type factor C_T after detailed investigation. Lower values for C_T are possible.

Table A.4 – Environmental factor C_E

Environment	C_E
Rural	1
Suburban	0,5
Urban	0,1
Urban with buildings higher than 20 m.	0,01

NOTE 6 The values given for C_E reduce the number of dangerous events caused by sources S3 and S4 due to the protection of the surrounding structures.

NOTE 7 Different values can be assigned to the environmental factor C_E after detailed investigation.

A.5 Assessment of average annual number of dangerous events N_I due to flashes near a line

A line can consist of several sections. For each section of line, the value of N_I can be evaluated by

$$N_I = (1/k) \times N_{SG} \times A_I \times C_I \times C_E \times C_T \times 10^{-6} \quad \text{(A.11)}$$

where

N_I is the number of overvoltages per year of amplitude higher than U_W on the line section;

N_{SG} is the lightning ground strike-point density per km^2 per year;

A_I is the equivalent collection area of flashes to ground near the line (m^2);

C_I is the installation factor (see Table A.2);

C_T is the line type factor (see Table A.3);

C_E is the environmental factor (see Table A.4).

NOTE 1 When N_{SG} is obtained directly by LLS, the factor k is provided by the LLS data provider. When not available, k = 2 can be assumed (see Clause A.1).

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The equivalent collection area A_I for flashes near a line extends to a line located at a conventional distance r_I from the line:

$$A_I = 2 \times r_I \times L_L \quad (A.12)$$

where

L_L is the length of the line section (m);

r_I = 2 000/$U_w^{1,8}$;

U_w is the equipment impulse rated voltage in kV.

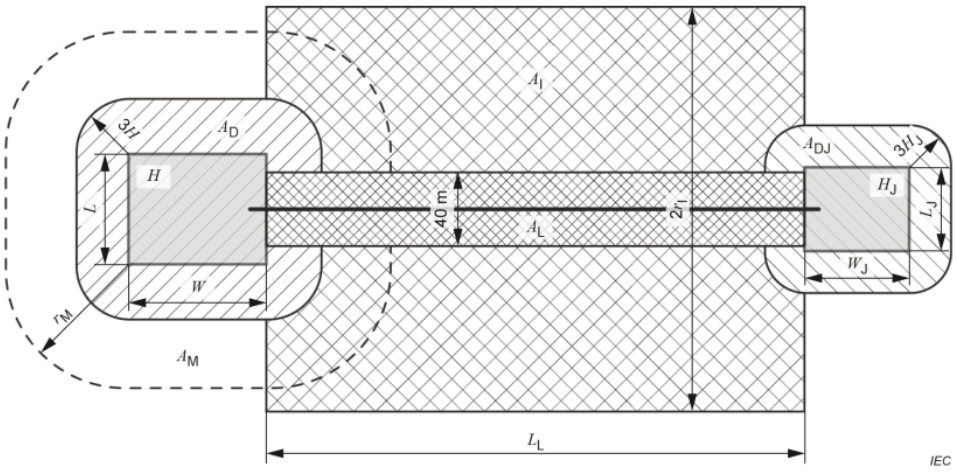
When information of the section lengths is not available, a maximum line length of 1 km for the sum of HV power lines and LV power lines and a maximum line length of 1 km for telecom lines can be assumed.

NOTE 2 A more precise evaluation of A_I can be found in Electra no. 161 [9] and no. 162 [10], 1995 for power lines and in ITU-T Recommendation K.46 [11] for telecommunication lines.

NOTE 3 A realistic maximum total length to be considered for power lines is generally 2 km.

A.6 Representation of the equivalent collection areas

Figure A.5 shows the relationship of the five collection areas, A_D, A_{DJ}, A_M, A_L and A_I, as specified in A.2.1.2, A.2.1.3, Clause A.3, Clause A.4 and Clause A.5 respectively. It should be noted that the areas are not drawn to scale for typical dimensions.



NOTE The figure represents the collection area for one specific lateral distance.

Figure A.5 – Equivalent collection areas A_D, A_{DJ}, A_M, A_L and A_I

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Annex B
(informative)

Assessment of probability P_X of damage

B.1 General

The probabilities given in this Annex B are valid if protection measures conform to:

– IEC 62305-3 for protection measures to reduce injury to human beings and for protection measures to reduce physical damage;
– IEC 62305-4 for protection measures to reduce failure of internal systems.

Other values can be chosen, if justified.

Values of probabilities P_X less than 1 can be selected only if the measure or characteristic is valid for the entire structure or risk zone of the structure (Z_S) to be protected and for all relevant equipment.

Values of probabilities P_X should take into account probability P_{TWS} if the relevant protective provisions provided are activated by means of a thunderstorm warning system (TWS) complying with IEC 62793 where P_{TWS} is the probability with which a TWS does not detect a lightning-related event in the target area.

NOTE 1 P_{TWS} = maximum value between failure to warn ratio (FTWR) and 1 − POD_x (probability that a lead time of x minutes is obtained). The FTWR and POD_x will generally be obtained from the manufacturer's product data sheet or the service provider. P_{TWS} = 1 can be assumed if the manufacturer does not declare the value of FTWR or POD_x.

NOTE 2 For protection measures and reduction values by the use of TWS, refer to IEC 62305-1 and IEC 62793. If temporary preventive measures are not applicable or a TWS is not provided P_{TWS} = 1 can be assumed. If the warning given by the TWS does not provide time enough for taking those measures, P_{TWS} = 1 can be assumed.

The values of factors to be used for the assessment of probability P_X of damage should be fixed by the lightning protection designer. The values of factors in a structure given in this Annex B are typical values. Different values can be assigned after detailed investigation.

The probability P_X of protection measures to reduce failure of internal systems depends on the probability P_{SPD} of a coordinated SPD system. According to the selected lightning protection level (LPL) value, a coordinated SPD system shall:

– withstand the lightning current expected at its installation point;
– limit the overvoltage value at the equipment input to a value not greater than equipment rated impulse voltage (U_w).

The probability P_{SPD} relevant to the coordinated SPD system depends on:

– the probability P_Q that the value of the expected charge associated with the current flowing through the SPD at its point of installation exceeds the one tolerated by the SPD;
– the probability P_{Up} that the value of residual voltage at the SPD exceeds the required protection level U_{pr} to limit the overvoltage value at the equipment input to a value not greater than the equipment rated impulse voltage (U_w).

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Then the probability P_{SPD} is given by:

$$P_{SPD} = 1 - (1 - P_Q)(1 - P_{Up}) \quad \text{(B.1)}$$

The probability P_Q refers to positive and negative first strokes, whereas the probability P_{Up} refers to the subsequent stroke of negative flashes.

NOTE 3 Internal systems can include externally mounted equipment provided it is not open to a direct strike according to the chosen LPS class.

B.2 Probability P_{AT} that a flash to a structure will cause dangerous touch and step voltages

The values of probability P_{AT} that a damage due to touch and step voltages by a lightning flash to the structure appear, depend on the protection measures provided:

$$P_{AT} = P_{LPS} \times P_{am} \times r_t \times P_{TWS} \quad \text{(B.2)}$$

where

P_{LPS} is the probability depending on the LPL of measures to protect the exposed areas of the structure against a direct flash. Values of P_{LPS} are given in Table B.3;

P_{TWS} is the probability with which a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area;

NOTE 1 The purpose of a warning message created by a TWS is to ensure prompt and complete evacuation of the exposed area. If this evacuation is not ensured or a TWS is not provided or if the manufacturer does not declare the FTWR, $P_{TWS} = 1$ is assumed (see also IEC 62305-1 and IEC 62793 for restrictions of application of a TWS).

P_{am} is the probability that a flash to a structure will cause damage due to touch and step voltages according to different protection measures. Values of P_{am} are given in Table B.1;

r_t is the reduction factor as a function of the type of surface of soil or floor. Values of r_t are given in Table B.2.

NOTE 2 Protection measures are effective in reducing P_{AT} only in structures protected by an LPS or structures with continuous metal or reinforced concrete framework acting as a natural LPS.

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Table B.1 – Values of probability P_{am} that a flash to a structure will cause damage due to touch and step voltages according to different protection measures

Protection measure	P_{am}
No protection measures	1
Warning notice	10^{-1}
Electrical insulation (e.g. at least 3 mm cross-linked polyethylene) of exposed parts (e.g. down conductors)	10^{-2}
Effective soil equipotentialization by means of meshed earth termination system[a]	10^{-2}
Natural LPS, see Note 3	10^{-3}
Access restrictions	0
[a] Protection measure effective against step voltages only.	

If more than one provision has been taken, the value of P_{am} is the product of the corresponding values.

NOTE 3 P_{am} = 0,001 can be assumed when the structure:

- has an extensive metal framework (see IEC 62305-3:2024, 8.1 and 8.2);
- is made of reinforced concrete cast on site, with the reinforcing rods interconnected in accordance with IEC 62305-3 and verified according to the method described in IEC 62305-3:2024, Annex D.
- is provided with a meshed earth termination system and there is no accessible metal installation which can become a part of the path of the lightning current.

Table B.2 – Reduction factor r_t as a function of the type of surface of soil or floor

Type of surface[a]	Contact resistance[b] kΩ	r_t
Agricultural, concrete	≤ 1	10^{-2}
Marble, ceramic	1 – 10	10^{-3}
Gravel, moquette, carpets	10 – 100	10^{-4}
Asphalt, linoleum, wood	≥ 100	10^{-5}
NOTE Particular attention is taken when isolating soil covering layers are in wet conditions or covered with a water layer.		
[a] A layer of insulating material, e.g. asphalt, of 5 cm thickness generally reduces the hazard to a tolerable level. In these cases r_t = 0 can be assumed.		
[b] Contact resistance as per definition IEV 581-23-08. Values measured between a 400 cm^2 electrode compressed with a uniform force of 750 N and a point where voltage is not modified by current injection.		

B.3 Probability P_{AD} that a flash will cause damage to an exposed person on the structure

The values of probability P_{AD} that a flash will strike a person on the structure depend on the position of people in the exposed area, on the lightning protection level (LPL) of adopted measures to protect the exposed areas of the structure against the direct flash and on additional protection measures such that:

$$P_{AD} = P_{TWS} \times P_{am} \times P_O \times P_{LPS} \quad \text{(B.3)}$$

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where

P_{TWS} is the probability with which a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area;

NOTE 1 The purpose of a warning message created by a TWS is to ensure prompt and complete evacuation of the exposed area. If this evacuation is not ensured or a TWS is not provided or if the manufacturer does not declare the FTWR, P_{TWS} = 1 is assumed (see also IEC 62305-1:2024, 7.1 for restrictions of application of a TWS).

NOTE 2 When a TWS is used, P_{am} can be ignored.

P_{am} is the probability that a flash to a structure will cause damage due to touch and step voltages according to different protection measures. Values of P_{am} are given in Table B.1;

P_O is the probability factor according to the position of a person in the exposed area, where P_O is assumed equal to 1 when the person is exposed (and equal to 0 when there is nobody);

P_{LPS} is the probability depending on the LPL of measures to protect the exposed areas of the structure against a direct flash. Values of P_{LPS} are given in Table B.3;

NOTE 3 P_{LPS} can be included in Equation (B.3) only when people are within the protected area of the LPS.

P_{am} is the probability that a flash to a structure will cause damage due to touch and step voltages.

Table B.3 – Values of probability P_{LPS} depending on the protection measures to protect the exposed areas of the structure against the direct flash and to reduce physical damage

Characteristics of structure	Class of LPS	P_{LPS}
Structure or exposed areas not protected	-	1
Structure or exposed areas protected by an LPS	IV	0,2
	III	0,1
	II	0,05
	I	0,02
Structure protected by an LPS I with a continuous metal or reinforced concrete framework acting as a natural down-conductor system		0,01
Structure protected by an LPS I with a metal roof and an air-termination system, possibly including natural components, with complete protection of any roof installations against direct lightning strikes and a continuous metal or reinforced concrete framework acting as a natural down-conductor system		0,001

NOTE 4 Values of P_{LPS} other than those given in Table B.3 are possible if based on a detailed investigation taking into account the requirements of sizing and interception criteria defined in IEC 62305-1.

NOTE 5 The characteristics of the LPS, including those of the SPD for lightning equipotential bonding, are reported in IEC 62305-3.

NOTE 6 The protection level of the LPS can be different for protection of the exposed areas of the structure against the direct flash or to reduce physical damage.

NOTE 7 For more information see IEC 62305-3:2024, 8.1 and 8.2.

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B.4 Probability P_B that a flash to a structure will cause physical damage by fire or explosion

The probability P_B that a flash to a structure will cause physical damage by fire or explosion is given by:

$$P_B = P_S \times P_{LPS} \times r_f \times r_p \quad \text{(B.4)}$$

where

P_S is the probability that a flash to a structure will cause dangerous sparking. Values of P_S are given in Table B.4;

P_{LPS} is the probability depending on the protection measures to reduce physical damage. Values of P_{LPS} are given in Table B.3;

r_p is the reduction factor as a function of provisions taken to reduce the consequences of fire. Values of r_p are given in Table B.5;

r_f is the reduction factor as a function of risk of fire or explosion of structure. Values of r_f are given in Table B.6.

Table B.4 – Values of probability P_S that a flash to a structure will cause dangerous sparking

Type of structure	P_S
Wood and masonry	1
Electrically-continuous reinforced concrete or Interconnected metal framework	0,5
NOTE 1 If there is no LPS installed or if the LPS is not installed according to IEC 62305-3, Table B.4 gives the value for P_S. If an LPS is installed according to IEC 62305-3, P_S = 1 and the beneficial effect of the LPS is taken into account by P_{LPS}. NOTE 2 If significant metal protruding parts not bonded to the structure framework are present, P_S = 1 can be adopted. NOTE 3 When walls and roof are not of the same type, a larger value for P_S can be considered. NOTE 4 For reinforcement, the value of 0,5 is only valid if reinforcement is sufficiently interconnected and connected to the earthing arrangement.	

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Table B.5 – Reduction factor r_p as a function of provisions taken to reduce the consequences of fire

Provisions	r_p
No provisions	1
One of the following provisions: extinguishers; fixed manually-operated extinguishing installations[a]; manual alarm installations; hydrants; fire compartments; escape routes	0,5
One of the following provisions: fixed automatically operated extinguishing installations; automatic alarm installations[b]	0,2
NOTE These provisions are only valid if they are available and operational at the time of a lightning event. If in doubt r_p = 1 is suggested. In some countries, it is not possible to use other values than r_p = 1 unless an LPS is provided. [a] Provisions are effective only if operated by persons trained for this purpose and able to do so. [b] Only if protected against overvoltages and other damages and if firefighters can arrive in less than 10 min.	

Provisions taken to reduce the consequences of fire as described in Table B.5 do not prevent fire occurrence due to lightning. If fire mitigation measures are used in lightning risk calculation (r_p different from 1), the user should be informed. If the user is not informed, r_p = 1 should be applied.

In zones with a risk of explosion, r_p = 1 for all cases unless provisions are taken to ensure that a fire cannot trigger an explosion inside the explosive area.

In zones with lithium-ion batteries r_p = 1 should be applied. Small volume of such batteries can be disregarded (e.g. a portable computer).

Table B.6 – Reduction factor r_f as a function of risk of fire or explosion of structure

Risk	Level of risk	r_f
Explosion	Zones 0, 20 and solid explosive	1
	Zones 1, 21	10^{-1}
	Zones 2, 22	10^{-3}
Fire	High	10^{-1}
	Ordinary	10^{-2}
	Low	10^{-3}
Explosion or fire	None	0
NOTE Examples of fire loads for different type of structures can be found in other documents, for example EN 1991-1-2 [12].		

NOTE 1 In the case of a structure with a possibility of explosion, the values for r_f are suggested values that are presented as worst case for the purpose of lightning protection calculation in the absence of input from a facility owner or other valid source. Since the probability of hazardous conditions and consequence of ignition can vary from site to site, the application of the definitions for Zones 1 and 21 and Zones 2 and 22 and other principles from the IEC 60079 and ISO/IEC 80079 series would allow values to be determined with input from the facility owners or other valid sources for the particular application. Examples of valid sources include applicable standards and codes for the application.

NOTE 2 Where different conditions are present the worst case is used.

NOTE 3 Structures with a high risk of fire can be assumed to be structures made of combustible materials or structures with roofs made of combustible materials or structures with a specific fire load larger than 800 MJ/m^2.

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NOTE 4 Structures with an ordinary risk of fire can be assumed to be structures with a specific fire load between 800 MJ/m2 and 400 MJ/m^2.

NOTE 5 Structures with a low risk of fire can be assumed to be structures with a specific fire load less than 400 MJ/m^2, or structures containing only a small quantity of combustible material.

NOTE 6 Specific fire load is the ratio of the energy of the total quantity of the combustible material in a structure and the overall surface of the structure.

NOTE 7 For the purposes of this document, structures associated with hazardous areas or solid explosive materials are not assumed to be structures with a risk of explosion if any one of the following conditions is fulfilled:

– the time of presence of explosive substances is lower than 0,1 h/year.

– the volume of explosive atmosphere leads to a zone of negligible extent.

– the hazardous area cannot be hit directly by a flash and dangerous sparking in the hazardous area is avoided. This condition is fulfilled in the following cases:

  For hazardous areas enclosed within metallic shelters, when the shelter, as a natural air-termination system, acts safely without puncture or hot-spot problems, and internal systems inside the shelter, if any, are protected against overvoltages to avoid dangerous sparking.

  For hazardous areas in structures, when the hazardous area is within structures protected by an LPS or structures with continuous metal or reinforced concrete framework acting as a natural LPS, where bonding requirements of IEC 62305-3 are satisfied and internal systems in the area, if any, are protected against overvoltages to avoid dangerous sparking.

NOTE 8 The definitions and criteria for hazardous areas and a zone of negligible extent are found in IEC 60079-10-1 [3] and IEC 60079-10-2 [4].

B.5 Probability P_C that a flash to a structure will cause failure of internal systems

A coordinated SPD system is suitable as a protection measure to reduce P_C.

The probability P_C that a flash to a structure will cause a failure of internal systems is given by:

$$P_C = P_{SPD} \times C_{LD} \quad \text{(B.5)}$$

P_{SPD} depends on the coordinated SPD system conforming to IEC 62305-4 and on internal system characteristics. Values of P_{SPD} are reported in Table B.7 and Table B.8.

C_{LD} is a factor depending on shielding, grounding and isolation conditions of the line to which the internal system is connected. Values of C_{LD} are given in Table B.9.

NOTE 1 A coordinated SPD system is effective in reducing P_C only in structures protected by an LPS or structures with continuous metal or reinforced concrete framework acting as a natural LPS, where bonding requirements of IEC 62305-3 are satisfied, irrespective of the LPS class.

NOTE 2 If the roof is considered as a zone of the building, then the protection measures are defined as for the other zones. If protection against direct flashes is required, the equipment on the roof is protected by the LPS and the SPDs are designed according to source of damage S1 (both resistive and inductive coupling) in Table B.7 or Table B.8 as a simple approach.

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Table B.7 – Typical values of P_{SPD} for SPDs on the low-voltage system, used to protect against sources of damage S1, S2, S3, S4

LPL	Direct and indirect flashes to the line				Flash near the structure		Flash to the structure		Flash to the structure	
	Source of damage S3[a]		Source of damage S4[a]		Source of damage S2[a]		Source of damage S1[a] (inductive coupling)		Source of damage S1[b] (resistive coupling)	
	kA 10/350 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 10/350 µs	P_{SPD}
No SPDs		1		1		1		1		1
III to IV	5	0,05	0,3	0,05	0,1	0,05	5	0,05	12,5	0,05
II	7,5	0,02	0,45	0,02	0,15	0,02	7,5	0,02	18,75	0,02
I	10	0,01	0,6	0,01	0,2	0,01	10	0,01	25	0,01
Better than LPL I			2,5[c d]	10^{-4}	2,5[c]	10^{-4}				
			3,75[c d]	5×10^{-5}	3,75[c]	5×10^{-5}				
			5[c d]	10^{-5}	5[c]	10^{-5}				

NOTE 1 The necessary LPL for the SPDs can be different from the LPL of the LPS.

NOTE 2 For shielded lines, the values of the currents can be halved.

[a] For information on values of current and specific conditions, refer to IEC 62305-1:2024, Table E.1.

[b] Current values refer to a single service line (n = 1) having three phase conductors + neutral (n' = 4); sharing factor k_e = 0,5; more detailed information is given in IEC 62305-1:2024, Clause E.2.

[c] SPD commonly used.

[d] Values for S4 in IEC 62305-1:2024, Table E.1 defined for LPL I to IV, are reported in this table in lines "better than LPL I".

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Table B.8 – Typical values of P_{SPD} for SPDs on the telecommunications system used to protect against sources of damage S1, S2, S3, S4

LPL	Direct and indirect flashes to the line				Flash near the structure		Flash to the structure		Flash to the structure	
	Source of damage S3[a]		Source of damage S4[a]		Source of damage S2[a e]		Source of damage S1[a d] (inductive coupling)		Source of damage S1[b] (resistive coupling)	
	kA 10/350 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 10/350 µs	P_{SPD}
No SPDs		1		1		1		1		1
III to IV	1	0,05	0,3	0,05	0,1	0,05	5	0,05	1,25[f]	0,05
II	1,5	0,02	0,45	0,02	0,15	0,02	7,5	0,02	1,875[f]	0,02
I	2	0,01	0,6	0,01	0,2	0,01	10	0,01	2,5[f]	0,01
Better than LPL I			2,5[c]	10^{-4}	2,5[c]	10^{-4}				
			3,75[c]	5×10^{-5}	3,75[c]	5×10^{-5}				
			5[c]	10^{-5}	5[c]	10^{-5}				

NOTE 1 The necessary LPL for the SPDs can be different from the LPL of the LPS.

NOTE 2 Refer to ITU-T Recommendation K.67 [13] for more information.

NOTE 3 Values referred to overhead unshielded lines. For buried lines, the values of the currents can be halved. For shielded lines, the values of the currents can be halved.

[a] For information on values of current and specific conditions, refer to IEC 62305-1:2024, Table E.2.

[b] Detailed information is given in IEC 62305-1:2024, Clause E.2.

[c] SPD commonly used.

[d] Loop conductors routing and distance from the inducing current affect the values of expected surge overcurrents. Values in IEC 62305-1:2024, Table E.2 refer to short-circuited, unshielded loop conductors with different routing in large buildings (loop area in the order of 50 m^2, width = 0,5 m), 1 m apart from the structure wall, inside an unshielded structure (k_c = 1). For other loop and structure characteristics, values should be multiplied by factors K_{S1}, K_{S2}, K_{S3} (see Clause B.6).

[e] Loop conductors routing and distance from inducing current affect the values of expected surge overcurrents. Values in IEC 62305-1:2024, Table E.2 refer to short-circuited, unshielded loop conductors with different routing (loop area in the order of 50 m^2, width = 0,5 m), 350 m apart from the lightning stroke, inside an unshielded structure. For other loop and structure characteristics, values should be multiplied by factors K_{S1}, K_{S2}, K_{S3} (see Clause B.6).

[f] Detailed information is given in IEC 62305-1:2024, Clause E.2.

Values of probability P_{SPD} given in Table B.7 and in Table B.8 refer to the case of P_{Up} being negligible in comparison with P_Q and then $P_{SPD} = P_Q$. The values of P_{SPD} given in Table B.7 and in Table B.8 can be obtained by means of an SPD system consisting of two SPDs. For some applications, the installation of two SPDs may not be possible. In order to assess the efficiency of an SPD system it is necessary to compare the protection level U_p and the discharge current parameters I_{imp}.

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Different values of probability P_{SPD} than those given in Table B.7 and in Table B.8 can be used if they are sufficient to reduce the risk R and the frequency of damage F below the tolerable values.

NOTE 3 The characteristics of the line upstream of the SPD system and of the internal circuit downstream of the SPD system have a strong influence on the value of the probability P_{SPD} that an apparatus, protected by an SPD system, is damaged. As the matter is complicated, when information on proper selection of an SPD system with negligible P_{Up} is not available, as a first approximation, the simplified rules given for general guidance in IEC 62305-4:2024, Annex C, can be used. In this case the values of P_{SPD} achieved are higher than those given in Table B.7 and in Table B.8.

NOTE 4 Additional information on the selection of an SPD system giving the required probability P_{SPD} can be provided after detailed investigation.

NOTE 5 Values given in Table B.7 and Table B.8 apply for common cases. Values of P_{SPD} based on a more detailed analysis can be determined based on Annex D.

Table B.9 – Values of factors C_{LD} and C_{LI} depending on shielding, grounding and isolation conditions

External line type	Connection at entrance	C_{LD}	C_{LI}
Aerial line unshielded	Undefined	1	1
Buried line unshielded	Undefined	1	1
Multi grounded neutral power line	None	1	0,2
Shielded buried line (power or telecom)	Shield not bonded to the same bonding bar as equipment	1	0,3
Shielded aerial line (power or telecom)	Shield not bonded to the same bonding bar as equipment	1	0,1
Shielded buried line (power or telecom)	Shield bonded to the same bonding bar as equipment	1	0
Shielded aerial line (power or telecom)	Shield bonded to the same bonding bar as equipment	1	0
Lightning protective cable or wiring in lightning protective cable-ducts, metallic conduit, or metallic tubes	Shield bonded to the same bonding bar as equipment	0	0
No external line or optical line	No connection to metallic external lines	0	0
Any type	Connection to an isolating interface according to IEC 62305-4[a]	0	0

[a] For this equipment, C_{LD} and C_{LI} values are given in this table according to the external line type and connection at entrance. C_{LD} = 0 only if the isolating interface is protected by an SPD or if it is demonstrated by tests that the isolating interface has the appropriate surge withstand. In other cases, C_{LD} = 1. See also Note 5.

NOTE 6 An isolating interface is a part of an internal system and its probability of failure can be evaluated according to its withstand voltage. An SPD protecting the isolating interface, if provided, protects even the downstream equipment when the internal system between the isolating interface and the equipment is shielded; when the internal system is unshielded and if the voltage induced in this loop, calculated according to the required LPL, is greater than the rated impulse voltage of the equipment, an additional SPD can be used to protect downstream equipment.

NOTE 7 In the evaluation of probability P_C, values of C_{LD} in Table B.9 refer to shielded internal systems. The value of C_{LD} of an unshielded internal system not connected to external lines or optical lines, or connected to external lines consisting of lightning protective cable or systems with wiring in lightning protective cable-ducts, metallic conduit, or metallic tubes, bonded to the same bonding bar as equipment, is equal to the probability for which the induced voltage U_I is not higher than the rated impulse voltage U_w of the internal system ($U_I \leq U_w$). For evaluation of induced

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B.6 Probability P_M that a flash near a structure will cause failure of internal systems

A grid-like LPS, screening, routing precautions, increased withstand voltage, isolating interfaces and coordinated SPD systems are suitable as protection measures to reduce P_M.

NOTE 1 An external LPS even to LPL I will generally have no significant screening effect.

The probability P_M that a lightning flash near a structure will cause the failure of internal systems depends on the adopted SPMs (see IEC 62305-4).

When a coordinated SPD system meeting the requirements of IEC 62305-4 is not provided, the value of P_M is equal to the value of P_{MS}.

When a coordinated SPD system according to IEC 62305-4 is provided, the value of P_M is given by:

$$P_M = P_{SPD} \times P_{MS} \quad \text{(B.6)}$$

For internal systems with equipment not conforming to the resistibility or withstand voltage level given in the relevant product standards, P_M = 1 should be assumed.

P_{SPD} depends on the coordinated SPD system and on the loop area of the circuit of the SPD and the apparatus to be protected. Values of P_{SPD} are reported in Table B.7 and Table B.8.

NOTE 2 Because of very low values of expected charge flowing through the SPD compared to what a typical selected SPD can withstand, P_{SPD} is the probability that the value of residual voltage exceeds the required protection level relevant to the current flowing through the SPD (P_{Up}); such probability depends on the loop area A of the circuit of the SPD and apparatus and on the rated impulse voltage U_W of the apparatus to be protected. Simplified rules are given for general guidance in IEC 62305-4:2024, Annex C.

The values of P_{MS} are obtained from the product:

$$P_{MS} = (K_{S1} \times K_{S2} \times K_{S3})^2 \quad \text{(B.7)}$$

where

K_{S1} takes into account the screening effectiveness of the structure, LPS or other shields at boundary LPZ 0/1;

K_{S2} takes into account the screening effectiveness of shields internal to the structure at boundary LPZ X/Y (X > 0, Y > 1);

K_{S3} takes into account the characteristics of internal wiring (see Table B.10);

NOTE 3 In Equation (B.6), K_{S4} (which was in previous editions of this document related to the impulse withstand voltage of the system to be protected) is taken equal to 1, because the withstand voltage is already taken into account when calculating N_M.

NOTE 4 $K_{S3} = S/50$,

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where

$S = w \times l$ is the loop area;

w (m) is the width of the internal circuit;

l (m) is the length of the internal circuit.

Inside an LPZ, at a safety distance from the boundary screen at least equal to the mesh width w_m, factors K_{S1} and K_{S2} for the LPS or spatial grid-like shields can be evaluated as:

$$K_{S1} = 0{,}12 \times w_{m1} \quad \text{(B.8)}$$

$$K_{S2} = 0{,}12 \times w_{m2} \quad \text{(B.9)}$$

where w_{m1} (m) and w_{m2} (m) are the mesh widths of grid-like spatial shields, or of mesh type LPS down conductors or the spacing between the structure metal columns, or the spacing between a reinforced concrete framework acting as a natural LPS.

For continuous metal electromagnetic shields with thicknesses not lower than 0,1 mm, $K_{S1} = K_{S2} = 10^{-4}$.

NOTE 5 Where a meshed bonding network is provided according to IEC 62305-4, values of K_{S1} and K_{S2} can be halved.

Where the induction loop is running closely to the LPZ boundary shield conductors at a distance from the shield shorter than the safety distance, the values of K_{S1} and K_{S2} will be higher. For instance, the values of K_{S1} and K_{S2} should be doubled where the distance to the shield ranges from 0,1 w_m to 0,2 w_m.

For a cascade of LPZs the resulting K_{S2} is the product of the relevant K_{S2} of each LPZ.

NOTE 6 The maximum value of K_{S1} and K_{S2} is limited to 1.

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Table B.10 – Value of factor K_{S3} depending on internal wiring

Type of internal wiring	K_{S3} [a]
Unshielded cable – no routing precaution in order to avoid loops[b]	1
Unshielded cable – routing precaution in order to avoid large loops[c]	0,5
Unshielded cable – routing precaution in order to avoid large loops[d]	0,2
Unshielded cable – routing precaution in order to avoid loops[e]	0,01
Shielded cables and cables running in metal conduits[f]	0,000 1

[a] Data referred to circuits 100 m long. For shorter circuits the K_{S3} values can be proportionally reduced.

[b] Loop conductors with different routing (spacing between live conductors and PE ≥ 0,5 m) in large buildings (loop area in the order of 50 m^2).

[c] Loop conductors routed in the same conduit (spacing between live conductors and PE ≤ 0,25 m) or loop conductors with different routing in small buildings (loop area in the order of 25 m^2).

[d] Loop conductors routed in the same conduit (spacing between live conductors and PE ≤ 0,1 m) or loop conductors with different routing in small buildings (loop area in the order of 10 m^2).

[e] Loop conductors routed in the same cable (spacing between live conductors and PE of the order of 0,005 m) (loop area of the order of 0,5 m^2).

[f] Shields and the metal conduits bonded to an equipotential bonding bar at both ends and equipment is connected to the same bonding bar.

B.7 Probability P_U that a flash to a line will cause damage due to touch voltage

The values of probability P_U that a flash to a line will cause damage due to touch voltage inside the structure, depends on the characteristics of the line shield, the impulse withstand voltage of internal systems connected to the line, the protection measures like physical restrictions or warning notices and the isolating interfaces or SPD(s) provided for equipotential bonding at the entrance of the line according to IEC 62305-3.

NOTE 1 A coordinated SPD system according to IEC 62305-4 is not necessary to reduce P_U; in this case SPD(s) according to IEC 62305-3 are sufficient.

The value of P_U is given by:

$$P_U = P_{am} \times P_{EB} \times P_{LD} \times P_{TWS} \times C_{LD} \times r_t \quad \text{(B.10)}$$

where

P_{am} depends on protection measures against touch voltages, such as physical restrictions or warning notices. Values of P_{am} are given in Table B.1;

P_{TWS} is the probability with which a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area;

NOTE 2 The purpose of a warning message created by a TWS is to ensure prompt and complete evacuation of the exposed area. If this evacuation is not ensured or a TWS is not provided or if the manufacturer does not declare the FTWR, P_{TWS} = 1 is assumed (see also IEC 62305-1:2024, 7.1 for restrictions of application of a TWS).

NOTE 3 Disconnection is an option that can be used in a case-by-case evaluation, taking care of voltage generated in absence of surge protection. Disconnection can be valid for surges coming from lines (either direct or induced).

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P_{LD} is the probability of failure of internal systems due to a flash to the connected line depending on the line characteristics. Values of P_{LD} are given in Table B.11 and Table B.12;

NOTE 4 Values of P_{LD} can be calculated with the following equations:

$P_{LD} = P(I)$

$I = U_w/(4 \times R_s \times \sqrt{\rho} \times 10^{-3})$

where

I is the peak current of positive and negative first strokes (kA);

R_s is the resistance per unit length of the sheath (Ω/km);

ρ is the soil resistivity (Ω · m).

P_{EB} depends on the equipotential bonding conforming to IEC 62305-3. Values of P_{EB} are reported in Table B.13;

NOTE 5 $P_{EB} = P_Q$

C_{LD} is a factor depending on shielding, grounding and isolation conditions of the line. Values of C_{LD} are given in Table B.9;

r_t is the reduction factor as a function of the type of surface of soil or floor. Values of r_t are given in Table B.2.

NOTE 6 When SPD(s) according to IEC 62305-3 are provided for equipotential bonding at the entrance of the line, earthing and bonding according to IEC 62305-4 can improve protection.

Table B.11 – Values of the probability P_{LD} depending on the resistance R_S of the cable screen and the impulse withstand voltage U_W of the equipment

Routing, shielding and bonding conditions		Withstand voltage U_W in kV							
		0,35	0,5	1	1,5	2,5	4	6	12
		P_{LD}							
Aerial or buried line, unshielded or shielded whose shield is not bonded to the same bonding bar as the equipment		1	1	1	1	1	1	1	1
Shielded aerial or buried, with shield bonded to the same bonding bar as the equipment	5 Ω/km < R_S ≤ 20 Ω/km	1	1	1	1	0,95	0,9	0,8	0,4
	1 Ω/km < R_S ≤ 5 Ω/km	1	1	0,9	0,8	0,6	0,3	0,1	0,02
	R_S ≤ 1 Ω/km	1	0,85	0,6	0,4	0,2	0,04	0,02	0,005

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Table B.12 – Values of the probability P_{LD} depending on the resistance R_S of the cable screen and the higher impulse withstand voltage U_W of the equipment

Routing, shielding and bonding conditions		Withstand voltage U_W in kV					
		16	20	40	60	75	95
		P_{LD}					
Aerial or buried line, unshielded or shielded whose shield is not bonded to the same bonding bar as the equipment		1	1	1	1	1	1
Shielded aerial or buried, with shield bonded to the same bonding bar as the equipment	5 Ω/km < R_S ≤ 20 Ω/km	0,3	0,15	0,03	0,01	0,007	0,005
	1 Ω/km < R_S ≤ 5 Ω/km	0,01	0,007	0,001 5	0,001	4×10^{-4}	2×10^{-4}
	R_S ≤ 1 Ω/km	0,002	0,001 5	4×10^{-4}	$1,5 \times 10^{-4}$	10^{-4}	$0,7 \times 10^{-4}$

NOTE 7 In suburban and urban areas, an LV power line uses typically unshielded buried cable whereas a telecommunication line uses a buried shielded cable (with a minimum of 20 conductors, a shield resistance of 5 Ω/km, a copper wire diameter of 0,6 mm). In rural areas, an LV power line uses an unshielded aerial cable whereas a telecommunication line uses an aerial unshielded cable (copper wire diameter: 1 mm). An HV buried power line uses typically a shielded cable with a shield resistance in the order of 1 Ω/km to 5 Ω/km. The information provided by this note can be improved after a more detailed investigation.

NOTE 8 Values lower than those reported in Table B.11 and Table B.12 can be assigned to probability P_{LD} where the shield of the line is bonded at both ends to the same earthing system.

Table B.13 – Typical values of probability P_{EB} relevant to protection level LPL for which the SPD is designed to protect against source of damage S3

LPL	Power lines kA 10/350 µs	Telecommunication lines kA 10/350 µs	P_{EB}
No SPDs			1
III to IV	5	1	0,05
II	7,5	1,5	0,02
I	10	2	0,01
NOTE For information on values of current and specific conditions, refer to IEC 62305-1:2024, Table E.1 and Table E.2.			

NOTE 9 Values of P_{EB} lower than in Table B.13 are possible if the values of I_{imp} and I_n for which SPDs are designed, are higher than those required for LPL I.

B.8 Probability P_V that a flash to a line will cause physical damage by fire or explosion

The values of probability P_V that a flash to a line entering the structure will cause physical damage by fire or explosion, depend on the characteristics of the line shield, the impulse withstand voltage of internal systems connected to the line and the isolating interfaces or the SPDs provided for equipotential bonding at the entrance of the line according to IEC 62305-3.

NOTE 1 A coordinated SPD system according to IEC 62305-4 is not necessary to reduce P_V; in this case, SPDs according to IEC 62305-3 are sufficient.

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The value of P_V is given by:

$$P_V = P_{EB} \times P_{LD} \times P_{TWS} \times C_{LD} \times r_f \times r_p \quad \text{(B.11)}$$

where

P_{LD} is the probability of failure of internal systems due to a flash to the connected line depending on the line characteristics. Values of P_{LD} are given in Table B.11 and Table B.12;

P_{TWS} is the probability with which a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area;

NOTE 2 The purpose of a warning message created by a TWS is to ensure prompt and complete evacuation of the exposed area. If this evacuation is not ensured or a TWS is not provided or if the manufacturer does not declare the FTWR, P_{TWS} = 1 is assumed (see also IEC 62305-1:2024, 7.1 for restrictions of application of a TWS).

NOTE 3 Disconnection is an option that can be used in a case-by-case evaluation, taking care of voltage generated in absence of surge protection. Disconnection can be valid for surges coming from lines (either direct or induced). See IEC 62305-1 for more details.

P_{EB} depends on the equipotential bonding conforming to IEC 62305-3; values of P_{EB} are reported in Table B.13;

C_{LD} is a factor depending on shielding, grounding and isolation conditions of the line. Values of C_{LD} are given in Table B.9;

r_p is the reduction factor as a function of provisions taken to reduce the consequences of fire. Values of r_p are given in Table B.5;

r_f is the reduction factor as a function of risk of fire or explosion of structure. Values of r_f are given in Table B.6.

NOTE 4 When a direct strike occurs on an external buried service it can damage the service (mechanical damage, fire, etc.) or create punctures on many places along the cable leading to long term degradation (corrosion for example). These damages are outside the scope of this document that is considering only the influence of the services to the studied structure.

B.9 Probability P_W that a flash to a line will cause failure of internal systems

The values of probability P_W that a flash to a line entering the structure will cause a failure of internal systems depend on the characteristics of line shielding, the impulse withstand voltage of internal systems connected to the line and the isolating interfaces or the coordinated SPD system installed.

The value of P_W is given by:

$$P_W = P_{SPD} \times P_{TWS} \times P_{LD} \times C_{LD} \quad \text{(B.12)}$$

where

P_{SPD} depends on the coordinated SPD system. Values of P_{SPD} are reported in Table B.7 and Table B.8;

P_{TWS} is the probability with which a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area;

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NOTE The purpose of a warning message created by a TWS is to ensure prompt and complete evacuation of the exposed area. If this evacuation is not ensured or a TWS is not provided or if the manufacturer does not declare the FTWR, P_{TWS} = 1 is assumed (see also IEC 62305-1:2024, 7.1 for restrictions of application of a TWS).

P_{LD} is the probability of failure of internal systems due to a flash to the connected line depending on the line characteristics. Values of P_{LD} are given in Table B.11 and Table B.12;

C_{LD} is a factor depending on shielding, grounding and isolation conditions of the line. Values of C_{LD} are given in Table B.9.

B.10 Probability P_Z that a lightning flash near an incoming line will cause failure of internal systems

The values of probability P_Z that a lightning flash near a line entering the structure will cause a failure of internal systems depend on the characteristics of the line shield and the isolating interfaces or the coordinated SPD system provided.

The value of P_Z is given by:

$$P_Z = P_{SPD} \times P_{TWS} \times C_{LI} \quad \text{(B.13)}$$

where

P_{SPD} depends on the coordinated SPD system. Values of P_{SPD} are reported in Table B.7 and in Table B.8;

P_{TWS} is the probability with which a thunderstorm warning system (TWS) does not detect a lightning-related event in the target area;

NOTE If a TWS creates a warning message, it is considered effective only if immediate and complete disconnection of the external distribution lines is ensured. If this disconnection is not ensured or a TWS is not provided P_{TWS} = 1 can be assumed.

C_{LI} is a factor depending on shielding, grounding and isolation conditions of the line. Values of C_{LI} are given in Table B.9.

B.11 Probability P_P that a person will be in a dangerous place

The probability P_P that a person will be in a dangerous place depends on the time t_z in hours per year for which the persons are present in the dangerous place:

$$P_P = t_z / 8\,760 \quad \text{(B.14)}$$

NOTE 1 Where the value of t_z is not known, the ratio t_z/8 760 = 1.

NOTE 2 In cases where a TWS allows a temporary evacuation of an area, t_z is multiplied by P_{TWS}.

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B.12 Probability P_e that an equipment will be exposed to a damaging event

The probability P_e that an undamaged equipment is exposed to a damaging event depends on the time t_e in hours per year of exposure of the equipment to the damaging event.

$$P_e = t_e / 8\,760 \quad \text{(B.15)}$$

NOTE 1 Where the value of t_e is not known, the ratio $t_e/8\,760 = 1$.

NOTE 2 In case of an explosive zone P_e can be calculated as $P_e = (t_e / 8\,760) \times r_f$ (r_f being related to the maximum presence of explosive atmosphere time divided by 8 760) when calculating risk components. This does not apply for the calculation of frequency of damage where only P_e is used.

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Annex C
(informative)

Assessment of loss L_X

C.1 General

L_X represents the mean extent of loss due to a dangerous event, expressed in a relative way related to the maximum extent of loss in the considered risk zone of the structure to be protected.

The values of L_X should be selected on the basis of the type of structure according to its function or contents, or both, the public impact of loss of structure (e.g. costs of emergency measures to limit the damage, the costs resulting from loss of the structure and production, the costs of reconstruction and in the general costs that the public has to bear).

The values of loss L_X should be evaluated and fixed by the lightning protection designer (or the owner of the structure). The mean values of loss L_X in a structure given in this Annex C are typical values. Different values can be assigned after detailed investigation.

NOTE 1 When the damage to a structure due to lightning can also involve surrounding structures or the environment (e.g. fire propagation, explosion, chemical or radioactive emissions), a more detailed evaluation of L_X taking into account this additional loss can be performed. See Annex E.

NOTE 2 It is rare that loss of human life is not considered at all because most of the structures are staffed (at least for some periods of time, for example a maintenance team or security personnel). Other structures have almost permanent presence of human life such as national heritage or office building having employees and visitors.

It is emphasized that the overall risk for a given structure or application most often consists of a combination of risk components. However, to only calculate the risk of loss of human life (including permanent injury), then one or both of the following mean relative losses can be fixed equal to 0:

L_{F2} is the typical mean ratio of physical damage by fire or explosion;

L_{O2} is the typical mean ratio of physical damage by failure of internal systems.

In the same way, to only calculate the risk assuming there is no risk of loss of human life (including permanent injury) it is then possible to fix one or more of the following mean relative losses equal to 0:

L_T is the typical mean ratio of persons injured by touch and step voltages;

L_D is the typical mean ratio of persons injured by direct lightning stroke;

L_{F1} is the typical mean ratio of persons injured by fire or explosion;

L_{O1} is the typical mean ratio of persons injured by failure of internal systems;

And other parameters are calculated taking into account the application.

C.2 Mean relative loss per dangerous event

The loss L_X refers to the mean relative extent of a specified type of loss for one dangerous event caused by a lightning flash, considering both its extent and effects.

The loss value L_X varies with the cause of damage (D_{1D}, D_{1T}, D_2 and D_3).

The loss L_X should be determined for each risk zone of the structure into which it is divided or the structure as a whole.

The loss value L_X for each risk zone or the structure can be determined according to Table C.1

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Table C.1 – Loss values for each zone

Typical loss
$L_{AT} = L_{UT} = L_T$
$L_{AD} = L_D$
$L_{B1} = L_{V1} = L_{F1}$
$L_{B2} = L_{V2} = L_{F2}$
$L_{C1} = L_{M1} = L_{W1} = L_{Z1} = L_{O1}$
$L_{C2} = L_{M2} = L_{W2} = L_{Z2} = L_{O2}$

where

L_T is the typical mean ratio of persons injured by touch and step voltages related to the total number of persons in the risk zone or the structure, due to one dangerous event (see Table C.2);

L_D is the typical mean ratio of persons injured by direct lightning stroke related to the total number of persons exposed in the risk zone or the structure, due to one dangerous event (see Table C.2);

L_{F1} is the typical mean ratio of persons injured by fire or explosion related to the total number of persons in the risk zone or the structure, due to one dangerous event (see Table C.2);

L_{F2} is the typical mean ratio of physical damage by fire or explosion related to the maximum extent of damage in the risk zone or the structure, due to one dangerous event (see Table C.2);

L_{O1} is the typical mean ratio of persons injured by failure of internal systems related to the total number of persons in the risk zone or the structure, due to one dangerous event (see Table C.2);

L_{O2} is the typical mean ratio of physical damage by failure of internal systems related to the maximum extent of damage in the risk zone or the structure, due to one dangerous event (see Table C.2).

NOTE 1 The typical mean value of the loss can be seen as the average value of the loss due to a dangerous event causing damages.

NOTE 2 Regarding L_{F1} or L_{O1} and L_{F2} or L_{O2} the levels of loss can be different for people and structure and this means that for example for a hospital, L_{F1} can be selected in the first row and L_{F2} in the second row of Table C.2 and vice versa for a museum.

NOTE 3 It is possible to use $L_{F1} = L_{F2}$ by selecting the highest value of both proposed values in Table C.2.

NOTE 4 L_T, L_D, L_{F1}, L_{O1} refer to human beings and L_{F2} and L_{O2} refer to structures and internal systems.

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Table C.2 – Typical mean values of L_T, L_D, L_{F1}, L_{F2}, L_{O1} and L_{O2}

Type of structures or risk zones	L_T	L_D	L_{F1}	L_{F2}	L_{O1}	L_{O2}
Very high loss or highly critical structures or risk zones[a]	10^{-2}	10^{-2} – 10^{-1}	10^{-2} – 2×10^{-1}	10^{-2} – 2×10^{-1}	10^{-3} – 10^{-2}	10^{-3} – 10^{-2}
High loss or critical structures or risk zones[b]			10^{-2} – 10^{-1}	10^{-2} – 10^{-1}	10^{-4} – 10^{-3}	10^{-4} – 10^{-3}
Normal loss structures or risk zones[c]			5×10^{-3} – 5×10^{-2}	5×10^{-3} – 5×10^{-2}	10^{-5} – 5×10^{-4} [e]	10^{-5} – 5×10^{-4} [e]
Low-loss structures or risk zones[d]			2×10^{-3} – 2×10^{-2}	2×10^{-3} – 2×10^{-2}	10^{-5} – 10^{-4} [e]	10^{-5} – 10^{-4} [e]

[a] Such as structures or risk zones with a risk of explosion, structures or risk zones with life-saving electrical equipment or other structures when failure of internal systems involve injury to human beings or danger to the environment (e.g. operating rooms and intensive care units in hospitals).

[b] Such as structures or risk zones related to people with reduced mobility (e.g. rooms block in hospitals, prisons), structures or risk zones with essential equipment for carrying out processes (e.g. control room in industrial structures, power station, telecommunication centre), structures or risk zones with cultural heritage (e.g. museum).

[c] Such as structures open to the public (e.g. churches, hotels, schools, offices, civic building open to public, public entertainment, supermarkets).

[d] Such as buildings in private ownership (e.g. apartment house, farmhouse).

[e] This is only applicable when risk of explosion or when failure of internal systems involve injury to human beings or danger to the environment (e.g. equipment failure by a surge leading to release of polluted water to the river or when an equipment fire created by a surge can propagate to the structure when there are PV systems or DC voltages). In general structure or risk zone with such a risk are classified very high loss or high loss.

A more detailed evaluation can be necessary for the values for loss (L_{F1}, L_{F2}, L_{O1}, L_{O2}). The highest values for losses given in Table C.2 are recommended as default values. Other values can be used based on a specific study or experience especially if lower values than the proposed minimum values given in Table C.2 are used.

When the damage to a structure due to lightning involves surrounding structures or the environment (e.g. explosion, chemical or radioactive emissions), additional loss L_E should be taken into account to evaluate the total loss (L_{BT} and L_{VT}).

$$L_{BT} = L_B + L_E \quad \text{(C.1)}$$

$$L_{VT} = L_V + L_E \quad \text{(C.2)}$$

where L_E is the typical mean ratio of loss outside the structure related to the maximum extent of loss in the zone, due to one dangerous event.

NOTE 5 L_E can be evaluated using Annex E.

NOTE 6 Environmental influences can also be considered, if they are treated as a separate zone.

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Annex D
(informative)

P_{SPD} evaluation

D.1 General

Values given in Table B.7 and Table B.8 apply for common cases. Values of P_{SPD} based on a more detailed analysis can be determined based on this Annex D.

This Annex D shows how the probability factor P_{SPD} of a coordinated SPD system can be determined. It is intended for specific applications when P_{SPD} values other than those given in Table B.7 and Table B.8 are used.

The evaluation of the P_{SPD} values against the different sources of damage (i.e. S1, S2, S3 and S4) is done through graphics, obtained by a calculation tool taking into account the propagation effect in the circuit between the SPD and the equipment to be protected, the induced voltage in this circuit and the voltage drop in the SPD connecting leads.

The graphics refer to typical installations and the defined rated impulse voltage of the equipment, i.e. 2,5 kV for power port and 1,5 kV for signal port of an equipment. It provides a guidance on how to obtain P_{SPD} for other cases using a similar method.

The probability P_X of protection measures to reduce the failure of internal systems depends on the probability P_{SPD} of a coordinated SPD system.

Failure of an equipment protected by an SPD system can occur either if:

a) the charge associated to the current I_{SPD} flowing through the SPD exceeds the value tolerated by the SPD or

b) the protection voltage U_p exceeds the required protection level U_{pr} of the SPD to limit the overvoltage value at the equipment input to a value not greater than the equipment impulse rated voltage (U_w).

The probability that an overvoltage will not damage an equipment protected by a coordinated SPD system is the probability that both conditions (a) and (b) will not occur.

Being:

– P_Q: probability associated with the source of damage causing the current described in condition (a);

– P_{Up}: probability associated with the source of damage causing the condition (b).

Then the probability P_{SPD} is given by:

$$P_{SPD} = 1 - (1 - P_Q) \times (1 - P_{Up}) \quad \text{(D.1)}$$

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The probability P_{SPD} can be simplified as follows when referring the probability P_Q to positive and negative first strokes and the probability P_{Up} to the subsequent strokes of negative flashes (worst case) and when P_Q and P_{Up} are much less than 1:

$$P_{SPD} = P_Q + 0{,}9 \times P_{Up} \quad \text{(D.2)}$$

D.2 P_Q values

D.2.1 Probability values of both the negative and positive first strokes

The probability values of the charge can be calculated using the log-normal distributions of the charge of both negative first short (P_{Q-}, mean m = 4,69 and dispersion σ = 0,383) and positive first short (P_{Q+}, mean m = 17,3, dispersion σ = 0,57), given in IEC 62305-1:2024, Annex A, and combining the probabilities associated with a given charge value considering that 90 % of flashes are negative and 10 % positive. This (P_Q) calculation is reported in Figure D.1.

D.2.2 Source of damage S1

According to IEC 62305-1:2024, Annex E, the charge of the source of damage S1 causing the impulse current I_{imp} in the SPD can be calculated as follows:

$$Q = I_{imp} \times n \times n' / k_e \quad \text{(D.3)}$$

where

$k_e = n' \times R_s / (n' \times R_s + R_c)$;

n is the number of services entering the structure;

n' is the number of conductors of the considered service;

R_s is the shield resistance per unit length of the shielded service;

R_c is the conductor resistance per unit length of the service.

k_e = 1 for unshielded conductors.

The value of the charge given by Equation (D.3) is used for reading, in Figure D.1, the probability P_Q of the impulse current I_{imp} of the SPD.

EXAMPLE n = 2 services and n' = 4 unshielded conductors, I_{imp} = 10 kA, Equation (D.3) gives Q = 80 C and P_Q = 0,012 can be estimated in Figure D.1, whereas when n = 1, for the same 10 kA current, Equation (D.3) gives Q = 40 C and P_Q = 0,033 can be estimated in Figure D.1.

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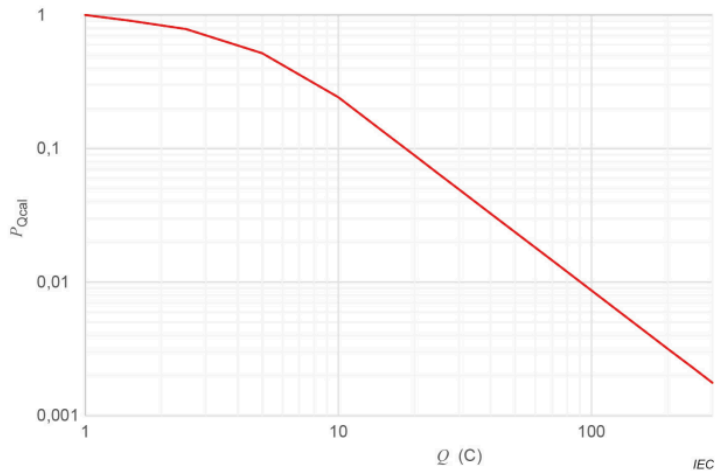


Figure D.1 – Charge probability of both negative and positive first strokes

D.2.3 Source of damage S3

According to IEC 62305-1:2024, Annex E, the charge of the source of damage S3 causing the impulse current I_{imp} in the SPD can be calculated as follows:

$$Q = 2{,}5 \times n' \times I_{imp} / k_e \quad \text{(D.4)}$$

The value of the charge given by Equation (D.4) is used for reading, in Figure D.1, the probability P_Q of the impulse current I_{imp} of the SPD.

EXAMPLE 1 n' = 2 unshielded conductors. For a power line when I_{imp} = 10 kA, Equation (D.4) gives Q = 50 C and then Figure D.1 gives P_{Q1} = 0,024. For a telecommunication line when I_{imp} = 2,5 kA, Equation (D.4) gives Q = 12,5 C and then Figure D.1 gives P_Q = 0,175.

For the specific case where a 2-conductor telecommunication line (one pair) it is usual (called hereafter "traditional telecommunication line") that the length (l_1) of the 2 conductors' section that enters the structure is about 10 % of the total length (typically about 4 km to 5 km of total length), where the other sections are composed by many pairs, e.g. some hundred pairs. In this case, the probability P_Q value can be specifically evaluated referring to the two conductors' section as follows:

$$P_Q = 0{,}1 \times P_{Q1} \quad \text{(D.5)}$$

where P_{Q1} is the probability of the charge given by Equation (D.4).

EXAMPLE 2 n' = 2 unshielded conductors. For a traditional telecommunication line, when I_{imp} = 1 kA, Equation (D.4) gives Q = 5 C and Figure D.1 gives P_{Q1} = 0,52 and then it is possible to use Equation (D.5) that gives P_Q = 0,052.

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D.2.4 Sources of damage S2 and S4

According to the induced current values due to source of damage S2 or S4 given in Table B.7 and Table B.8 or in IE 62305-1:2024, Table E.2 and Table E.3, considering that the SPDs typically used have a nominal discharge current values I_n = 5 kA, the probability P_{QM} and P_{QZ} values are about 10^{-4} to 10^{-5} (almost negligible).

D.3 SPD protection level

D.3.1 General

For the purpose of this document, voltage switching and voltage limiting SPDs are defined as follows:

– voltage switching SPD: SPD that has a high impedance when no surge is present, but can have a sudden change in impedance to a low value in response to a voltage surge;

– voltage limiting SPD: SPD that has a high impedance when no surge is present, but will reduce it continuously with increased surge current and voltage.

D.3.2 Source of damage S1

D.3.2.1 One voltage limiting SPD

P_{Up} value is obtained for a current of 1 kA (due to the fact that P_{Up} relates to subsequent strokes) and the residual voltage at 1 kA is called U_p' hereafter.

NOTE 1 This value can be obtained from the SPD datasheet or, if not available, a common approximation is to take the residual voltage at 5 kA and reduce it by 200 V.

The P_{Up} values as a function of the residual voltage at 1 kA (U_p') are reported in Figure D.2 for different k_{1i} parameter values, when U_w = 2,5 kV, l_c = 0,5 m, $n \times n' \geq 8$ and $k_r > 1$.

where

k_{1i} = $w \times k_c \times l_{eq} / d$;

l_{eq} = $l_v + k_o \times l_o$ [m] (see IEC 62305-4:2024, Annex H);

l_v and l_o are the lengths (m) of the induction loop between the SPD and the equipment parallel and orthogonal to the down conductors respectively;

l_o' = $k_o \times l_o = [l_o \times w \times \ln(d + l_o) / d]/[l_o \times \ln(d + w) / d]$ [m];

w is the width (m) of the internal system;

k_c is the current sharing between down conductors;

d is the distance (m) of the induction loop from the nearest down conductor;

k_r is the reflection coefficient;

k_0 is the ratio between the induced voltage in a loop orthogonal and parallel to the down conductor.

NOTE 2 According to Table B.10, a shielded cable can be represented by w = 0,000 05 m.

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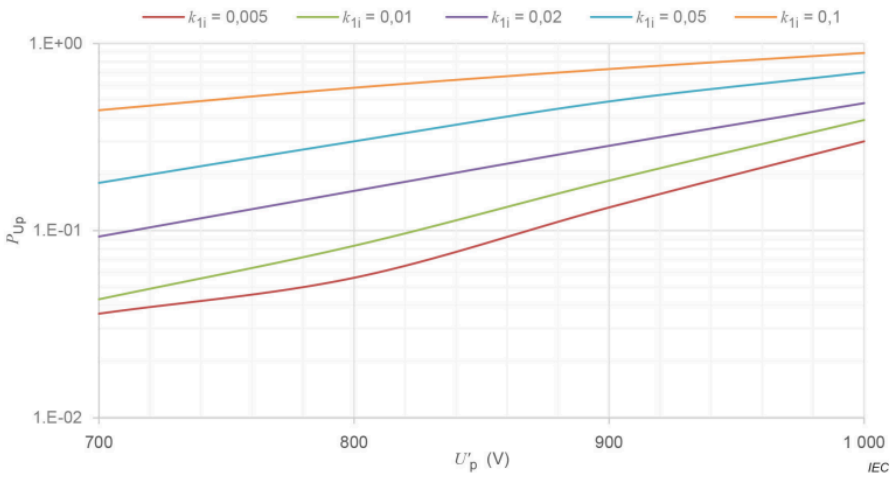


Figure D.2 – Probability P_{Up} as a function of the SPD residual voltage U_p' at 1 kA

EXAMPLE n = 2, n' = 4, w = 0,005 m, k_c = 0,44, d = 1 m, l_v = 6 m, l_o = 44 m, l_c = 0,5 m, U_w = 2,5 kV. In this case, l_o' = 3,8 m, l_{eq} = 9.8 m, k_{1i} = 0,02, selecting a voltage limiting SPD with U_p' = 900 V, Figure D.2 indicates $P_{Up} \approx 0,3$.

D.3.2.2 One voltage switching SPD

The voltage switching SPDs are typically used on telecommunication lines at the entrance of the structure and typical protection levels of gas discharge tubes (GDT) are 700 V or 550 V.

Figure D.3 shows the P_{Up} values as a function of different k_{1i} parameter values for the two typical U_p values of GDTs, i.e. 700 V and 550 V, when U_w = 1,5 kV, l_c = 0,5 m, k_r > 1, n' ≥ 20 conductors.

NOTE U_p values refer to 1 kV/µs (see IEC 61643-21).

EXAMPLE n = 2, n' = 20, w = 0,1 m, k_c = 0,1, d = 2 m, l_v = 5 m, l_o = 21 m, l_c = 0,5 m, U_w = 1,5 kV. In this case, l_{eq} = 10 m, k_{1i} = 0,05, and selecting a voltage switching SPD with U_p = 550 V, Figure D.3 indicates $P_{Up} \approx 0,3$.

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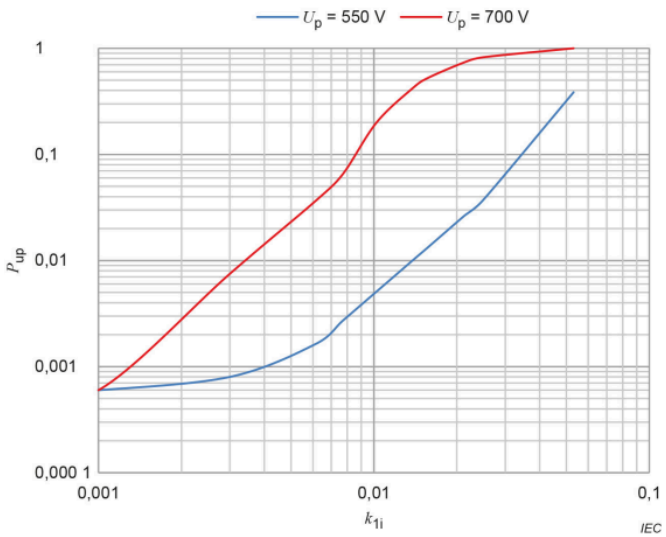


Figure D.3 – Probability P_{Up} as a function of k_{1i}

D.3.2.3 Combination of voltage limiting SPD and voltage switching SPD

When power is distributed according to the TT system, an SPD tested according to Class I tests can be installed upstream of the RCD. But in this case, protection against direct contact requires the installation of a voltage switching SPD between neutral and PE conductors (N-PE) in addition to voltage limiting SPDs between phase(s) and neutral conductors. In this case, it is possible to assume that the P_{Up} value is the greater value between that related to limiting or voltage switching SPDs.

Referring to typical installations where U_w = 2,5 kV and U_p = 1,5 kV of the voltage switching SPD, protection with one SPD can be achieved only when k_r = 1, i.e. when the distance of the SPD from the equipment to be protected is less than 10 m and damage to the equipment does not cause danger to persons. In this case, the P_{Up} value is that related to the voltage limiting SPD; the P_{Up} values for a typical installation are reported in Table D.1 as a function of the protection level at 1 kA of the voltage limiting SPD.

Table D.1 – P_{Up} values of the voltage limiting SPD for combination between a voltage limiting and a voltage switching SPD

n	n'	w m	d m	L_v m	L_o m	L_a m	k_c	k_r	U_p' kV	P_{Up}
2	4	0,005	1	2	8	10	0,44	1	0,8	0,005
									1	0,007
									1,2	0,009
When w = 0,1 m, P_{Up} values should be multiplied by a factor 60.										

When k_r > 1, a second SPD voltage limiting SPD shall be installed for protecting the equipment power port.

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D.3.2.4 Two voltage limiting SPDs

When the necessary P_{SPD} cannot be achieved by only one SPD at the entrance of the service into the structure, a second voltage limiting SPD (SPD2), which can withstand a charge coordinated with the charge of the first SPD, should be installed.

The P_{SPD} of this coordinated SPD system is obtained adding the P_Q of the first SPD and the P_{Up} of the second SPD according to Equation (D.2).

These P_{Up} values as a function of the protection level at 1 kA (U_p') of SPD2 are reported in Figure D.4 for different k_{1i} parameter values, when U_w = 2,5 kV, l_c = 0,5 m, $n \times n' \geq 8$ and $k_r > 1$.

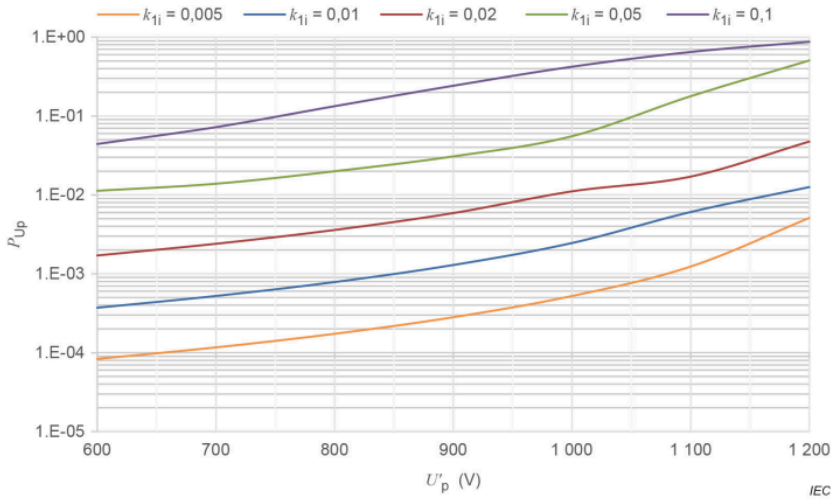


Figure D.4 – Probability P_{Up} as a function of the SPD2 residual voltage U_p' at 1 kA

D.3.2.5 Two SPDs: one voltage switching SPD and one voltage limiting SPD

When the required P_{SPD} cannot be achieved by only one voltage switching SPD at the entrance of the service into the structure, a second voltage limiting SPD (SPD2), which can withstand a charge coordinated with the charge of the first SPD, shall be installed.

The P_{SPD} of this coordinated SPD system is obtained adding the P_Q of the first SPD and the P_{Up} of the second SPD according to Equation (D.2).

These P_{Up} values as a function of the residual voltage at 1 kA (U_p') of SPD2 are reported in Figure D.5 for different k_{1i} parameter values, when U_w = 1,5 kV, l_c = 0,5 m, $n \times n' \geq 8$ and $k_r > 1$.

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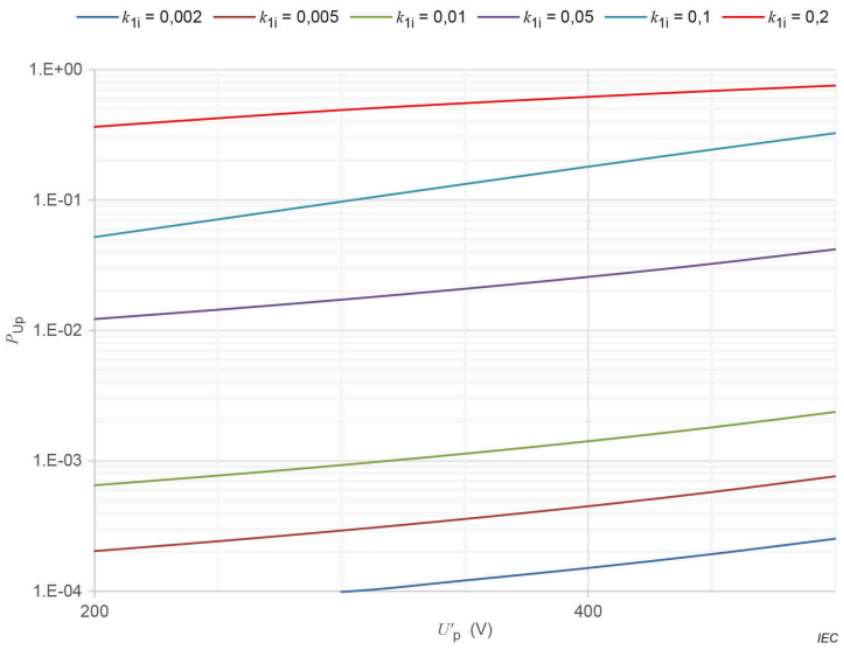


Figure D.5 – Probability P_{Up} as a function of the SPD2 residual voltage U_p' at 1 kA

D.3.3 Source of damage S3

D.3.3.1 One voltage limiting SPD

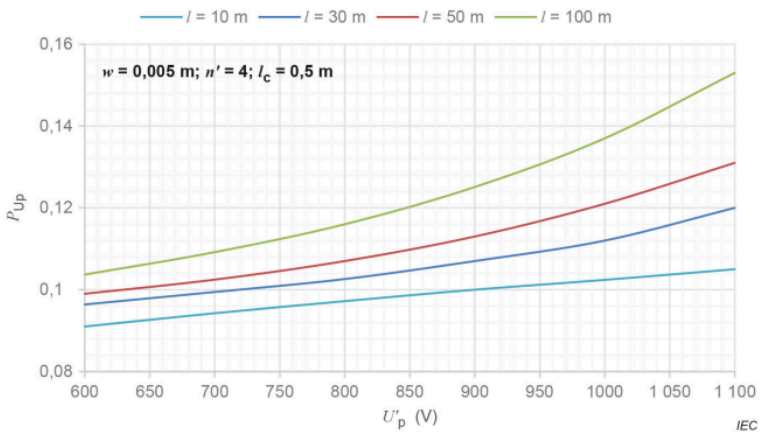
The P_{Up} values as a function of the residual voltage at 1 kA (U_p') are reported in Figure D.6 for different internal installation length values (l), when U_w = 2,5 kV, l_c = 0,5 m, n'= 4, k_r > 1, w = 0,005 m and external line length l_l is equal to 500 m.

EXAMPLE n' = 4, w = 0,1 m, l_v = 20 m, l_o = 80 m, l = 100 m, l_c = 0,5 m, U_w = 2,5 kV. Selecting a voltage limiting SPD with U_p' = 900 V, Figure D.6 indicates P_{Up} ≈ 0,125 when w = 0,005 m and n' = 4 conductors. However, Note 3 in Figure D.6 indicates that this value is multiplied by 1,4 when w = 0,1 m, then P_{Up} ≈ 0,125 × 1,4 = 0,175.

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NOTE 1 For other line external lengths (l_l), the P_{Up} values are multiplied by the factor 500/l_l.

NOTE 2 When n' = 2, the P_{Up} values are multiplied by 1,4 (approximate values).

NOTE 3 When w = 0,1 m, the P_{Up} values are multiplied by 1,4 (approximate values).

Figure D.6 – Probability P_{Up} as a function of the residual voltage at 1 kA (U_p')

D.3.3.2 One voltage switching SPD

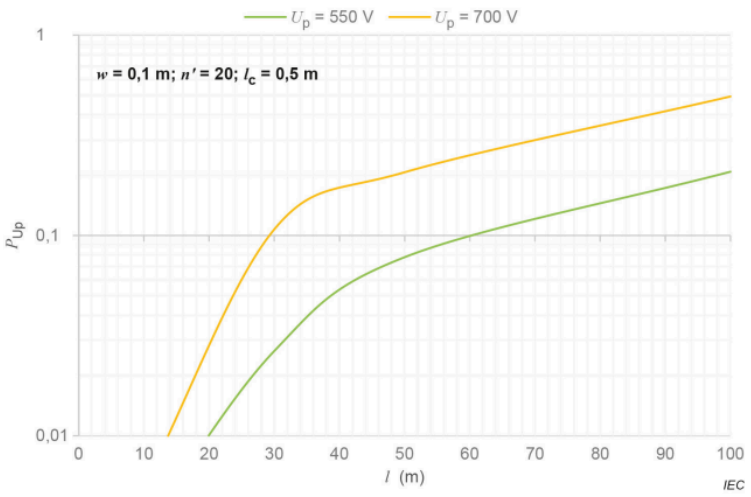
The P_{Up} values as a function of different internal installation length values (l), for two typical protection levels of GDTs, when U_w = 1,5 kV, l_c = 0,5 m, w = 0,1 m, k_r > 1 and external line length l_l = 500 m, are reported in Figure D.7 when n' = 20 conductors and in Figure D.8 when n' = 2 conductors.

NOTE The internal length of the circuit has been assumed to be 20 % vertical and 80 % horizontal (e.g. l = 30 m is composed by 6 m vertical and 24 m horizontal).

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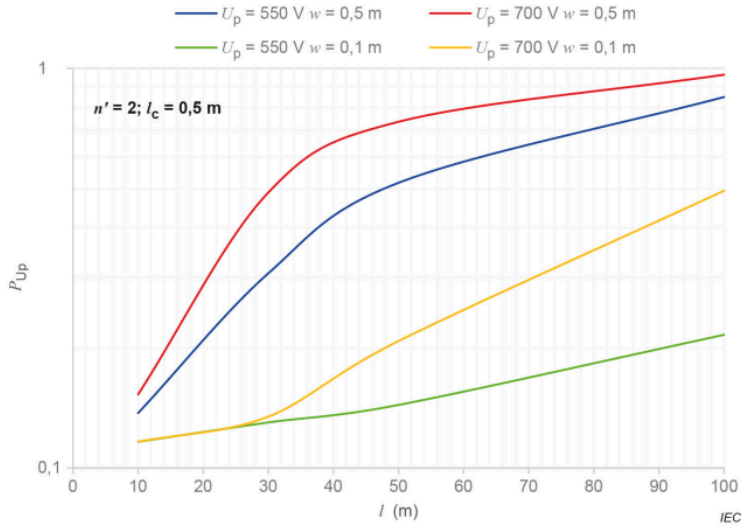


NOTE 1 For other external line lengths (l_l), the P_{Up} values are multiplied by the factor 500/l_l.

NOTE 2 When w = 0,005 m and n' = 20, the approximate P_{Up} value is 0,0034 for l_l = 500 m for both U_p values (550 V and 700 V). This value does not change significantly when the internal installation is shielded.

Figure D.7 – Probability P_{Up} as a function of different lengths of the internal circuit

EXAMPLE 2 unshielded conductors, 500 m external line length, U_w = 1,5 kV, l_c = 0,5 m, w = 0,1 m and l = 30 m. Installing GDTs with U_p = 550 V, Figure D.8 indicates P_{Up} = 0,134.



NOTE 1 For other external line lengths (l_l), the P_{Up} values are multiplied by the factor 500/l_l.

NOTE 2 When w = 0,5 m and n' = 20, the P_{Up} values do not change significantly.

NOTE 3 When w = 0,005 m and n' = 2, the approximate P_{Up} value is 0,12 for l_l = 500 m and for both U_p values (550 V and 700 V). This value does not change significantly when the internal installation is shielded.

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D.3.3.3 Limiting type SPD and voltage switching SPD

When power is distributed according to the TT system, an SPD tested according to Class I tests can be installed upstream of the RCD. But in this case, protection against direct contact requires the installation of a voltage switching SPD between neutral and PE conductors (N-PE) in addition to voltage limiting SPDs between phase(s) and neutral conductors. In this case, it is possible to assume that the P_{Up} value is the greater value between that related to limiting or voltage switching SPDs.

Referring to typical installations where U_w = 2,5 kV and U_p = 1,5 kV of the voltage switching SPD, protection with only one SPD can be achieved only when k_r = 1, i.e. when the distance of the SPD from the equipment to be protected is less than 10 m and damage to the equipment does not cause danger to persons. In this case, the P_{Up} value is that related to the voltage limiting SPD. In this case, the P_{Up} values for a typical installation are reported in Table D.2 as a function of the protection level at 1 kA of the voltage limiting SPD.

Table D.2 – P_{Up} values of the voltage limiting SPD

n'	w m	l_v m	l_o m	l m	k_r	U_p' kV	P_{Up}
4	0,1	2	8	10	1	0,8	0,05
						1	0,07
						1,2	0,1
When w = 0,005 m, P_{Up} values should be multiplied by a factor 0,8.							

When k_r > 1, a second SPD voltage limiting SPD shall be installed for protecting the equipment power port.

D.3.3.4 Two voltage limiting SPDs

When the necessary P_{SPD} cannot be achieved by only one SPD at the entrance of the service into the structure, a second voltage limiting SPD (SPD2), which can withstand a charge coordinated with the charge of the first SPD, shall be installed.

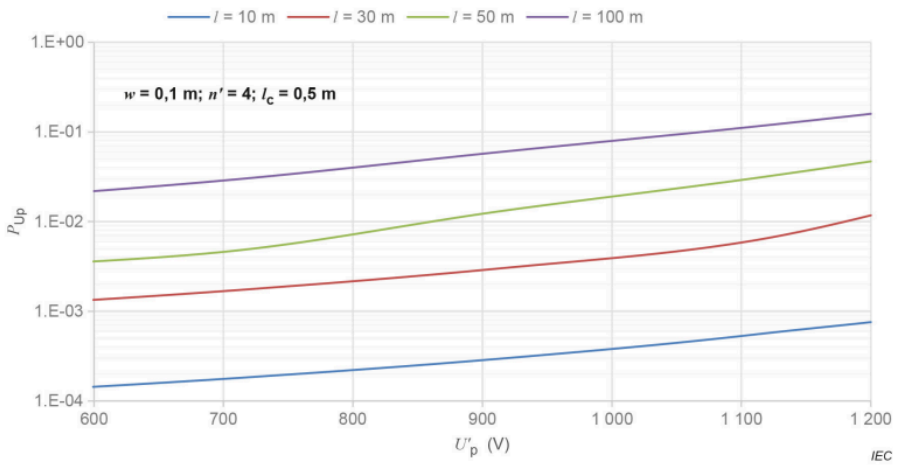
The P_{SPD} of this coordinated SPD system is obtained adding the P_Q of the first SPD and the P_{Up} of the second SPD according to Equation (D.2).

These P_{Up} values as a function of the protection level at 1 kA (U_p') of SPD2 are reported in Figure D.9 for different internal installation lengths (l), when U_w = 2,5 kV, l_c = 0,5 m, w = 0,1 m, n' = 4 and k_r > 1.

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NOTE 1 For other line external lengths (l_l), the P_{Up} values are multiplied by the factor 500/l_l.

NOTE 2 When n' = 2, the P_{Up} values are multiplied by 1,4 (approximate values).

NOTE 3 When w = 0,005 m, the P_{Up} values become almost negligible.

Figure D.9 – Probability P_{Up} as a function of the SPD2 residual voltage U_p' at 1 kA

D.3.4 Energy coordinated SPDs: One voltage switching SPD and one voltage limiting SPD downstream

When the necessary P_{SPD} cannot be achieved by only one SPD at the entrance of the service into the structure, a second voltage limiting SPD (SPD2), which can withstand a charge coordinated with the charge of the first SPD, shall be installed.

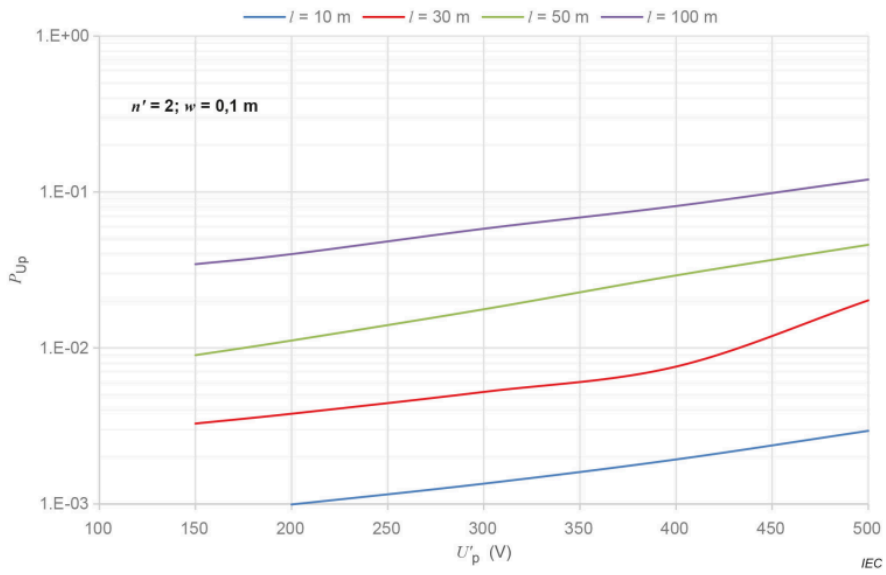
The P_{SPD} of this coordinated SPD system is obtained adding the P_Q of the first SPD and the P_{Up} of the second SPD according to Equation (D.2).

These P_{Up} values as a function of the protection level at 1 kA (U_p') of SPD2 are reported in Figure D.10 for different internal installation lengths (l), when U_w = 1,5 kV, l_c = 0,5 m, w = 0,1, n' = 2 and k_r > 1, in Figure D.11 when w = 0,5 m with n' = 2 or 20 conductors and in Figure D.12 when w = 0,1 and n' = 20 conductors.

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NOTE 1 For other external line lengths (l_l), the P_{Up} values are multiplied by the factor $500/l_l$.

NOTE 2 When n' = 4, the P_{Up} values are multiplied by 0,7 (approximate values).

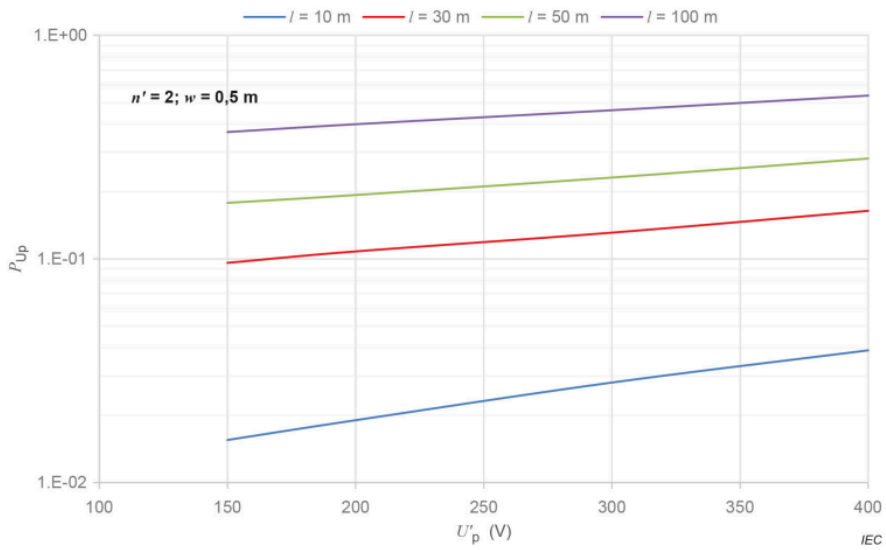
NOTE 3 When w = 0,005 m and n' = 2, the P_{Up} values become almost negligible (P_{Up} = 0,000 4 when U_p' = 400 V and P_{Up} = 0,000 2 when U_p' = 200 V for the maximum length of 100 m).

Figure D.10 – Probability P_{Up} as a function of the internal loop area for n' = 2 and w = 0,1 m

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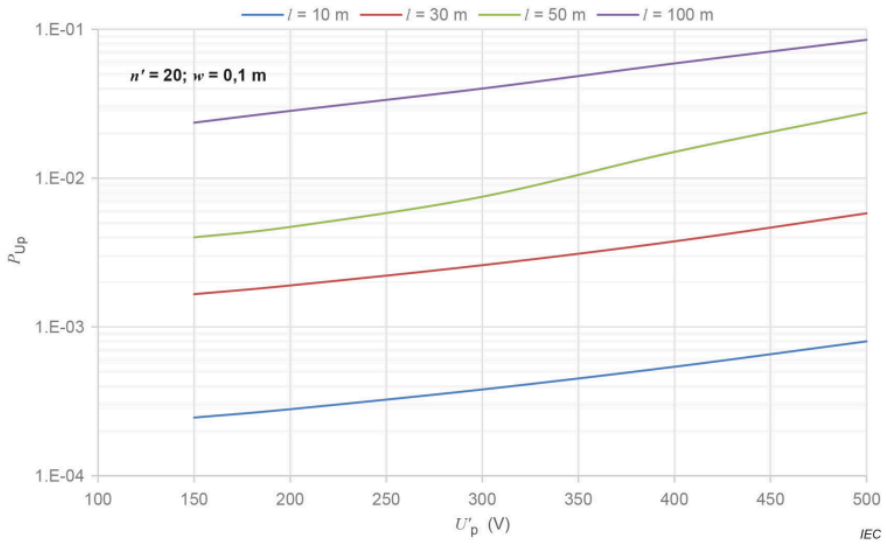
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NOTE 1 For other external line lengths (ll), the P_{Up} values are multiplied by the factor 500/ll.

NOTE 2 Similar results to those shown in Figure D.11 can be obtained when n' = 20 with w = 0,5 m.

Figure D.11 – Probability P_{Up} as a function of the internal loop area for n' = 2 and w = 0,5 m



NOTE 1 For other line external lengths (l_l), the P_{Up} values are multiplied by the factor 500/l_l.

NOTE 2 When w = 0,005 m, the P_{Up} values become negligible.

Figure D.12 – Probability P_{Up} as a function of the internal loop area for n' = 20 and w = 0,1 m

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D.4 Source of damage S4

D.4.1 One voltage limiting SPD

The P_{Up} evaluation as a function of the protection level at 1 kA (U_p') is reported in Figure D.13 for a different internal loop area as a function of the protection level at 1 kA (U_p'), when U_w = 2,5 kV, l_c = 0,5 m, n' = 4 and k_r is almost equal to 1.

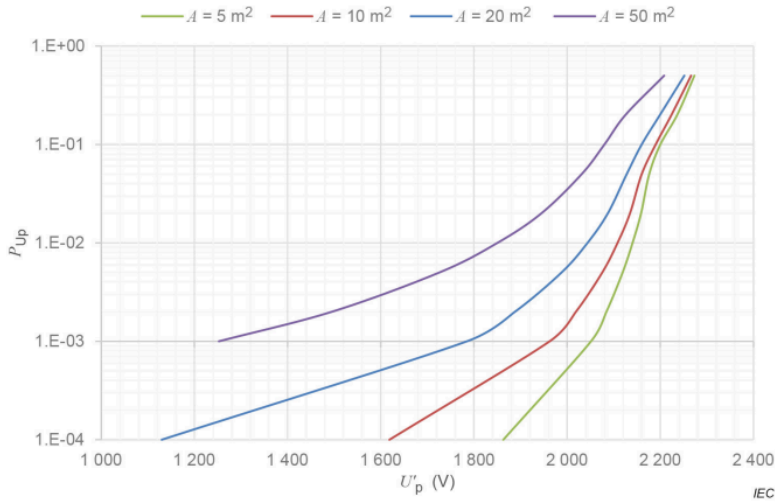


Figure D.13 – Probability P_{Up} as a function of the SPD protection level U_p' at 1 kA for different internal loop areas

EXAMPLE Figure D.13 shows that when w = 0,1 m and l = 100 m, the probability P_{Up} is about 0,000 1 when U_p' = 1,6 kV. An SPD tested according to Class II tests with I_n = 5 kA and U_p' ≤ 1,6 kV offers a P_{SPD} = 0,000 1 against source of damage S4.

D.4.2 One voltage switching SPD

The voltage switching SPD is typically used on telecommunication lines at the entrance of the structure and typical protection levels of GDTs are 700 V or 550 V.

Figure D.14 shows the P_{Up} evaluation as a function of a different internal loop area for the two typical U_p values of GDTs, i.e. 700 V and 550 V, when U_w = 1,5 kV, l_c = 0,5 m and k_r > 1.

EXAMPLE Figure D.14 shows that when U_w = 1,5 kV, w = 0,5 m and l = 100 m, the probability P_{Up} is about 0,004 when U_p' = 0,7 kV and P_{Up} = 0,002 when U_p' = 0,55 kV.

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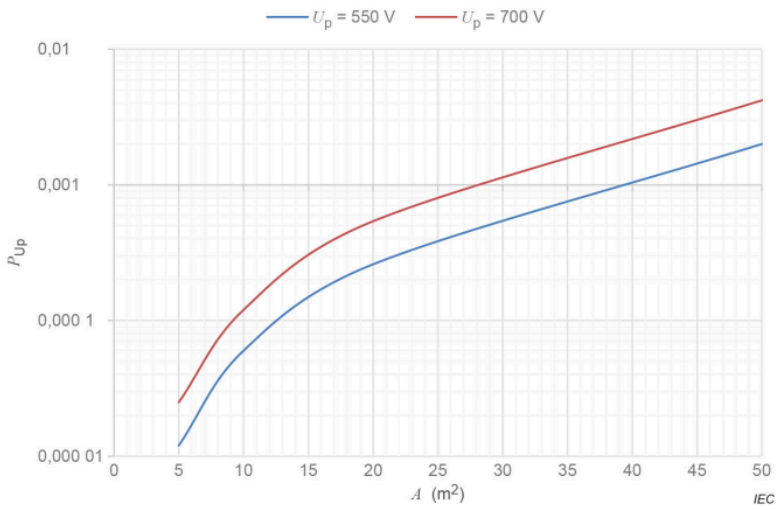


Figure D.14 – Probability P_{Up} as a function of different internal loop areas for two typical protection levels of GDTs

D.5 Source of damage S2

An SPD installed at the far end of the internal loop, from the equipment to be protected, cannot protect the equipment because the induced voltage in the loop between the SPD and equipment is not reduced and it is equal to the rated impulse voltage of the equipment (U_w).

Protection can be achieved by installing a voltage limiting SPD closer to the equipment in order to reduce the induction loop dimensions. This SPD can even be a second SPD coordinated with the first one located at the far end from the equipment to be protected.

Defining $S = w \times l$ the original loop dimension (m²) and $S^* = w_1 \times l_1$ the loop dimensions (m²) between this SPD and the equipment, the P_{Up} value is given by:

$$P_{Up} = [S^*/(U_w - -)]^2$$

where

U (V) is the protection level U_p of the switching type SPD or the residual voltage at 1 kA (U_p') of a limiting type SPD.

The P_{Up} values are the P_{SPD} values because the P_Q values are typically negligible when the nominal discharge current I_n is equal to or greater than 2,5 kA.

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Annex E
(informative)

Detailed investigation of additional losses L_E related to surroundings

E.1 General

This Annex E is intended for specific applications. For most of the structures there is no need to calculate an environmental risk, but when necessary, it is possible to use this Annex E as a guidance.

Annex E describes a simple method to take into account damages to a structure which can involve surrounding structures or the environment by defining an additional loss L_E. If it is necessary to investigate the damage to a surrounding structure or the environment in more detail, the following concept described in Annex E can be used for calculating the additional loss L_E. With this concept, the influence of different characteristics and conditions of the structure struck by lightning and its surroundings to the additional losses at these surroundings can be considered in a more accurate way.

The following conditions are valid:

– In the surroundings the risk components R_{AT}, R_{AD} and R_U are not considered, because these are only relevant in the structure struck by lightning itself.
– Relevant for the surroundings are the following types of losses:

  L_1: loss due to injury to human beings in the surroundings;

  L_2: loss due to physical damage to the surroundings.

E.2 Calculation of risk components

The relevant components of the risk for the surroundings are calculated according to the equations given in Table E.1.

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Table E.1 – Risk components for different sources of damage and types of loss, valid for damage to the surroundings

Type of loss	Source of damage			
	S1 Lightning flash to a structure	S2 Lightning flash near a structure	S3 Lightning flash to an (incoming) line	S4 Lightning flash near a line
L_1 Injury to living beings	$R_{B1E} = N_D \times P_B \times P_{PE} \times L_{B1E}$		$R_{V1E} = (N_L + N_{DJ}) \times P_V \times P_{PE} \times L_{V1E}$	
	$R_{C1E} = N_D \times P_C \times P_{PE} \times P_e \times L_{C1E}$ See footnote "a".	$R_{M1E} = N_M \times P_M \times P_{PE} \times P_e \times L_{M1E}$ See footnote "a".	$R_{W1E} = (N_L + N_{DJ}) \times P_W \times P_{PE} \times P_e \times L_{W1E}$ See footnote "a".	$R_{Z1E} = N_I \times P_Z \times P_{PE} \times P_e \times L_{Z1E}$ See footnote "a".
L_2 Physical damage	$R_{B2E} = N_D \times P_B \times L_{B2E}$		$R_{V2E} = (N_L + N_{DJ}) \times P_V \times L_{V2E}$	
	$R_{C2E} = N_D \times P_C \times P_e \times L_{C2E}$ See footnote "b".	$R_{M2E} = N_M \times P_M \times P_e \times L_{M2E}$ See footnote "b".	$R_{W2E} = (N_L + N_{DJ}) \times P_W \times P_e \times L_{W2E}$ See footnote "b".	$R_{Z2E} = N_I \times P_Z \times P_e \times L_{Z2E}$ See footnote "b".

[a] R_{C1E}, R_{M1E}, R_{W1E} and R_{Z1E} apply mainly for structures with a risk of explosion and for hospitals or other structures where failures of internal systems immediately endanger human life.

[b] R_{C2E}, R_{M2E}, R_{W2E} and R_{Z2E} apply mainly for structures with a risk of explosion.

where the general relations are given below:

$$L_{B1E} = L_{V1E} = L_{F1E} \quad \text{(E.1)}$$

$$L_{C1E} = L_{M1E} = L_{W1E} = L_{Z1E} = L_{O1E} \quad \text{(E.2)}$$

$$P_{PE} = t_{zE} / 8\,760 \quad \text{(E.3)}$$

$$L_{B2E} = L_{V2E} = L_{F2E} \quad \text{(E.4)}$$

$$L_{C2E} = L_{M2E} = L_{W2E} = L_{Z2E} = L_{O2E} \quad \text{(E.5)}$$

where

L_{F1E} is the typical mean ratio of persons injured by fire or explosion related to the total number of persons in the surroundings, due to one dangerous event (see Table E.3);

L_{O1E} is the typical mean ratio of persons injured by failure of internal systems related to the total number of persons in the surroundings, due to one dangerous event (see Table E.3);

L_{F2E} is the typical mean ratio of physical damage by fire or explosion related to the maximum extent of damage in the surroundings, due to one dangerous event (see Table E.4);

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L_{O2E} is the typical mean ratio of physical damage by failure of internal systems related to the maximum extent of damage in the surroundings, due to one dangerous event (see Table E.4);

t_{zE} is the time of presence of persons in a potentially dangerous place in the surroundings (see Table E.2).

All these parameters are based on scenarios and should be evaluated precisely. When a scenario does not justify a component then this component should be taken equal to zero. For example, if an internal induced surge in a structure cannot create a scenario that itself creates a damage to a property outside the structure, then L_{M2E} should be taken equal to 0.

All the other parameters given in the equations of Table E.1 are used and calculated as described in Annex A and Annex B and in the main part of this document.

If values of t_{ZE} are unknown, t_{ZE}/8 760 = 1 should be assumed, as a matter of fact, in the surroundings of the structure, residential areas can exist with a permanent attendance of people.

Otherwise the values proposed in Table E.2 can be used. These values can be changed after detailed investigation.

Table E.2 – Type of loss L1: Proposed typical values for the related time of presence for people t_{zE}/8 760 in different environments as limited by Table E.3

Type of surrounding	t_{zE}/8 760[a]
Working site	0,25
Working site with operation with more than one shift	1,0
Structures open to the public	0,5
Zones of activities (industries and other activities not usually open to the public)	0,75
Residences	1
Roads	1
Railways	0,25
Inland waterways	0,1
Pedestrian ways	0,75
Open grounds and very infrequently attended areas (fields, meadows, forests, waste lands, marsh…)	0,25
Infrequently attended areas (horticultural gardens and zones, vineyards, fishing zones, marshalling yards …)	0,25
Normally or frequently attended areas (car parks, parks, zones of supervised baths, sports grounds)	0,5
Special cases (sporadic attendance)	0,1
[a] In case of "mixed" environments with different values, the highest value should be used.	

For L_{F1E} and L_{O1E} the values given in Table E.3 are a proposal. More detailed calculations can be performed. When there is no risk for the surroundings, L_{F1E} = L_{O1E} = 0 should be assumed.

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Table E.3 – Type of loss L1: Typical mean values of L_{F1E} and L_{O1E} outside the structure

Values of L_{F1E} and L_{O1E} Scenario	Environmental risk – Remaining inside the site fence		Environmental risk – Spreading outside of the site fence	
	L_{F1E} [g]	L_{O1E} [g]	L_{F1E}	L_{O1E}
Explosion and overpressure[a]	0,25	0,025	0,5	0,05
Thermal flux[b]	0,05	0,005	0,1	0,01
Toxic fumes[c]	0,1	0,01	1,0	0,1
Soil pollution[c]	0,1	0,01	0,5	0,05
Water pollution[c]	0,25[d]	0,025	2,5	0,25
Radioactive material[c e f]	0,5	0,05	5	0,5

[a] The overpressure exceeds a value of 5 kPa.

[b] The thermal power per area exceeds a value of 3 kW/m^2.

[c] These maximum values can be reduced based on quantity of pollutant, danger of the pollutant and sensitivity of the environment.

[d] Only if pollution can reach the water table or fresh water or sea or oceans.

[e] It is possible this will not be applicable when a specific study including all scenarios has been developed.

[f] This is not applicable to sealed sources for example used in measuring devices or medical equipment.

[g] In case of a TWS the values for L_{F1E} and L_{O1E} inside the site fence are multiplied by $(1 - P_{TWS})$.

For L_{F2E} and L_{O2E} the values given in Table E.4 are a proposal. More detailed calculations can be performed. When there is no risk for the surroundings, $L_{F2E} = L_{O2E} = 0$ should be assumed.

Table E.4 – Type of loss L2: Typical mean values of L_{F2E} and L_{O2E} outside the structure

Scenario	Environmental risk	
	L_{F2E}	L_{O2E}
Explosion and overpressure[a]	0,5	0,05
Thermal flux[b]	0,1	0,01
Toxic fumes[c]	0,5	0,05
Soil pollution[c]	0,2	0,02
Water pollution[c]	0,5[d]	0,05
Radioactive material[c e f]	1	0,1

[a] The overpressure exceeds a value of 14 kPa.

[b] The thermal power per area exceeds a value of 8 kW/m^2.

[c] These maximum values can be reduced based on quantity of pollutant, danger of the pollutant and sensitivity of the environment.

[d] Only if pollution can reach the water bed or fresh water or sea or oceans.

[e] It is possible this will not be applicable when a specific study including all scenarios has been developed.

[f] This is not applicable to sealed sources for example used in measuring devices or medical equipment.

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Annex F
(informative)

Case studies

F.1 General

In this Annex F, case studies relevant to a house, an office building and a hospital are developed with the aim of showing, for risk and frequency of damage:

– how to calculate with the value of parameters and determine the need for protection;
– the contribution of different components to the overall value;
– the effect of different protection measures to mitigate both the risk and the frequency of damage.

NOTE This Annex F presents hypothetical data for all cases. It is intended to provide information about risk and frequency of damage evaluation in order to illustrate the principles contained in this document. It is not intended to address the unique aspects of the conditions that exist in all facilities or systems.

For simplicity some factors will be shown as follows:

$R_B = R_{B1} + R_{B2}$

$R_C = R_{C1} + R_{C2}$

$R_M = R_{M1} + R_{M2}$

$R_V = R_{V1} + R_{V2}$

$R_W = R_{W1} + R_{W2}$

$R_Z = R_{Z1} + R_{Z2}$

The dash (–) in tables means "not applicable".

The risk and frequency values calculated in tables are fixed to 3 decimal places. Smaller values are therefore expressed as ≈ 0.

Owing to rounded values used for calculation, one can obtain slightly different results for calculated values.

F.2 House

F.2.1 Relevant data and characteristics

NOTE Throughout this example, additional subscripts P, T and D have been added to existing parameters to signify power, telecom and data lines respectively.

The house has no existing lightning protection and is located in flat territory without any neighbouring structures. The lightning ground strike-point density is N_{SG} = 8 (strike-points/km^2/year). The house is inhabited for six months a year. It is assumed that there is nobody outside the house during a thunderstorm.

The house is fed by one low-voltage aerial (overhead) power line and one aerial telephone line; no external conductive parts are connected to the house.

Data for the house and its surroundings are given in Table F.1.

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Data for the incoming lines and their internal systems connected to these lines are given in Table F.2 for the power line and in Table F.3 for the telecom line. The last column provides locations where the values selected can be found or the process used to determine the value. In Table F.1, the source of the LLS data cannot provide the value of k so the default value of 2 is used. The structure provides no shielding against LEMP so the default value of K_{S1} is selected. There is no thunderstorm warning system (TWS) in use at the structure. In places where there is no justification nor reference to specific clauses, the values have been selected for the purpose of the example.

Table F.1 – House: environment and structure characteristics

Input parameter	Comment	Symbol	Value	Reference
Lightning ground strike-point density (strike-points/km^2/year)		N_{SG}	8,0	
Factor relating N_G to N_{SG}		k	2	Clause A.1
Structure dimensions (m)		L, W, H	15, 20, 6	
Location factor of structure	Isolated structure	C_D	1	Table A.1
Construction material	Masonry	P_S	1	Table B.4
Structure shielding	None	K_{S1}	1	Clause B.6
Environmental factor	Rural	C_E	1	Table A.4
LPS	None	P_{LPS}	1	Table B.3
TWS	None	P_{TWS}	1	Clause B.1

Table F.2 – House: power line

Input parameter	Comment	Symbol	Value	Reference
Length (m)[a]		L_L	1 000	Clause A.4
Installation factor	Aerial	C_{IP}	1	Table A.2
Line type factor	LV line	C_{TP}	1	Table A.3
Environmental factor	Rural	C_{EP}	1	Table A.4
Shielding, grounding, isolation	None	C_{LDP}	1	Table B.9
		C_{LIP}	1	
Equipotential bonding	None	P_{EBP}	1	Table B.13
Adjacent structure	None	L_J, W_J, H_J	–	
Location factor of structure	None	C_{DJ}	–	Table A.1
Withstand voltage of internal system (kV)		U_{WP}	2,5	
Number of conductors	Three phase conductors + neutral	n_P	4	Table B.7
	Resulting parameter	P_{LDP}	1	Table B.11
Lateral distance for $S2$ (m)	U_{WP} is higher than U_{WT}	r_{MP}	-	Not used, see Equation (A.8) and Table F.3
Lateral distance for $S4$ (m)		r_{IP}	384	2 000/$U_{WP}^{1.8}$, see Equation (A.12)

[a] As the length L_L of the line section is unknown, L_L = 1 000 m is assumed (Clause A.4).

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Table F.3 – House: telecom line

Input parameter	Comment	Symbol	Value	Reference
Length (m)		L_L	800	Clause A.4
Installation factor	Aerial	C_{IT}	1	Table A.2
Line type factor	Telecom line	C_{TT}	1	Table A.3
Environmental factor	Rural	C_{ET}	1	Table A.4
Shielding, grounding, isolation	None	C_{LDT}	1	Table B.8
		C_{LIT}	1	
Equipotential bonding	None	P_{EBT}	1	Table B.13
Adjacent structure	None	L_J, W_J, H_J	–	The telecom cabinet at the other end of the line is too small to be considered
Location factor of structure	Isolated structure	C_{DJ}	–	Table A.1
Withstand voltage of internal system (kV)		U_{WT}	1,5	
Number of conductors		n_T	2	Table B.8
	Resulting parameter	P_{LDT}	1	Table B.11
Lateral distance for S2 (m)	U_{WT} is lower than U_{WP}	r_{MT}	233	$350/U_{WT}$, see Equation (A.8)
Lateral distance for S4 (m)		r_{IT}	964	$2\,000/U_{WT}^{1.8}$, see Equation (A.12)

F.2.2 Calculation of expected annual number of dangerous events

Calculations are given in Table F.4 for the equivalent collection areas and in Table F.5 for the expected number of dangerous events.

Table F.4 – House: equivalent collection areas of structure and lines

	Symbol	Result m^2	Reference
Structure	A_D	$2{,}58 \times 10^3$	A.2.1.2, Equation (A.3)
	A_M	$1{,}87 \times 10^5$	Clause A.3, Equation (A.8)
Power line	A_{LP}	$4{,}00 \times 10^4$	Clause A.4, Equation (A.10)
	A_{IP}	$7{,}69 \times 10^5$	Clause A.5, Equation (A.12)
Telecom line	A_{LT}	$3{,}20 \times 10^4$	Clause A.4, Equation (A.10)
	A_{IT}	$1{,}54 \times 10^6$	Clause A.5, Equation (A.12)

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Table F.5 – House: expected annual number of dangerous events

	Symbol	Result 1/year	Reference
Structure	N_D	$2{,}06 \times 10^{-2}$	A.2.4, Equation (A.5)
	N_M	$7{,}5 \times 10^{-1}$	Clause A.3, Equation (A.7)
Power line	N_{LP}	$3{,}2 \times 10^{-1}$	Clause A.4, Equation (A.9)
	N_{IP}	3,07	Clause A.5, Equation (A.11)
Telecom line	N_{LT}	$2{,}56 \times 10^{-1}$	Clause A.4, Equation (A.9)
	N_{IT}	6,17	Clause A.5, Equation (A.11)

F.2.3 Risk management

As a first step, the risk zones should be identified in which the structure can be divided. For each risk zone, both the risk R and the frequency of damage F to internal systems are assessed.

This implies:

a) the need to determine the risk R and to compare it with the tolerable risk $R_T = 10^{-5}$ (7.3). If necessary, suitable protection measures to mitigate such risk should be selected.

   Risk components are evaluated according to Table 3.

b) the need to determine the frequency of damage F and to compare it with the required tolerable frequency of damage F_T (9.3). In this case the tolerable frequency of damage was fixed by the owner of the building to the value $F_T = 10^{-1}$. Therefore, if necessary, suitable protection measures to reduce such frequency of damage should be selected. Frequency of damage components are evaluated according to Table 4.

In this example, only the risk is calculated. Frequency of damages are addressed in the other examples.

F.2.4 Definition of risk zones in the house

The following main risk zones can be defined as follows:

Z_1 (outside the building);

Z_2 (inside the building) is defined taking into account that:

- both internal systems (power and telecom) extend throughout the building,
- no spatial shields exist,
- the structure is a single fireproof compartment,
- losses are assumed to be constant in all the building and to correspond to the typical mean values of Table C.2.

The values of time of annual attendance of persons in each risk zone and the risk components to be considered are shown in Table F.6. Time outside the building is very limited and thus for the purpose of this example it is assumed that there is nobody outside the building (as a consequence Z_1 is ignored).

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Table F.6 – House: time of presence of persons and risk components into risk zones

Risk zone	Time of presence hours/year	Risk components								
		R_{AT}	R_{AD}	R_B	R_C	R_M	R_U	R_V	R_W	R_Z
Z_2 (inside the building)	4 380	X		X			X	X		

For zone Z_1, as there is nobody outside the building, the risk of shock to people R_{AT} = 0. It is also assumed that there are no electrical systems outside the building and then the frequency of damage F = 0.

The defined parameters for zone Z_2 are reported in Table F.7.

Table F.7 – House: values for zone Z_2 (inside the building)

Input parameter		Comment	Symbol	Value	Reference
Type of floor		Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)		None	P_{am}	1	Table B.1
Position of persons in the exposed area		Not applicable	P_o	0	Clause B.3
Risk of fire		Low	r_f	10^{-3}	Table B.6
Fire protection		None	r_p	1	Table B.5
Factor for persons in zone		t_z/8 760 = 4 380/8 760	P_P	0,5	Equation (B.14)
Factor for equipment in zone		t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
Zone shielding		None	K_{S2}	1	Equation (B.9)
Power internal system	Internal wiring	Unshielded conductors routed in the same conduit	K_{S3P}	2×10^{-1}	Table B.10
	Withstand voltage factor (kV)		U_{WP}	2,5	
	SPD system	None	P_{SPD}	1	Table B.7
Telecom internal system	Internal wiring	Unshielded conductors with different routing	K_{S3T}	1	Table B.10
	Withstand voltage factor (kV)		U_{WT}	1,5	
	SPD system	None	P_{SPD}	1	Table B.8
Type of zone according to loss		Low loss zone	-	-	Table C.2

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Input parameter	Comment	Symbol	Value	Reference
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	
	Persons injured by fire	L_{F1}	2×10^{-2}	
	Physical damage due to fire	L_{F2}	2×10^{-2}	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	10^{-1}	

F.2.5 Risk assessment

The risk R can be expressed according to Equation (1). Involved components are given in Table F.6 and risk values are given in Table F.8.

Table F.8 – House: risk for the unprotected structure (values × 10^{-5})

Symbol	Z_2
R_{AT}	≈ 0
R_B	0,062
R_U	0,003
R_V	1,728
R	1,793
R_T	1

Because the risk R is higher than the tolerable value R_T = 10^{-5}, lightning protection for the structure is required to mitigate the risk.

F.2.6 Risk – Selection of protection measures

According to Table F.8 the main contribution to the value of risk is given by component R_V (lightning flash to lines) and reducing this component can be enough to reduce the risk below the tolerable level.

To reduce the risk R to a tolerable value, the protective measures influencing the components R_V should be considered. Suitable measures are SPDs of LPL IV installed on power and telephone lines at the entrance point in the house (equipotential bonding). According to Table F.7 this reduces the value of P_{EB} (due to SPDs on connected lines) from 1 to 0,05 and the values of P_V by the same factor. Inserting these values into the equations, new values of risk components are obtained, as shown in Table F.9 and this table shows that the total risk is by now lower than the tolerable level.

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Table F.9 – House: risk components for protected structure (values × 10^{-5})

Symbol	Z_2
R_{AT}	≈ 0
R_B	0,062
R_U	≈ 0
R_V	0,086
R	0,149
R_T	1

F.2.7 Conclusions

The risk R can be reduced below the tolerable level by installing an SPD tested according to Class I test of LPL IV for both power and telephone lines.

F.3 Office building

F.3.1 Relevant data and characteristics

As a second case study, an office building with an archive, offices and a computer centre is considered.

The office building is located in flat territory without any neighbouring structures. The lightning striking point to ground density is N_{SG} = 4 (strike-points/km^2/year).

The office building is fed by one power line and one telecommunication line. In addition, one external conductive part is connected to the structure (water pipe). The external telecommunication line is made of a metal free fibre optic cable but the internal telecommunication line is made of unshielded copper line.

Data for the building and its surroundings are given in Table F.10. Data for the incoming lines and their connected internal systems are given in Table F.11 for the power line and in Table F.12 for the telecom line.

Table F.10 – Office building: environment and structure characteristics

Input parameter	Comment	Symbol	Value	Reference
Lightning ground strike-point density (strike-points/km^2/year)		N_{SG}	4,0	
Factor relating N_G to N_{SG}		k	2	Clause A.1
Structure dimensions (m)		L, W, H	20, 40, 25	
Location factor of structure	Isolated structure	C_D	1	Table A.1
Construction material	Reinforced concrete	P_S	0,5	Table B.4
Structure shielding	None	K_{S1}	1	Equation (B.8)
Environmental factor	Suburban	C_E	0,5	Table A.4
LPS	None	P_{LPS}	1	Table B.3
TWS	None	P_{TWS}	1	Clause B.1

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Table F.11 – Office building: power line

Input parameter		Comment	Symbol	Value	Reference
HV section	Length (m)		L_L	1 000	Clause A.4
	Installation factor	Buried	C_I	0,3	Table A.2
	Line type factor	HV line	C_T	0,2	Table A.3
	Environmental factor	Suburban	C_E	0,5	Table A.4
	Shield of line (Ω/km)	Unshielded	R_S	–	
LV section	Length (m)		L_L	100	
	Installation factor	Buried	C_I	0,3	Table A.2
	Line type factor	LV line	C_T	1	Table A.3
	Environmental factor	Suburban	C_E	0,5	Table A.4
	Shield of line (Ω/km)	Unshielded	R_S	–	
Shielding, grounding, isolation		None	C_{LD}	1	Table B.9
			C_{LI}	1	
Equipotential bonding		None	P_{EB}	1	Table B.13
Adjacent structure		None	L_J, W_J, H_J	–	HV line is 1 km long
Location factor of adjacent structure		None	C_{DJ}	–	Table A.1
Withstand voltage of internal system (kV)			U_{WP}	2,5	
Number of conductors		3 phase conductors + neutral	n_P	4	Table B.7
		Resulting parameter	P_{LD}	1	Table B.11 and Table B.12
Lateral distance for S2 (m)		U_{WP} is higher than U_{WT}	r_{MP}	-	Not used, see Equation (A.8) and Table F.12
Lateral distance for S4 (m)			r_{IP}	384	$2\,000/U_{WP}^{1.8}$, see Equation (A.12)

Table F.12 – Office building: telecom line

Input parameter	Comment	Symbol	Value	Reference
Length (m)	Fibre optic cable	L_L	0	Clause A.4
Withstand voltage of internal system (kV) connected to internal telecommunication copper unshielded line		U_{WT}	1,5	
Lateral distance for S2 (m)	U_{WT} is lower than U_{WP}	r_{MT}	233	$350/U_{WT}$, see Equation (A.8)

F.3.2 Calculation of expected annual number of dangerous events

The results of calculations are given in Table F.13 for the collection areas and in Table F.14 for the expected number of dangerous events.

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Table F.13 – Office building: collection areas of structure and lines

	Symbol	Result m^2	Reference Equation
Structure	A_D	$2{,}75 \times 10^4$	Equation (A.3)
	A_M	$1{,}99 \times 10^5$	Equation (A.8)
Power line	A_{LP1}	4×10^4	Equation (A.10)
	A_{IP1}	$7{,}69 \times 10^5$	Equation (A.12)
	A_{LP2}	4×10^3	Equation (A.10)
	A_{IP2}	$7{,}69 \times 10^4$	Equation (A.12)
Telecom line	A_{LT}	0	Equation (A.10)
	A_{IT}	0	Equation (A.12)

Table F.14 – Office building: expected annual number of dangerous events

	Symbol	Result 1/year	Reference Equation
Structure	N_D	$1{,}1 \times 10^{-1}$	Equation (A.5)
	N_M	$3{,}98 \times 10^{-1}$	Equation (A.7)
Power line	N_{LP1}	$4{,}8 \times 10^{-3}$	Equation (A.9)
	N_{IP1}	$4{,}61 \times 10^{-2}$	Equation (A.11)
	N_{LP2}	$2{,}4 \times 10^{-3}$	Equation (A.9)
	N_{IP2}	$2{,}31 \times 10^{-2}$	Equation (A.11)
Telecom Line	N_{LT}	0	Equation (A.9)
	N_{IT}	0	Equation (A.11)

F.3.3 Risk management

As a first step, the zones in which the structure can be divided should be identified. For each zone, both the risk R of public loss and the frequency of damage F to internal systems shall be assessed.

This implies:

a) the need to determine the risk R and to compare it with the tolerable risk $R_T = 10^{-5}$ (7.3). If necessary, suitable protection measures to mitigate such risk will be selected. Risk components will be evaluated according to Table 3;

b) the need to determine the frequency of damage F and to compare it with the required tolerable risk F_T (9.3). In this case, based on technical-economical evaluations relevant to the service exploited in the building, the tolerable frequency of damage was fixed by the Technical Director of the company to the value $F_T = 5 \times 10^{-2}$. Therefore, if necessary, suitable protection measures to reduce such frequency of damage should be selected. Frequency of damage components will be evaluated according to Table 4.

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F.3.4 Definition of zones in the office building

The following zones are defined:

Z_1 (entrance area outside);

Z_2 (roof);

Z_3 (archive);

Z_4 (offices);

Z_5 (computer centre);

taking into account that:

- the roof is accessible to people;
- the structure is divided into two separate fireproof compartments: the first is the archive (Z_3) and the second is the offices together with the computer centre (Z_4 and Z_5);
- in all inner zones, Z_3, Z_4 and Z_5, internal systems connected to the power as well as to the telecom line exist;
- no spatial shields exist;
- people in the two outside zones, Z_1 and Z_2, are protected by the structure or its external LPS from a direct strike and therefore in this example it is not necessary to calculate R_B for these zones;
- people in the two outside zones, Z_1 and Z_2, are not protected from step and touch voltages caused by a direct strike to the structure and therefore it is necessary to calculate R_{AT} for these zones.

The use of values less than 1 for r_p has been selected in agreement with the building owner, see Clause B.4.

The values of time of annual attendance of persons in each zone and the risk components to be considered are shown in Table F.15.

Table F.15 – Office building: time of presence of persons and risk components in zones

Zone	Time of presence hours/year	Risk components								
		R_{AT}	R_{AD}	R_B	R_C	R_M	R_U	R_V	R_W	R_Z
Z_1 (entrance outside)	175	X								
Z_2 (roof)	18	X	X							
Z_3 (archive)	440	X		X			X	X		
Z_4 (offices)	2 630	X		X			X	X		
Z_5 (computer centre)	2 200	X		X			X	X		

The relevant parameters for the zones Z_1 to Z_5 are given in Table F.16 to Table F.20.

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Table F.16 – Office building: factors valid for zone Z_1 (entrance area outside)

Input parameter	Comment	Symbol	Value	Reference
Ground surface	Marble	r_t	10^{-3}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	None	r_f	0	Table B.6
Fire protection	None	r_p	1	Table B.5
Factor for persons in zone	t_z/8 760 = 175/8 760	P_P	0,02	Equation (B.14)
Factor for equipment in zone	Not applicable	P_e	-	Equation (B.15)
SPD system (Power line)	No internal systems	P_{SPD}	1	Table B.7
SPD system (Telecom line)	No internal systems	P_{SPD}	1	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	No internal systems	K_{S3}	0	Table B.10
Internal wiring (Telecom line)	No internal systems		0	
Type of zone according to loss	Low loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	
	Persons injured by fire	L_{F1}	-	
	Physical damage due to fire	L_{F2}	-	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	-	

Table F.17 – Office building: factors valid for zone Z_2 (roof)

Input parameter	Comment	Symbol	Value	Reference
Ground surface	Asphalt	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Maintenance team present in the exposed area	P_o	1	Clause B.3
Risk of fire	None	r_f	0	Table B.6
Fire protection	None	r_p	1	Table B.5
Factor for persons in zone	t_z/8 760 = 18/8 760	P_P	0,002	Equation (B.14)
Factor for equipment in zone	Not applicable	P_e	-	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	-	Table B.7
SPD system (Telecom line)	None	P_{SPD}	-	Table B.8

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Input parameter	Comment	Symbol	Value	Reference
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	No internal systems	K_{S3}	-	Table B.10
Internal wiring (Telecom line)				
Type of zone according to loss	Low loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	10^{-1}	
	Persons injured by fire	L_{F1}	-	
	Physical damage due to fire	L_{F2}	-	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	-	

Table F.18 – Office building: factors valid for zone Z_3 (archive)

Input parameter	Comment	Symbol	Value	Reference
Type of floor	Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	High	r_f	10^{-1}	Table B.6
Fire protection	Automatic alarm	r_p	0,2	Table B.5
Factor for persons in zone	t_z/8 760 = 440/8 760	P_P	0,05	Equation (B.14)
Factor for equipment in zone	t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	1	Table B.7
SPD system (Telecom line)	None	P_{SPD}	1	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	Unshielded (loop conductors in the same conduit)	K_{S3}	0,2	Table B.10
Internal wiring (Telecom line)	Unshielded (loop conductors with different routing)		1	
Withstand voltage factor (Power internal system)	U_W = 2,5 kV			
Withstand voltage factor (Telecom internal system)	U_W = 1,5 kV			
Type of zone according to loss	Normal loss zone	-	-	Table C.2

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Input parameter	Comment	Symbol	Value	Reference
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	
	Persons injured by fire	L_{F1}	5×10^{-2}	
	Physical damage due to fire	L_{F2}	5×10^{-2}	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	5×10^{-2}	

Table F.19 – Office building: factors valid for zone Z_4 (offices)

Input parameter	Comment	Symbol	Value	Reference
Type of floor	Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	Low	r_f	10^{-3}	Table B.6
Fire protection	Extinguishers	r_p	0,5	Table B.5
Factor for persons in zone	t_z/8 760 = 2 630/8 760	P_P	0,3	Equation (B.14)
Factor for equipment in zone	t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	1	Table B.7
SPD system (Telecom line)	None	P_{SPD}	1	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	Unshielded (loop conductors in the same conduit)	K_{S3}	0,2	Table B.10
Internal wiring (Telecom line)	Unshielded (loop conductors with different routing)		1	
Withstand voltage factor (Power internal system)	U_W = 2,5 kV			
Withstand voltage factor (Telecom internal system)	U_W = 1,5 kV			
Type of zone according to loss	Normal loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	
	Persons injured by fire	L_{F1}	5×10^{-2}	
	Physical damage due to fire	L_{F2}	5×10^{-2}	
	Persons injured by failure of internal systems	L_O	-	

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Input parameter	Comment	Symbol	Value	Reference
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	5×10^{-2}	

Table F.20 – Office building: factors valid for zone Z_5 (computer centre)

Input parameter	Comment	Symbol	Value	Reference
Type of floor	Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	Low	r_f	10^{-3}	Table B.6
Fire protection	Automatic alarm installation	r_p	0,2	Table B.5
Factor for persons in zone	t_z/8 760 = 2 200/8 760	P_P	0,25	Equation (B.14)
Factor for equipment in zone	t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	1	Table B.7
SPD system (Telecom line)	None	P_{SPD}	1	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	Unshielded (loop conductors in the same conduit)	K_{S3}	0,2	Table B.10
Internal wiring (Telecom line)	Unshielded (loop conductors with different routing)		1	
Withstand voltage factor (Power internal system)	U_W = 2,5 kV			
Withstand voltage factor (Telecom internal system)	U_W = 1,5 kV			
Type of zone according to loss	High loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	
	Persons injured by fire	L_{F1}	10^{-1}	
	Physical damage due to fire	L_{F2}	10^{-1}	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	5×10^{-2}	

F.3.5 Risk assessment

The risk R can be expressed according to Equation (1). Involved components are given in Table F.15 and risk values are given in Table F.21.

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Table F.21 – Office building: risk for the unprotected structure (values × 10^{-5})

Symbol	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	0,002	≈ 0	≈ 0	≈ 0	≈ 0
R_{AD}	-	2,259	-	-	-
R_B	-	-	5,770	0,179	0,137
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,756	0,023	0,018
R	0,002	2,259	6,526	0,202	0,156
R_T	1				

Because in zones Z_2 and Z_3 the risk is higher than the tolerable value $R_T = 10^{-5}$, lightning protection for the structure is required to mitigate the risk in these zones.

F.3.6 Frequency of damage assessment

The frequency of damage F can be expressed according to Equation (12). Frequency components are to be evaluated according to Clause 9.2. Involved components and frequency of damage evaluation are given in Table F.22.

Table F.22 – Office building: frequency of damage for the unprotected structure

Symbol	Z_1	Z_2	Z_3	Z_4	Z_5
F_C	-	-	0,11	0,11	0,11
F_M	-	-	0,398	0,398	0,398
F_{WP}	-	-	0,007	0,007	0,007
F_{WT}	-	-	-	-	-
F_{ZP}	-	-	0,0692	0,0692	0,0692
F_{ZT}	-	-	-	-	-
F	-	-	0,584	0,584	0,584
F_T	-	-	0,05	0,05	0,05

Because in all zones where internal systems are installed, F is higher than the tolerable value $F_T = 5 \times 10^{-2}$, lightning protection for the structure is required to reduce the frequency of damage.

F.3.7 Risk – Selection of protection measures

According to Table F.21, the zone at a higher risk is zone Z_3 (archive) because of the high value of risk of fire (risk components R_B and R_V).

Suitable protection measures to reduce the risk R in zone Z_3 are to install an LPL II LPS for protection of the building, thus reducing the risk component R_B in zones Z_2, Z_3, Z_4 and Z_5. According to Table B.3 this reduces the value of P_{LPS} from 1 to 0,05 and the value of P_{EB} from 1 to 0,02 (due to SPDs on connected lines) and finally the values of P_U and P_V by the same factor.

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For the equipotential bonding, the LPS is equipped with SPDs installed on the power line, at the entrance of the line in the structure.

By applying these protection measures, new values of risk components are obtained, as shown in Table F.23.

Table F.23 – Risk components for protected structure (values × 10^{-5})

Symbol	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0
R_{AD}	-	0,113	-	-	-
R_B	-	-	0,577	0,018	0,014
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,015	≈ 0	≈ 0
R	≈ 0	0,113	0,592	0,018	0,014
R_T	1				

F.3.8 Frequency of damage – Selection of protection measures

To reduce the frequency of damage F to the required value ($F_T = 5 \times 10^{-2}$), the suitable measure is to install a coordinated SPD system to protect internal systems connected to the power line.

The telecom line inside the building is a copper unshielded line and thus protection of telecom equipment is also necessary as it has an impact on components F_C and F_M.

According to Table F.22: for coordinated SPD systems, LPL II to protect internal systems connected to the power line is suitable. The same level LPL II is used for the SPD protecting the internal telecom equipment.

Such an SPD system reduces the value of P_{SPD} relevant to the frequency of damage F_1 in zones Z_3, Z_4 and Z_5 from 1 to 0,02; it reduces also the value of P_{SPD} relevant to frequencies of damage F_2, F_3 and F_4. The new values of frequency of damage components are shown in Table F.24.

Table F.24 – Office building: frequency of damage for protected structure

Symbol	Z_3	Z_4	Z_5
F_C	0,004	0,004	0,004
F_M	0,008	0,008	0,008
F_{WP}	≈ 0	≈ 0	≈ 0
F_{WT}	-	-	-
F_{ZP}	0,001	0,001	0,001
F_{ZT}	-	-	-
F	0,014	0,014	0,014
F_T	0,05	0,05	0,05

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F.3.9 Conclusions

Both risk R and frequency of damage F can be reduced below the tolerable level by installing:

– an LPL II LPS for protection of the building,

– a coordinated LPL II SPD system for power systems and an LPL II SPD for telecom equipment.

NOTE As indicated in Clause B.4, the fire alarm has been taken into account in the risk calculation because it was protected against overvoltages and other damages and firefighters can arrive in less than 10 min.

F.4 Hospital

F.4.1 Relevant data and characteristics

As a more complex case, this study considers a standard hospital facility with a rooms block, an operating block and an intensive care unit.

The hospital is located in flat territory without any neighbouring structures. The lightning striking point to ground density is N_{SG} = 8 (strike-points /km^2/year).

The hospital is fed by one power line and one telecommunication line; two external conductive parts are connected to the structure (water pipe and gas pipe).

The telecommunication line is made of metal free fibre optic, as well as the internal systems connected to it. Since it is not possible to transmit or induce surges on fibre optic lines or circuits, these lines and internal systems can be neglected in the risk assessment and the frequency of damage assessment.

Data for the building and its surroundings are given in Table F.25.

Data for the incoming power line and the internal systems connected thereto are given in Table F.26.

Table F.25 – Hospital: environment and structure characteristics

Input parameter	Comment	Symbol	Value	Reference
Lightning ground strike-point density (strike-points /km^2/year)		N_{SG}	8,0	
Factor relating N_G to N_{SG}		k	2	Clause A.1
Structure dimensions (m)		L, W, H	50, 150, 10	
Location factor of structure	Isolated structure	C_D	1	A.2.3, Table A.1
Construction material	Reinforced concrete	P_S	0,5	Clause B.4, Table B.4
Structure shielding	None	K_{S1}	1	Clause B.6, Equation (B.8)
Environmental factor	Suburban	C_E	0,5	Clause A.4, Table A.4
LPS	None	P_{LPS}	1	Clause B.3, Table B.3
TWS	None	P_{TWS}	1	Clause B.1

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Table F.26 – Hospital: power line

Input parameter		Comment	Symbol	Value	Reference
HV section	Length (m)		L_L	1 000	Clause A.4
	Installation factor	Buried	C_I	0,3	Table A.2
	Line type factor	HV line	C_T	0,2	Table A.3
	Environmental factor	Suburban	C_E	0,5	Table A.4
	Shield of line (Ω/km)	Unshielded	R_S	–	
LV section	Length (m)		L_L	50	
	Installation factor	Buried	C_I	0,3	Table A.2
	Line type factor	LV line	C_T	1	Table A.3
	Environmental factor	Suburban	C_E	0,5	Table A.4
	Shield of line (Ω/km)	Unshielded	R_S	–	
Shielding, grounding, isolation		None	C_{LD}	1	Table B.9
			C_{LI}	1	
Equipotential bonding		None	P_{EB}	1	Table B.13
Adjacent structure		None	L_J, W_J, H_J	–	HV line is 1 km long
Location factor of adjacent structure		None	C_{DJ}	–	Table A.1
Withstand voltage of internal system (kV)			U_W	2,5	
Number of conductors		3 phase conductors + neutral	n_P	4	Table B.7
		Resulting parameter	P_{LD}	1	Table B.11 and Table B.12
Lateral distance for S2 (m)			r_{MP}	140	$350/U_{WP}$, see Equation (A.8)
Lateral distance for S4 (m)			r_{IP}	384	$2\,000/U_{WP}^{1.8}$, see Equation (A.12)

F.4.2 Calculation of expected annual number of dangerous events

The results of calculations are given in Table F.27 for the collection areas and in Table F.28 for the expected number of dangerous events.

Table F.27 – Hospital: collection areas of structure and power line

	Symbol	Result m^2	Reference Equation
Structure	A_D	$2{,}23 \times 10^4$	Equation (A.3)
	A_M	$1{,}18 \times 10^5$	Equation (A.8)
Power line	A_{LP1}	$4{,}00 \times 10^4$	Equation (A.10)
	A_{IP1}	$7{,}69 \times 10^5$	Equation (A.12)
	A_{LP2}	$2{,}00 \times 10^3$	Equation (A.10)
	A_{IP2}	$3{,}84 \times 10^4$	Equation (A.12)

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Table F.28 – Hospital: expected annual number of dangerous events

	Symbol	Result 1/year	Reference Equation
Structure	N_D	$1{,}79 \times 10^{-1}$	Equation (A.5)
	N_M	$4{,}70 \times 10^{-1}$	Equation (A.7)
Power line	N_{LP1}	$9{,}6 \times 10^{-3}$	Equation (A.9)
	N_{IP1}	$9{,}23 \times 10^{-2}$	Equation (A.11)
	N_{LP2}	$2{,}4 \times 10^{-3}$	Equation (A.9)
	N_{IP2}	$2{,}31 \times 10^{-2}$	Equation (A.11)
	N_{LP}	$1{,}2 \times 10^{-2}$	
	N_{IP}	$1{,}15 \times 10^{-1}$	

F.4.3 Risk management

As a first step, the zones in which the structure can be divided should be identified. For each zone, both the risk R and the frequency of damage F to internal systems are assessed.

This implies:

a) the need to determine the risk R and to compare it with the tolerable risk $R_T = 10^{-5}$ (7.3). If necessary, suitable protection measures to mitigate such risk will be selected. Risk components will be evaluated according to Table 3;

b) the need to determine the frequency of damage F and to compare it with the required tolerable risk F_T (9.3). In this case, based on evaluations relevant to the quality of the service provided by the hospital, the tolerable frequency of damage was fixed by the General Manager of the hospital to the value $F_T = 10^{-2}$ for the operating block and the intensive care unit and $F_T = 5 \times 10^{-2}$ for the rooms block. If necessary, suitable protection measures to reduce such frequency of damage will be selected. Frequency of damage components will be evaluated according to 9.2.

F.4.4 Definition of zones in the hospital

The following zones are defined as follows:

Z_1 (entrance area outside);

Z_2 (roof);

Z_3 (rooms block);

Z_4 (operating block);

Z_5 (intensive care unit);

taking into account the following:

– the surface type is different from the inside to the outside;
– two separate fireproof compartments exist: the first is the rooms block (Z_3) and the second is the operating block together with the intensive care unit (Z_4 and Z_5);
– in all inner zones Z_3, Z_4 and Z_5, internal systems connected to the power line exist;
– no spatial shields exist;

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- the intensive care unit contains extensive sensitive electronic systems and a spatial shield can be adopted as a protection measure;
- people in the two outside zones, Z_1 and Z_2, are protected by the structure or its external LPS from a direct strike and therefore in this example it is not necessary to calculate R_B for these zones;
- people in the two outside zones, Z_1 and Z_2, are not protected from step and touch voltages caused by a direct strike to the structure and therefore it is necessary to calculate R_{AT} for these zones.

The use of values less than 1 for r_p has been selected in agreement with the building owner, see Clause B.4.

The values of the time of annual attendance of persons in each zone and the risk components to be considered are shown in Table F.29.

Table F.29 – Hospital: time of presence of persons and risk components in zones

Zone	Time of presence hours/year	Risk components								
		R_{AT}	R_{AD}	R_B	R_C	R_M	R_U	R_V	R_W	R_Z
Z_1 (entrance outside)	175	X								
Z_2 (roof)	90	X	X				X			
Z_3 (room block)	8 760	X		X	X	X	X	X	X	X
Z_4 (operating block)	3 100	X		X	X	X	X	X	X	X
Z_5 (intensive care unit)	8 760	X		X	X	X	X	X	X	X

The defined parameters for the zones Z_1 to Z_5 are given in Table F.30 to Table F.34.

Table F.30 – Hospital: factors valid for zone Z_1 (outside the building)

Input parameter	Comment	Symbol	Value	Reference
Ground surface	Concrete	r_t	10^{-2}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	None	r_f	-	Table B.6
Fire protection	None	r_p	-	Table B.5
Factor for persons in zone	t_z/8 760 = 175/8 760	P_P	0,02	Equation (B.14)
Factor for equipment in zone	Not applicable	P_e	-	Equation (B.15)
Zone shielding	None	K_{S2}	-	Equation (B.9)
Internal wiring (Power line)	No internal systems	K_{S3P}	-	Table B.10
Internal wiring (Telecom line)	No internal systems	K_{S3T}	-	
Type of zone according to loss	Low loss zone	-	-	Table C.2

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Input parameter	Comment	Symbol	Value	Reference
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	Table C.2
	Persons injured by fire	L_{F1}	-	
	Physical damage due to fire	L_{F2}	-	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	-	

Table F.31 – Hospital: factors valid for zone Z_2 (roof)

Input parameter	Comment	Symbol	Value	Reference
Ground surface	Asphalt	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Maintenance team present in the exposed area	P_o	1	Clause B.3
Risk of fire	None	r_f	0	Table B.6
Fire protection	None	r_p	-	Table B.5
Factor for persons in zone	t_z/8 760 = 90/8 760	P_P	0,01	Equation (B.14)
Factor for equipment in zone	Not applicable	P_e	-	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	-	Table B.7
SPD system (Telecom line)	None	P_{SPD}	-	Table B.8
Zone shielding	None	K_{S2}	-	Equation (B.9)
Internal wiring (Power line)	not applicable	K_{S3P}	-	Table B.10
Internal wiring (Telecom line)	No internal systems	K_{S3T}	-	
Type of zone according to loss	Low loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	10^{-1}	Table C.2
	Persons injured by fire	L_{F1}	-	
	Physical damage due to fire	L_{F2}	-	
	Persons injured by failure of internal systems	L_O	-	
Tolerable value	Risk	R_T	10^{-5}	Table B.2
	Frequency of damage	F_T	-	Table B.1

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Table F.32 – Hospital: factors valid for zone Z_3 (rooms)

Input parameter	Comment	Symbol	Value	Reference
Type of floor	Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	Ordinary	r_f	10^{-2}	Table B.6
Fire protection	Automatic alarm	r_p	0,2	Table B.5
Factor for persons in zone	t_z/8 760 = 8 760/8 760	P_P	1	Equation (B.14)
Factor for equipment in zone	t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	1	Table B.7
SPD system (Telecom line)	None	P_{SPD}	1	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	Unshielded (loop conductors in the same conduit)	K_{S3P}	0,2	Table B.10
Internal wiring (Telecom line)	Metal free fibre optical cables	K_{S3T}	-	
Withstand voltage factor (Power internal system)	U_W = 2,5 kV			
Withstand voltage factor (Telecom internal system)	Not applicable			
Type of zone according to loss	High loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	Table C.2
	Persons injured by fire	L_{F1}	10^{-1}	
	Physical damage due to fire	L_{F2}	10^{-1}	
	Persons injured by failure of internal systems	L_O	10^{-3}	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	5×10^{-2}	

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Table F.33 – Hospital: factors valid for zone Z_4 (operating block)

Input parameter	Comment	Symbol	Value	Reference
Type of floor	Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	Low	r_f	10^{-3}	Table B.6
Fire protection	Automatic alarm installations	r_p	0,2	Table B.5
Factor for persons in zone	t_z/8 760 = 3 100/8 760	P_P	0,35	Equation (B.14)
Factor for equipment in zone	t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	1	Table B.7
SPD system (Telecom line)	None	P_{SPD}	-	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	Unshielded (loop conductors in the same cable)	K_{S3P}	0,01	Table B.10
Internal wiring (Telecom line)	Metal free fibre optical cables	K_{S3T}	-	
Withstand voltage factor (Power internal system)	U_W = 2,5 kV			
Withstand voltage factor (Telecom internal system)	Not applicable			
Type of zone according to loss	Very high loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	Table C.2
	Persons injured by fire	L_{F1}	2×10^{-1}	
	Physical damage due to fire	L_{F2}	2×10^{-1}	
	Persons injured by failure of internal systems	L_O	10^{-2}	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	10^{-2}	

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Table F.34 – Hospital: factors valid for zone Z_5 (intensive care unit)

Input parameter	Comment	Symbol	Value	Reference
Type of floor	Linoleum	r_t	10^{-5}	Table B.2
Protection against shock (flash to structure)	None	P_{am}	1	Table B.1
Position of persons in the exposed area	Not applicable	P_o	-	Clause B.3
Risk of fire	Low	r_f	10^{-3}	Table B.6
Fire protection	Automatic alarm installations	r_p	0,2	Table B.5
Factor for persons in zone	t_z/8 760 = 8 760/8 760	P_P	1	Equation (B.14)
Factor for equipment in zone	t_e/8 760 = 8 760/8 760	P_e	1	Equation (B.15)
SPD system (Power line)	None	P_{SPD}	1	Table B.7
SPD system (Telecom line)	None	P_{SPD}	1	Table B.8
Zone shielding	None	K_{S2}	1	Equation (B.9)
Internal wiring (Power line)	Unshielded (loop conductors in the same cable)	K_{S3P}	0,01	Table B.10
Internal wiring (Telecom line)	Metal free fibre optical cables	K_{S3T}	-	
Withstand voltage factor (Power internal system)	U_W = 2,5 kV			
Withstand voltage factor (Telecom internal system)	Not applicable			
Type of zone according to loss	Very high loss zone	-	-	Table C.2
L: Loss	Persons injured by touch and step voltages	L_T	10^{-2}	Table C.2
	Persons injured by direct stroke	L_D	-	Table C.2
	Persons injured by fire	L_{F1}	2×10^{-1}	
	Physical damage due to fire	L_{F2}	2×10^{-1}	
	Persons injured by failure of internal systems	L_O	10^{-2}	
Tolerable value	Risk	R_T	10^{-5}	
	Frequency of damage	F_T	10^{-2}	

F.4.5 Risk assessment

The risk R can be expressed according to Equation (1). Involved components are given in Table F.29 and risk values are given in Table F.35.

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Table F.35 – Hospital: risk for the unprotected structure (values × 10^{-5})

Symbol	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	0,036	≈ 0	0,002	0,001	0,002
R_{AD}	-	18,357	-	-	-
R_B	-	-	3,572	0,484	0,714
R_C	-	-	17,862	63,213	178,619
R_M	-	-	1,881	0,017	0,047
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,480	0,065	0,096
R_W	-	-	1,200	4,247	12,000
R_Z	-	-	11,531	40,807	115,308
R	0,036	18,357	36,528	108,834	306,787
R_T	1				

Because in zones Z_2, Z_3, Z_4 and Z_5, R is higher than the tolerable value $R_T = 10^{-5}$, lightning protection for the structure is required to mitigate the risk in such zones.

F.4.6 Frequency of damage assessment

The frequency of damage F can be expressed according to Equation (12). Frequency components are to be evaluated according to 9.2. Involved components and total frequency evaluation are given in Table F.36.

Table F.36 – Hospital: frequency of damage for the unprotected structure

Symbol	Z_3	Z_4	Z_5
F_C	0,179	0,179	0,179
F_M	0,019	≈ 0	≈ 0
F_W	0,012	0,012	0,012
F_Z	0,115	0,115	0,115
F	0,325	0,306	0,306
F_T	0,05	0,01	0,01

NOTE No values are shown for zone Z_2 as Table F.31 states that there is no equipment in zone Z_2.

The following consideration can be made on the basis of Table F.36: because in all zones where internal systems are installed, F is higher than the tolerable values F_T, surge protection of equipment in the structure is required to reduce the frequency of damage.

F.4.7 Risk – Selection of protection measures

According to Table F.35, the zones at a higher risk are generally zones:

– Z_5 (intensive care unit);

– Z_4 (operating block), because of the high value R_C of failures of internal systems (risk

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High values of risk are also reported in zones:

– Z_3 (room block), because of the high value of attendance of people in the zone (risk components R_B, R_C and R_Z);

– Z_2 (roof) because of the high probability of a direct lightning flash to people standing in the exposed area (risk component R_{AD}).

These dominant risk components can be reduced by:

a) providing the building with a warning notice which prohibits maintenance personnel from going on the roof during thunderstorms, thus reducing the risk component R_{AD} (P_{am} = 0,1 for zone Z_2);

b) providing the whole building (including the exposed areas on the roof) with an LPS class II conforming to IEC 62305-3, reducing components R_{AD} and R_B via probability P_{LPS} = 0,05. For the equipotential bonding, the LPS is equipped with SPDs installed on the power line, at the entrance of the line in the structure (LPL II). The mandatory lightning equipotential bonding reduces also the components R_U and R_V via probability P_{EB} = 0,02;

c) providing zones Z_3, Z_4 and Z_5 with a coordinated SPD system protection conforming to IEC 62305-4 for the internal power system. This will reduce the components R_C, R_M, R_W and R_Z via the probability P_{SPD}.

- Zone Z_3: LPL I, P_{SPD} = 0,01;
- Zone Z_4: better than LPL I, P_{SPD} = 0,002;
- Zone Z_5: better than LPL I, P_{SPD} = 0,002.

Using this solution, the risk values from Table F.35 will change to the reduced values reported in Table F.37.

Table F.37 – Hospital: risk for the protected structure (values × 10^{-5})

Symbol	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	0,002	≈ 0	≈ 0	≈ 0	≈ 0
R_{AD}	-	0,092	-	-	-
R_B	-	-	0,357	0,048	0,071
R_C	-	-	0,179	0,126	0,357
R_M	-	-	0,019	≈ 0	≈ 0
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,010	0,001	0,002
R_W	-	-	0,012	0,008	0,024
R_Z	-	-	0,115	0,082	0,231
R	0,002	0,092	0,692	0,266	0,685
R_T	1				

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F.4.8 Frequency of damage – Selection of protection measures

To reduce the frequency of damage F to the required value F_T, a suitable measure is to install a coordinated SPD system to protect internal systems connected to the power line.

According to Table F.38, the solution to be used to reduce the risk R is also valid to reduce the frequency of damage. A coordinated SPD system to protect internal systems connected to the power line is suitable.

Such an SPD system reduces the value of P_{SPD} in the zone Z_3 from 1 to 0,01, and in zones Z_4 and Z_5 from 1 to 0,002. The new values of frequency of damage components are shown in Table F.38.

Table F.38 – Hospital: frequency of damage for the protected structure

Symbol	Z_3	Z_4	Z_5
F_C	0,001 8	0,000 4	0,000 4
F_M	0,000 2	≈ 0	≈ 0
F_W	0,000 1	≈ 0	≈ 0
F_Z	0,001 1	0,000 2	0,000 2
F	0,003 2	0,000 6	0,000 6
F_T	0,05	0,01	0,01
NOTE For this table, 4 digits are used due to very small values.			

F.4.9 Conclusions

Both risk R and frequency of damage F can be reduced below the tolerable level by installing:

– a warning notice which prohibits the maintenance personnel from going on the roof during thunderstorms,

– an LPS class II for protection of the building and of the exposed areas on the roof, including equipotential bonding for the incoming power line for LPL II,

– a coordinated SPD system for power systems in all zones.

NOTE As indicated in Clause B.4, the fire alarm has been taken into account in the risk calculation because it was protected against overvoltages and other damages and firefighters were able to arrive in less than 10 min.

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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PROTECTION CONTRE LA FOUDRE –

Partie 2: Évaluation des risques

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L'IEC 62305-2 a été établie par le comité d'études 81 de l'IEC: Protection contre la foudre. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2010. Cette édition constitue une révision technique.

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Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) adoption du concept de risque unique, afin de combiner les pertes de vies humaines et les pertes dues à un incendie;

b) adoption du concept de fréquence des dommages qui peuvent influencer la disponibilité des réseaux internes à la structure;

c) adoption de la densité de points d'impact au sol de la foudre N_{SG} en remplacement de la densité des coups de foudre N_G dans l'évaluation du nombre moyen annuel d'événements dangereux prévisibles;

d) la réduction de quelques composantes de risque peut être obtenue par l'utilisation de mesures préventives temporaires activées par un système d'alerte aux orages (TWS) conforme à l'IEC 62793. Le risque que des personnes soient directement frappées par la foudre dans des espaces ouverts a été décrit, en tenant compte de la réduction de ce risque au moyen d'un TWS.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
81/769/FDIS	81/772/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

La version française de la norme n'a pas été soumise au vote.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Une liste de toutes les parties de la série IEC 62305, publiées sous le titre général *Protection contre la foudre*, se trouve sur le site web de l'IEC.

Les différentes pratiques suivantes, à caractère moins permanent, existent dans les pays indiqués ci-après.

En Allemagne, la valeur de r_p = 1 s'applique dans tous les cas. Pour les composantes de risque R_B, R_C, R_M, R_V, R_W et R_Z, il est admis par hypothèse que P_{TWS} = 1. Pour LF1 et LF2, il convient d'utiliser les valeurs les plus élevées indiquées dans le Tableau C.2.

En Grèce, la valeur de P_{TWS} = 1 est admise par hypothèse pour tous les cas.

En Italie, il est exigé de calculer le risque de perte de vies humaines, RL1 dans l'Équation (7), et le risque de perte due à des dommages physiques, RL2 dans l'Équation (8), puis de comparer chaque risque au risque tolérable. La protection est assurée lorsque les deux risques, RL1 et RL2, sont inférieurs à la valeur tolérable.

Aux Pays-Bas et en Afrique du Sud, il convient de ne pas appliquer l'Annexe D et l'Annexe E pour les études courantes.

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Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé, ou
- révisé.

IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de ce document indique qu'il contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer ce document en utilisant une imprimante couleur.

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INTRODUCTION

Les coups de foudre à la terre peuvent être dangereux pour les structures et les lignes qui alimentent la structure.

Ces dangers peuvent donner lieu:

– à des dommages qui altèrent la structure et son contenu;
– à des défaillances des réseaux de puissance et de communication associés;
– à des blessures sur des êtres vivants dans la structure ou à proximité de celle-ci.

Les effets consécutifs à des dommages et à des défaillances peuvent s'étendre à la proximité immédiate de la structure ou peuvent impliquer son environnement. De plus, indépendamment de l'étendue des pertes, la disponibilité de la structure et de ses réseaux internes peut être altérée de manière inacceptable si la fréquence des dommages est élevée.

Des mesures de protection peuvent être exigées pour réduire la fréquence des dommages et les pertes dues à la foudre. Il convient de déterminer la nécessité d'une telle protection et dans quelle mesure, selon la fréquence des dommages et l'appréciation du risque.

NOTE 1 La décision de mise en œuvre d'une protection contre la foudre peut être prise sans tenir compte du résultat de l'appréciation du risque ou de la fréquence des dommages lorsque le risque zéro est recherché.

NOTE 2 L'IEC 60364-4-44 [1][1] exige systématiquement l'installation d'un dispositif de protection contre les surtensions (SPD, *Surge Protective Device*) au point d'entrée de l'alimentation électrique de la structure si les conséquences de surtensions ont une incidence sur:

– la préservation des vies humaines, par exemple services de sécurité, installations de soins médicaux;
– les services publics et le patrimoine culturel, par exemple la perte de services publics, de centres informatiques, de musées;
– les activités commerciales ou industrielles, par exemple hôtels, banques, industries, centres commerciaux, fermes.

La fréquence des dommages, définie dans le présent document comme le nombre annuel de dommages dans une structure dus aux impacts de foudre, dépend:

– du nombre annuel d'impacts de foudre qui impliquent la structure;
– de la probabilité d'événements dommageables dus à l'un de ces impacts de foudre.

Le risque, défini dans le présent document comme les pertes annuelles moyennes probables dans une structure dues aux impacts de foudre, dépend:

– de la fréquence des dommages;
– de l'étendue moyenne des pertes consécutives.

Les impacts de foudre qui impliquent une structure peuvent être divisés en:

– impacts directs sur la structure;
– impacts à proximité de la structure, directement sur les lignes connectées (lignes de puissance, de communication) ou à proximité de celles-ci.

Les impacts directs sur la structure ou une ligne connectée peuvent entraîner des dommages physiques et mettre en danger la vie des personnes. Les impacts à proximité de la structure ou d'une ligne, comme les impacts directs sur la structure ou une ligne, peuvent entraîner des défaillances des réseaux de puissance et de communication en raison des surtensions dues à un couplage résistif ou inductif entre ces réseaux et le courant de foudre.

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En outre, les défaillances dues aux surtensions de foudre dans les installations des utilisateurs et dans les lignes d'alimentation peuvent également générer des surtensions de manœuvre dans les installations.

NOTE 3 Le dysfonctionnement des réseaux de puissance et de communication n'est pas couvert par la série IEC 62305. Il est fait référence à l'IEC 61000-4-5 [2].

Le nombre d'impacts de foudre qui impliquent la structure dépend des dimensions, des caractéristiques de la structure et des lignes connectées, des caractéristiques de l'environnement de la structure et des lignes, ainsi que de la densité des points d'impact au sol de la foudre à l'emplacement de la structure et des lignes. Des recommandations sur l'évaluation du nombre d'impacts de foudre qui impliquent la structure sont données à l'Annexe A.

La probabilité de dommages dépend de la structure, de la résistivité du matériel situé sur la structure, des lignes connectées et des caractéristiques du courant de foudre, ainsi que du type et de l'efficacité des mesures de protection appliquées. Des recommandations sur l'évaluation de la probabilité de dommages dus à la foudre sont données à l'Annexe B.

L'étendue moyenne annuelle des pertes consécutives dépend de l'étendue des dommages et des effets consécutifs qui peuvent être dus à un impact de foudre. Des recommandations sur l'évaluation des pertes consécutives sont données à l'Annexe C.

L'effet des mesures de protection résulte des caractéristiques de chacune d'elles et peut réduire les probabilités de dommages.

NOTE 4 Il est admis par hypothèse que les dispositifs de protection sont mis en œuvre selon la qualité nécessaire.

Les mesures de protection sont destinées à être conformes à la série IEC 62305, à la série IEC 61643 et à l'IEC 62793, selon le cas.

NOTE 5 Pour les structures complexes (telles que les usines pétrochimiques, les grandes installations industrielles), les facteurs mentionnés dans les annexes du présent document peuvent exiger une évaluation plus approfondie des caractéristiques de la structure.

Les réglementations nationales ou locales peuvent fournir des recommandations ou des exigences minimales pour l'application du présent document. Il s'agit notamment de fixer les valeurs de risque tolérable R_T et de la fréquence tolérable des dommages F_T, ainsi que les règles de calcul et les valeurs des paramètres indiquées à l'Annexe A, l'Annexe B, l'Annexe C et l'Annexe E.

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PROTECTION CONTRE LA FOUDRE –

Partie 2: Évaluation des risques

1 Domaine d'application

La présente partie de l'IEC 62305 s'applique à l'évaluation des risques auxquels une structure est exposée en raison des coups de foudre à la terre.

Elle est destinée à proposer une procédure d'évaluation d'un tel risque. Lorsque la limite supérieure du risque tolérable est fixée, la procédure permet de choisir les mesures de protection appropriées pour réduire le risque à une valeur inférieure ou égale à la valeur limite tolérable.

L'évaluation des risques comprend également l'évaluation de la fréquence des dommages causés aux réseaux internes par les chocs dus aux coups de foudre à la terre. Lorsque la limite supérieure tolérable de la fréquence des dommages est fixée, la procédure permet de choisir les mesures de protection appropriées pour réduire la fréquence des dommages à une valeur inférieure ou égale à la valeur limite tolérable.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 61643 (toutes les parties), *Parafoudres basse tension*

IEC 62305-1:2024, *Protection contre la foudre – Partie 1: Principes généraux*

IEC 62305-3:2024, *Protection contre la foudre – Partie 3: Dommages physiques sur les structures et risques humains*

IEC 62305-4:2024, *Protection contre la foudre – Partie 4: Réseaux de puissance et de communication dans les structures*

IEC 62793, *Systèmes d'alerte aux orages – Protection contre la foudre*

IEC 62858, *Densité de foudroiement basée sur des systèmes de localisation de la foudre – Principes généraux*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/

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3.1
structure à protéger
tout endroit, installation ou bâtiment susceptible de contenir des personnes, des animaux, des matériaux ou des systèmes

Note 1 à l'article: Une structure à protéger peut faire partie d'une structure de plus grandes dimensions.

3.2
structure qui présente un risque d'explosion
structures associées qui comportent des zones dangereuses comme cela est déterminé conformément à l'IEC 60079-10-1 [3] et à l'IEC 60079-10-2 [4] ou des matériaux explosifs solides

Note 1 à l'article: L'IEC 60079-10-1 et l'IEC 60079-10-2 ne traitent pas des dangers liés aux explosifs solides.

3.3
structure dangereuse pour l'environnement
structure qui peut être à l'origine d'émissions biologiques, chimiques et radioactives à la suite d'un foudroiement

EXEMPLE Usines chimiques, pétrochimiques.

3.4
environnement urbain
zone qui présente une forte densité de bâtiments ou une population importante et des bâtiments élevés

EXEMPLE Centre-ville.

3.5
environnement suburbain
zone qui présente une densité moyenne de bâtiments

EXEMPLE Zones à la périphérie immédiate des villes, communautés résidentielles.

3.6
environnement rural
zone qui présente une faible densité de bâtiments

EXEMPLE Campagne.

3.7
tension assignée de tenue aux chocs
U_W
valeur de tension assignée de tenue aux chocs fixée par le fabricant aux matériels ou à une partie d'entre eux, caractérisant la capacité de tenue spécifiée de son isolation contre des surtensions

Note 1 à l'article: Pour les besoins du présent document, seule la tension de tenue entre les conducteurs actifs et la terre est prise en compte.

[SOURCE: IEC 60664-1:2020, 3.1.18 [5], modifié – Le symbole U_{imp} a été remplacé par U_W, dans la définition "surtensions transitoires" a été remplacé par "tensions" et la Note à l'article a été ajoutée.]

3.8
réseau de puissance
réseau qui comprend des composants de l'alimentation basse tension

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3.9
réseau de communication
réseau qui comprend des composants électroniques sensibles tels que le matériel de communication, les systèmes informatiques, de commande et d'instrumentation, les systèmes radioélectriques et les installations électroniques de puissance

3.10
réseaux internes
réseaux de puissance et de communication d'une structure

3.11
ligne
ligne de puissance ou de communication connectée à la structure à protéger

3.12
ligne de communication
ligne prévue pour la communication entre des matériels qui peuvent être situés dans des structures distinctes

EXEMPLE Lignes téléphoniques, lignes de données.

3.13
ligne de puissance
ligne de distribution alimentant en énergie électrique les équipements électriques et électroniques d'une structure

EXEMPLE Réseaux électriques basse tension (BT) ou haute tension (HT).

3.14
événement dangereux
impact de foudre direct ou à proximité de la structure à protéger, ou direct ou à proximité d'une ligne connectée à la structure à protéger, susceptible de provoquer des dommages

3.15
impact de foudre sur une structure
coup de foudre qui frappe une structure à protéger

3.16
impact de foudre à proximité d'une structure
coup de foudre qui frappe suffisamment près d'une structure à protéger pour pouvoir causer des surtensions dangereuses

3.17
impact de foudre sur une ligne
coup de foudre qui frappe une ligne connectée à la structure à protéger

3.18
impact de foudre à proximité d'une ligne
coup de foudre qui frappe suffisamment près d'une ligne connectée à la structure à protéger pour pouvoir causer des surtensions dangereuses

3.19
densité de foudroiement au sol
N_G
nombre moyen d'éclairs nuage-sol par unité de surface et par unité de temps (éclairs × km^{-2} × an^{-1})

Note 1 à l'article: Les coups de foudre au sol peuvent avoir plusieurs points d'impact au sol.

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3.20
densité de points d'impact au sol de la foudre
N_{SG}
nombre moyen de points d'impact au sol ou sur des objets situés au sol, par unité de surface et par unité de temps (points d'impact × km^{-2} × an^{-1})

3.21
fréquence des événements dangereux dus aux impacts sur une structure
N_D
nombre annuel moyen prévisible des événements dangereux dus aux impacts de foudre sur une structure

3.22
fréquence des événements dangereux dus aux impacts sur une ligne
N_L
nombre annuel moyen prévisible des événements dangereux dus aux impacts de foudre sur une ligne

3.23
fréquence des événements dangereux dus aux impacts à proximité d'une structure
N_M
nombre annuel moyen prévisible des événements dangereux dus aux impacts de foudre à proximité d'une structure

3.24
fréquence des événements dangereux dus aux impacts à proximité d'une ligne
N_I
nombre annuel moyen prévisible des événements dangereux dus aux impacts de foudre à proximité d'une ligne

3.25
impulsion électromagnétique de foudre
IEMF
champ électromagnétique qui varie rapidement dans le temps, qui est émis par la foudre et qui crée des chocs par couplage résistif, inductif, capacitif et électromagnétique aux circuits

3.26
choc
onde transitoire qui crée une surtension ou une surintensité, due aux impulsions électromagnétiques de foudre (IEMF) couplées aux lignes et aux matériels

3.27
nœud
point d'une ligne où la propagation d'un choc peut être négligée

EXEMPLE Une sous-station HT pour une ligne de puissance, ou un central de communications pour une ligne de communication.

3.28
dommages physiques
dommage subi par une structure (ou son contenu) en raison des effets mécaniques, thermiques, chimiques et explosifs de la foudre

3.29
blessures sur des êtres humains
blessures, y compris la mort, de personnes causées par la foudre

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3.30
défaillance des réseaux internes
dommage des réseaux de puissance et de communication dû aux impulsions électromagnétiques de foudre (IEMF)

3.31
probabilité de dommages
P
probabilité qu'un événement dangereux entraîne des dommages dans la zone concernée ou au système interne de la structure à protéger

3.32
fréquence des dommages
F
valeur du nombre annuel d'événements qui provoquent des dommages et qui sont susceptibles de se produire sur les réseaux internes à la structure à protéger

3.33
composante de fréquence des dommages
F_X
fréquence partielle des dommages, qui dépend de la source des dommages

3.34
fréquence tolérable des dommages
F_T
valeur maximale de la fréquence des dommages qui peut être tolérée par les matériels dans la structure ou dans une zone à protéger

3.35
pertes
L_X
étendue moyenne d'un type spécifié de dommage consécutif à un événement dangereux, dans la zone concernée d'une structure

3.36
service
fonction réalisée par les réseaux internes à la structure afin de répondre à un besoin spécifique

3.37
risque
R
perte moyenne annuelle probable due à la foudre, subie par une structure ou une zone spécifique de la structure

3.38
composante de risque
R_X
risque partiel qui dépend de la source et du type de dommage

3.39
risque tolérable
R_T
valeur maximale du risque qui peut être tolérée pour la structure à protéger

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3.40
zone à risque
Z_X
<d'une structure> partie d'une structure dont les caractéristiques sont homogènes et dans laquelle un seul jeu de paramètres est applicable à l'appréciation du risque

Note 1 à l'article: Une structure peut contenir une ou plusieurs zones.

3.41
section d'une ligne
S_L
partie d'une ligne dont les caractéristiques sont homogènes et pour laquelle un seul jeu de paramètres est utilisé dans l'évaluation d'une composante du risque ou de la fréquence des dommages

3.42
zone de protection contre la foudre
ZPF
zone dont l'environnement électromagnétique est défini

Note 1 à l'article: Les frontières d'une ZPF ne sont pas nécessairement physiques.

3.43
niveau de protection contre la foudre
NPF
chiffre lié à un ensemble de paramètres du courant de foudre et relatif à la probabilité que les valeurs de conception associées maximales et minimales ne soient pas dépassées lorsque la foudre apparaît de manière naturelle

Note 1 à l'article: Un niveau de protection contre la foudre est utilisé pour prévoir des mesures de protection conformément à l'ensemble approprié de paramètres du courant de foudre.

3.44
mesures de protection
mesures adoptées dans la structure à protéger pour réduire le risque ou la fréquence des dommages

3.45
protection contre la foudre
PCLF
mesures prises pour protéger des structures contre les effets de la foudre, y compris leurs réseaux internes, leur contenu et les personnes qui s'y trouvent, qui comprennent généralement un SPF et une MPF

Note 1 à l'article: Il est également admis de faire appel à des mesures de protection auxiliaires telles qu'un système d'alerte aux orages (TWS).

3.46
système de protection contre la foudre
SPF
système complet utilisé pour réduire les dangers de blessures sur des êtres vivants et de dommages physiques dus aux coups de foudre sur une structure

Note 1 à l'article: Un système de protection contre la foudre comprend à la fois un système de protection contre la foudre d'extérieur et un système de protection contre la foudre d'intérieur.

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3.47
mesures de protection contre la foudre
MPF
mesures prises pour protéger les réseaux internes contre les effets de l'IEMF

Note 1 à l'article: Les mesures de protection contre les chocs font partie d'une protection globale contre la foudre.

3.48
blindage électromagnétique
écran en matériau conducteur destiné à réduire la pénétration d'un champ électromagnétique qui varie dans le temps dans la structure à protéger, ou une partie de celle-ci, afin de réduire les défaillances des réseaux internes

3.49
câble de protection contre la foudre
câble spécial avec une tension assignée de tenue aux chocs U_w supérieure à U_w du matériel connecté et qui dispose d'une gaine métallique en contact permanent avec le sol, que ce soit de manière directe ou par l'intermédiaire d'un revêtement plastique conducteur

3.50
conduit de protection contre la foudre
conduit de faible résistivité en contact avec le sol

EXEMPLE Conduits en béton armé avec connexion aux structures métalliques internes, conduits métalliques.

3.51
dispositif de protection contre les surtensions
parafoudre
SPD
dispositif incluant au moins un composant non linéaire destiné à limiter les surtensions transitoires et à écouler les courants de foudre

Note 1 à l'article: L'abréviation "SPD" est dérivée du terme anglais développé correspondant "surge protective device".

[SOURCE: IEC 61643-11:2011, 3.1.1 [6], modifié – Le terme "surtensions" a été remplacé par "surtensions transitoires" et la Note a été supprimée.]

3.52
système de protection par parafoudres coordonnés
système composé de parafoudres choisis, coordonnés et mis en œuvre de manière appropriée afin de constituer un réseau destiné à réduire les défaillances des réseaux de puissance et de communication

3.53
interface d'isolement
dispositif capable de réduire les chocs conduits sur une ligne qui pénètre dans la zone de protection contre la foudre (ZPF)

Note 1 à l'article: L'interface d'isolement comprend des transformateurs d'isolement à écran mis à la terre entre les enroulements, les câbles fibroniques non métalliques et les optoisolateurs.

Note 2 à l'article: Les caractéristiques de tenue d'isolement de ce dispositif adaptées à cette application sont fournies de manière intrinsèque ou par l'intermédiaire d'un parafoudre.

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3.54
liaison équipotentielle de foudre
EB
interconnexion des parties métalliques d'un SPF, par des connexions directes ou par des parafoudres réduisant les différences de potentiel engendrées par le courant de foudre

Note 1 à l'article: L'abréviation "EB" est dérivée du terme anglais développé correspondant "equipotential bonding".

3.55
système d'alerte aux orages
TWS
système composé d'un ou de plusieurs détecteurs d'orage capables de surveiller l'activité orageuse ou l'activité orageuse à venir dans la zone de surveillance (MA) et d'outils qui permettent de traiter les données acquises pour déclencher une alarme (alerte) valide en cas de phénomène de foudre (LRE) ou de conditions de foudre (LRC) pour une zone environnante (SA) définie

Note 1 à l'article: Dans certains pays, les TWS sont appelés "systèmes d'alerte à la foudre".

Note 2 à l'article: L'abréviation "TWS" est dérivée du terme anglais développé correspondant "thunderstorm warning system".

[SOURCE: IEC 62793:2020, 3.1.23]

3.56
phénomène de foudre
LRE
phénomène où un ou plusieurs éclairs nuage-sol (CG) surviennent à l'intérieur de la zone environnante (SA)

Note 1 à l'article: L'abréviation "LRE" est dérivée du terme anglais développé correspondant "lightning-related event".

[SOURCE: IEC 62793:2020, 3.1.15]

3.57
conditions de foudre
LRC
champ électrique statique qui a atteint un niveau suffisamment élevé pour s'attendre à la survenue d'un éclair à tout moment dans la zone environnante (SA)

Note 1 à l'article: L'abréviation "LRC" est dérivée du terme anglais développé correspondant "lightning-related conditions".

[SOURCE: IEC 62793:2020, 3.1.16]

3.58
zone de surveillance
MA
zone géographique dans laquelle l'activité orageuse ou l'activité orageuse à venir (la survenue d'un éclair est attendue à tout moment) est surveillée afin de produire des alertes valides pour la zone environnante (SA)

Note 1 à l'article: La zone de surveillance est de taille inférieure ou égale à la zone de couverture.

Note 2 à l'article: L'abréviation "MA" est dérivée du terme anglais développé correspondant "monitoring area".

[SOURCE: IEC 62793:2020, 3.1.18]

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3.59
zone environnante
SA
zone géographique dans laquelle un phénomène de foudre (LRE) occasionne un danger potentiel et qui entoure et inclut la cible (TA) à protéger

Note 1 à l'article: Tout phénomène de foudre (LRE) qui survient dans la zone environnante (SA) est potentiellement dangereux pour la cible. Cette zone est utilisée lors de l'évaluation d'un système d'alerte aux orages (TWS) afin d'établir les paramètres de performance tels que le taux de défaillance d'alerte (FTWR).

Note 2 à l'article: L'abréviation "SA" est dérivée du terme anglais développé correspondant "surrounding area".

[SOURCE: IEC 62793:2020, 3.1.20]

3.60
zone 0
emplacement dans lequel une atmosphère explosive gazeuse est présente en permanence, ou pour de longues périodes ou fréquemment

Note 1 à l'article: Les termes "longues" et "fréquemment" sont destinés à décrire une très forte probabilité de présence d'une atmosphère potentiellement explosive dans l'emplacement. À cet égard, il n'est pas nécessaire de quantifier ces termes.

[SOURCE: IEC 60079-10-1:2020, 3.3.4 [3]]

3.61
zone 1
emplacement dans lequel une atmosphère explosive gazeuse est susceptible de se présenter occasionnellement en fonctionnement normal

[SOURCE: IEC 60079-10-1:2020, 3.3.5 [3]]

3.62
zone 2
emplacement dans lequel une atmosphère explosive gazeuse n'est pas susceptible de se présenter en fonctionnement normal, mais qui si c'est le cas, peut persister uniquement sur une durée courte

[SOURCE: IEC 60079-10-1:2020, 3.3.6 [3]]

3.63
zone 20
emplacement dans lequel une atmosphère explosive poussiéreuse, sous la forme de nuage de poussière dans l'air, est présente en permanence, ou pendant de longues périodes ou fréquemment

[SOURCE: IEC 60079-10-2:2015, 3.25.1 [4]]

3.64
zone 21
emplacement dans lequel une atmosphère explosive poussiéreuse, sous la forme de nuage de poussière dans l'air, est susceptible de se présenter occasionnellement, en fonctionnement normal

[SOURCE: IEC 60079-10-2:2015, 3.25.2 [4]]

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3.65
zone 22
emplacement dans lequel une atmosphère explosive poussiéreuse, sous la forme de nuage de poussières combustibles dans l'air, n'est pas susceptible de se présenter en fonctionnement normal, mais peut persister uniquement pendant une courte durée

Note 1 à l'article: La possibilité de créer un nuage de poussière explosif à partir d'une couche de poussière nécessite aussi d'être prise en compte.

[SOURCE: IEC 60079-10-2:2015, 3.25.3 [4]]

3.66
structure adjacente
structure reliée à la structure soumise à l'étude par au moins une ligne

4 Symboles et abréviations

A_D Surface équivalente d'exposition pour les impacts sur une structure isolée A.2.1.2
A_D' Surface d'exposition pour les toitures élevées saillantes A.2.1.3
A_{DJ} Surface équivalente d'exposition pour les impacts sur une structure adjacente A.2.5
A_I Surface équivalente d'exposition pour les impacts à proximité d'une ligne ..... Article A.5
A_L Surface équivalente d'exposition pour les impacts sur une ligne ..... Article A.4
A_M Surface équivalente d'exposition pour les impacts à proximité de la structure .. Article A.3
B Bâtiment A.2.2
C_D Facteur d'emplacement ..... Tableau A.1
C_{DJ} Facteur d'emplacement d'une structure adjacente ..... A.2.5, Tableau A.1
C_E Facteur d'environnement ..... Tableau A.4
C_I Facteur d'installation de la ligne ..... Tableau A.2
C_{LD} Facteur qui dépend des conditions de blindage, de mise à la terre et d'isolement de la ligne pour les impacts sur une ligne ..... Tableau B.9
C_{LI} Facteur qui dépend des conditions de blindage, de mise à la terre et d'isolement de la ligne pour les impacts à proximité d'une ligne ..... Tableau B.9
C_T Facteur de type de ligne dû à la présence d'un transformateur HT/BT sur la ligne ..... Tableau A.3
D_{1D} Choc électrique qui résulte d'impacts qui frappent directement des êtres humains 5.2
D_{1T} Choc électrique qui frappe des êtres humains à la suite d'un couplage résistif et inductif 5.2
D_2 Étincelage dangereux qui entraîne un incendie ou une explosion 5.2
D_3 Chocs dus à toutes les sources de dommages 5.2
F Fréquence des dommages 9.1
F_C Fréquence des dommages dus à des impacts sur la structure (source S_1) 9.1
F_M Fréquence des dommages dus à des impacts à proximité de la structure (source S_2) 9.1

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F_T Fréquence tolérable des dommages 9.3

F_W Fréquence des dommages dus à des impacts sur la ligne (source S_3) 9.1

F_Z Fréquence des dommages dus à des impacts à proximité de la ligne (source S_4) 9.1

H Hauteur de la structure A.2.1.2

k Facteur qui lie N_G à N_{SG} ..... Article A.1

K_{S1} Facteur associé à l'efficacité de blindage de la structure ..... Article B.6

K_{S2} Facteur associé à l'efficacité de blindage des écrans internes à la structure ..... Article B.6

K_{S3} Facteur associé aux caractéristiques du câblage interne ..... Article B.6

L Longueur de structure A.2.1.2

L_1 Pertes dues à des blessures sur des êtres humains 5.3

L_2 Pertes dues à des dommages physiques causés à la structure et à son contenu 5.3

L_3 Pertes dues à une défaillance des réseaux de puissance et de communication 5.3

L_{AD} Pertes liées à des blessures sur des êtres humains par choc électrique qui résulte de coups de foudre frappant directement ces êtres humains (impacts sur une structure) ..... Tableau 3, Article C.2

L_{AT} Pertes liées à des blessures sur des êtres humains par choc électrique résultant d'un couplage résistif et inductif (impacts sur une structure) ..... Tableau 3, Article C.2

L_{B1} Pertes liées à des blessures sur des êtres humains, causées par des dommages physiques sur une structure (impacts sur une structure) ..... Tableau 3, Article C.2

L_{B2} Pertes liées à des dommages physiques sur une structure (impacts sur une structure) ..... Tableau 3, Article C.2

L_{BT} Pertes totales liées à des dommages physiques sur une structure, y compris des dommages d'environnement (impacts sur une structure) ..... Article C.2

L_{C1} Pertes liées à des blessures sur des êtres humains, causées par des défaillances des réseaux internes (impacts sur une structure) ..... Tableau 3, Article C.2

L_{C2} Pertes associées à des défaillances des réseaux internes (impacts sur une structure) ..... Tableau 3, Article C.2

L_D Rapport type moyen du nombre de personnes blessées par coup de foudre direct du fait d'un événement dangereux sur le nombre total de personnes exposées dans la zone ..... Article C.2

L_E Rapport type moyen des pertes à l'extérieur de la structure du fait d'un événement dangereux sur le montant maximal des pertes dans la zone ..... Article C.2

L_{F1} Rapport type moyen du nombre de personnes blessées par un incendie ou une explosion du fait d'un événement dangereux sur le nombre total de personnes dans la zone ..... Article C.2

L_{F2} Rapport type moyen des dommages physiques causés par un incendie ou une explosion du fait d'un événement dangereux sur le montant maximal des dommages dans la zone ..... Article C.2

L_L Longueur de la section de la ligne ..... Article A.4

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L_{M1} Pertes liées à des blessures sur des êtres humains, causées par des défaillances des réseaux internes (impacts à proximité d'une structure) ..... Tableau 3, Article C.2

L_{M2} Pertes associées à des défaillances des réseaux internes (impacts à proximité d'une structure) ..... Tableau 3, Article C.2

L_{O1} Rapport type moyen du nombre de personnes blessées par des défaillances des réseaux internes du fait d'un événement dangereux sur le nombre total de personnes dans la zone ..... Article C.2

L_{O2} Rapport type moyen des dommages physiques causés par des défaillances des réseaux internes du fait d'un événement dangereux sur le montant maximal des dommages dans la zone ..... Article C.2

L_T Rapport type moyen du nombre de personnes blessées par des tensions de contact et de pas du fait d'un événement dangereux sur le nombre total de personnes dans la zone ..... Article C.2

L_{UT} Pertes liées à des blessures sur des êtres humains par choc électrique qui résulte d'un couplage résistif et inductif (impacts sur une ligne)..... ..... Article C.2

L_{V1} Pertes liées à des blessures sur des êtres humains, causées par des dommages physiques sur une structure (impacts sur une ligne) ..... Article C.2

L_{V2} Pertes occasionnées à une structure, liées à des dommages physiques (impacts sur une ligne) ..... Article C.2

L_{VT} Pertes totales occasionnées à une structure, liées à des dommages physiques, y compris des dommages d'environnement (impacts sur une ligne) ..... Article C.2

L_{W1} Pertes liées à des blessures sur des êtres humains, causées par des défaillances des réseaux internes (impacts sur une ligne) ..... Article C.2

L_{W2} Pertes associées à des défaillances des réseaux internes (impacts sur une ligne) ..... Article C.2

L_X Pertes consécutives à des dommages 8.1

L_{Z1} Pertes liées à des blessures sur des êtres humains, causées par des défaillances des réseaux internes (impacts à proximité d'une ligne)..... Article C.2

L_{Z2} Pertes associées à des défaillances des réseaux internes (impacts à proximité d'une ligne)..... Article C.2

n' Nombre de conducteurs dans un câble ..... Tableau B.7

n Nombre total de conducteurs de câbles et de chemins conducteurs externes ..... Tableau B.7

N_D Nombre annuel d'événements dangereux dus à des impacts sur une structure..... A.2.4

N_{DJ} Nombre d'événements dangereux dus à des impacts sur une structure adjacente .. A.2.5

N_G Densité annuelle de foudroiement au sol ..... Article A.1

N_I Nombre d'événements dangereux dus aux impacts à proximité d'une ligne..... Article A.5

N_L Nombre d'événements dangereux dus aux impacts sur une ligne..... Article A.4

N_M Nombre d'événements dangereux dus aux impacts à proximité d'une structure..... Article A.3

N_{SG} Densité annuelle de points d'impact au sol de la foudre..... Article A.1

N_X Nombre annuel d'événements dangereux 8.1, 9.2

P_{AD} Probabilité qu'un impact sur une structure provoque un choc sur une personne..... Article B.3

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P_{am} Probabilité qu'un impact sur une structure provoque des blessures sur des êtres humains dues à des tensions de contact et de pas ..... Article B.2

P_{AT} Probabilité qu'un impact sur une structure provoque des tensions dangereuses de contact et de pas ..... Article B.2

P_B Probabilité de dommages physiques sur une structure (impacts sur une structure) .. Article B.4

P_C Probabilité de défaillances des réseaux internes (impacts sur une structure) ... Article B.5

P_e Probabilité qu'un matériel soit exposé à un événement dommageable ..... Article B.12

P_{EB} Probabilité qu'une étincelle apparaisse entre des sections conductrices électriquement isolées, malgré une protection par liaison équipotentielle de foudre (EB) ..... Article B.7, Tableau B.13

P_{LD} Probabilité de réduction de P_U, P_V et P_W en fonction des caractéristiques de la ligne et de la tension de tenue du matériel (impacts sur la ligne connectée) ..... Article B.7

P_{LPS} Probabilité qui dépend du NPF du système de protection contre la foudre (SPF) ..... Article B.3

P_M Probabilité de défaillances des réseaux internes (impacts à proximité d'une structure) ..... Article B.6

P_{MS} Probabilité de réduction de P_M en fonction du blindage, du câblage et de la tension de tenue du matériel ..... Article B.6

P_O Facteur de probabilité en fonction de la position d'une personne dans la zone exposée ..... Article B.3

P_P Probabilité qu'une personne se trouve à un emplacement dangereux ..... Article B.11

P_Q Probabilité que la valeur de la charge associée au courant qui traverse le parafoudre dépasse la valeur tolérée par le parafoudre ..... Annexe D

P_S Probabilité qu'un impact sur une structure provoque un étincelage dangereux . Article B.4

P_{SPD} Probabilité qu'un appareil soit endommagé malgré sa protection par un système de protection par parafoudres coordonnés ..... Tableau B.8, Tableau B.9

P_{TWS} Probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible ..... Article B.1

P_U Probabilité de blessures sur des êtres humains par choc électrique (impacts sur une ligne connectée) ..... Article B.7

P_{Up} Probabilité que la valeur de tension résiduelle sur un SPD dépasse le niveau de protection exigé U_p, pertinent pour le courant qui traverse le SPD ..... Annexe D

P_V Probabilité de dommages physiques sur une structure (impacts sur une ligne connectée) ..... Article B.8

P_W Probabilité de défaillances des réseaux internes (impacts sur une ligne connectée) ..... Article B.9

P_X Probabilité de dommages 8.1, 9.2

P_Z Probabilité de défaillances des réseaux internes (impacts à proximité d'une ligne connectée) ..... Article B.10

r_f Facteur de réduction de pertes associées au risque d'incendie ..... Article B.4

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r_M	Distance conventionnelle	Article A.3, Article A.5
r_p	Facteur de réduction de pertes dues aux dispositions contre l'incendie	Article B.4
r_t	Facteur de réduction associé au type de surface	Article B.2
R	Risque	6.1, 6.3.1, 6.3.2
R_{AD}	Composante de risque (blessures causées par un éclair qui frappe des êtres humains exposés sur une structure – impacts sur une structure)	6.2.1, Tableau 2, Tableau 3
R_{AT}	Composante de risque (blessures sur des êtres humains causées par un choc électrique en raison de tensions de contact et de pas – impacts sur une structure)	6.2.1, Tableau 2, Tableau 3
R_B	Composante de risque (dommages physiques sur une structure – impacts sur une structure)	6.2.1, Tableau 2, Tableau 3
R_C	Composante de risque (défaillances des réseaux internes – impacts sur une structure)	6.2.1, Tableau 2, Tableau 3
R_M	Composante de risque (défaillances des réseaux internes – impacts à proximité d'une structure)	6.2.2, Tableau 2, Tableau 3
R_S	Résistance de blindage par unité de longueur d'un câble	Tableau B.12, Tableau B.13
R_T	Risque tolérable	7.3
R_U	Composante de risque (blessures sur des êtres humains – impacts sur une ligne connectée)	6.2.3, Tableau 2, Tableau 3
R_V	Composante de risque (dommages physiques sur une structure – impacts sur une ligne connectée)	6.2.3, Tableau 2, Tableau 3
R_W	Composante de risque (défaillances des réseaux internes – impacts sur une ligne connectée)	6.2.3, Tableau 2, Tableau 3
R_X	Composante de risque pour une structure	8.1
R_Z	Composante de risque (défaillances des réseaux internes – impacts à proximité d'une ligne)	6.2.4, Tableau 2, Tableau 3
S	Structure	A.2.2
S1	Source de dommages – impacts sur une structure	5.1, Tableau 3
S2	Source de dommages – impacts à proximité d'une structure	5.1, Tableau 3
S3	Source de dommages – impacts sur une ligne	5.1, Tableau 3
S4	Source de dommages – impacts à proximité d'une ligne	5.1, Tableau 3
S_L	Section d'une ligne	8.4
t_z	Temps, en heures, par année de présence de personnes à un emplacement dangereux	Article B.11
U_W	Tension de choc assignée d'un réseau	Article A.3, Article A.5, Article B.7
w_m	Largeur de maille	Article B.6
W	Largeur de structure	A.2.1.2
X	Indice générique de la composante de risque, du nombre d'événements dangereux, de la probabilité et des pertes	8.1, 9.2
Z_S	Zones d'une structure	8.3

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5 Dommages et pertes

5.1 Source de dommages

Le courant de foudre est la source principale des dommages. Les détails relatifs aux courants de foudre et aux propriétés de la foudre doivent être pris en compte, conformément à l'IEC 62305-1:2024. Les sources suivantes sont distinguées en fonction de l'emplacement du point d'impact:

S1: impacts sur la structure;

S2: impacts à proximité de la structure;

S3: impacts sur une ligne connectée à la structure;

S4: impacts à proximité d'une ligne connectée à la structure.

5.2 Causes de dommages

Un impact de foudre peut entraîner des dommages qui dépendent, à plus d'un titre, des caractéristiques de la structure évaluée. Parmi les caractéristiques les plus importantes, il y a le type de construction, le contenu et ses applications, le type de service et les mesures de protection prises. Les dommages physiques sur les structures et les risques humains doivent être pris en compte, conformément à l'IEC 62305-3.

En conséquence, quatre causes de dommages peuvent être distinguées:

– D_{1D}: choc électrique qui frappe des êtres humains à la suite d'un coup de foudre;

– D_{1T}: choc électrique qui frappe des êtres humains à la suite d'un couplage résistif et inductif;

– D_2: étincelage dangereux à l'intérieur de la structure, qui déclenche un incendie ou une explosion ou provoque des effets mécaniques et chimiques, ou les deux, qui peuvent également mettre en danger l'environnement;

– D_3: chocs dus à toutes les sources de dommages qui entraînent des défaillances des réseaux internes.

Les dommages à une structure dus à la foudre peuvent être limités à une partie de la structure ou peuvent s'étendre à l'ensemble de celle-ci. Ils peuvent également concerner les structures environnantes ou l'environnement (structures dangereuses pour l'environnement).

5.3 Type de perte

Chaque type de dommage propre à une structure à protéger, qu'elle soit seule ou associée, peut entraîner différents types de pertes. Le type de perte qui peut apparaître dépend des caractéristiques de la structure elle-même.

Pour les besoins du présent document, les types de pertes suivants, qui peuvent apparaître à la suite de coups de foudre, sont envisagés:

L_1: pertes dues à des blessures sur des êtres humains. Ce type de dommage est associé aux causes D_{1D}, D_{1T}, D_2 voire D_3 dans les structures dans lesquelles une défaillance des réseaux internes met en danger la vie humaine, par exemple dans les structures avec risque d'explosion et dans les hôpitaux;

L_2: pertes dues aux dommages physiques de la structure et de son contenu. Ce type de dommage est associé aux causes D_2 et D_3 (D_3 dans les structures avec risque d'explosion, en général);

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L_3: pertes dues à une défaillance des réseaux internes. Ce type de dommage est associé à la cause D_3.

NOTE 1 Les pertes L_3 ne concernent pas les dommages physiques causés à un réseau interne. Elles se concentrent sur les chocs qui altèrent la fonction assurée par le réseau interne.

Le calcul du risque s'applique à toutes les structures lorsque les types de pertes L_1 ou L_2 sont impliqués.

Le type de dommage L_3 peut altérer de manière inacceptable les services fournis par les réseaux internes de la structure. Dans ce cas, le calcul de la fréquence des dommages est effectué en complément du calcul du risque. La fréquence des dommages peut englober les pertes économiques pures ou les pertes de services. Lorsque des dommages occasionnés aux réseaux internes entraînent des conséquences pour l'environnement ou impliquent du matériel essentiel lié à la sécurité, il convient d'évaluer l'incidence des pertes par calcul du risque et non pas par le biais de la fréquence des dommages. La protection contre la foudre des réseaux de puissance et de communication dans les structures doit être prise en compte, conformément à l'IEC 62305-4:2024 et à la série IEC 61643.

NOTE 2 La perte d'un patrimoine national est traitée par les pertes L_2 et la perte d'un service public est traitée par F et par les pertes L_2/L_3.

6 Risque et composantes de risque

6.1 Risque

Le risque R doit être évalué compte tenu de la sécurité des personnes (type de perte L_1) et de la structure et de son contenu (type de perte L_2).

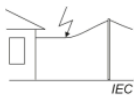
Pour évaluer le risque R, les composantes de risque (risques partiels qui dépendent de la source de dommages et du type de perte) doivent être définies et calculées (voir le Tableau 1).

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Tableau 1 – Sources de dommages, causes de dommages, types de pertes et composantes de risque en fonction du point d'impact

Point d'impact		Source de dommages	Causes de dommages	Type de perte	Composante de risque
Structure		S1	D_{1T}	L_1	R_{AT}
			D_{1D} [c]	L_1	R_{AD}
			D_2	L_1, L_2	R_{B1}, R_{B2}
			D_3	L_1[a], L_2[b]	R_{C1}, R_{C2}
À proximité de la structure		S2	D_3	L_1[a], L_2[b]	R_{M1}, R_{M2}
Lignes connectées à la structure		S3	D_{1T}	L_1	R_U
			D_2	L_1, L_2	R_{V1}, R_{V2}
			D_3	L_1[a], L_2[b]	R_{W1}, R_{W2}
À proximité des lignes connectées à la structure		S4	D_3	L_1[a], L_2[b]	R_{Z1}, R_{Z2}

Les composantes de risque de la dernière colonne sont calculées d'après le type de perte examiné (voir la colonne Type de perte).

[a] En général pour les structures dans lesquelles une défaillance des réseaux internes met en danger la vie humaine, par exemple dans les structures avec risque d'explosion et dans les hôpitaux.

[b] En général pour les structures avec risque d'explosion.

[c] Cela concerne uniquement les personnes exposées sur une structure comme un parking sur un toit ou une terrasse, un balcon.

Des exemples de calculs de risques sont fournis à l'Annexe F.

6.2 Composantes de risque

6.2.1 Composantes de risque pour une structure dû à la source S1

R_{AT}: composante liée au type de perte L_1, causé par un choc électrique qui frappe des êtres humains du fait de tensions de contact et de pas dans la structure et, à l'extérieur, dans des zones jusqu'à 3 m autour des conducteurs de descente.

R_{AD}: composante liée au type de perte L_1, causé par un éclair qui frappe des êtres humains exposés sur une structure.

R_B: composante liée aux types de pertes L_1 (R_{B1}) et L_2 (R_{B2}), causés par un étincelage dangereux dans la structure qui entraîne un incendie ou une explosion, ou qui a des répercussions mécaniques et chimiques, et qui peut également mettre en danger l'environnement.

R_C: composante liée aux types de pertes L_1 (R_{C1}) et L_2 (R_{C2}), causés par des défaillances des réseaux internes dues à l'IEMF. Des pertes peuvent généralement se produire dans le cas de structures avec risque d'explosion et dans le cas d'hôpitaux ou d'autres structures dans lesquelles les défaillances des réseaux internes impliquent des risques de blessures sur des êtres humains ou de danger pour l'environnement.

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6.2.2 Composante de risque pour une structure dû à la source S2

R_M: composante liée aux types de pertes L_1 (R_{M1}) et L_2 (R_{M2}), causés par des défaillances des réseaux internes dues à l'IEMF. Des pertes peuvent se produire dans le cas de structures avec risque d'explosion et dans le cas d'hôpitaux ou d'autres structures dans lesquelles les défaillances des réseaux internes impliquent des risques de blessures sur des êtres humains ou de danger pour l'environnement.

6.2.3 Composantes de risque pour une structure dû à la source S3

R_U: composante liée au type de perte L_1, causé par un choc électrique qui frappe des êtres humains du fait des tensions de contact à l'intérieur de la structure.

R_V: composante liée aux types de pertes LL_1 (R_{V1}) et L_2 (R_{V2}),causés par un incendie ou une explosion (dus à un étincelage dangereux entre une installation extérieure et les parties métalliques généralement situées au point de pénétration de la ligne dans la structure) ou qui ont des répercussions mécaniques ou chimiques en raison du courant de foudre transmis dans les lignes entrantes.

R_W: composante liée aux types de pertes L_1 (R_{W1}) et L_2 (R_{W2}), causés par des défaillances des réseaux internes en raison des surtensions induites sur les lignes entrantes et transmises à la structure. Des pertes peuvent généralement se produire dans le cas de structures avec risque d'explosion et dans le cas d'hôpitaux ou d'autres structures dans lesquelles les défaillances des réseaux internes impliquent des risques de blessures sur des êtres humains ou de danger pour l'environnement.

NOTE 1 Toutes les lignes connectées à la structure sont prises en compte dans l'évaluation.

NOTE 2 Les impacts de foudre sur ou à proximité de canalisations métalliques sont considérés comme une source de dommages, sauf si les canalisations sont reliées à une borne d'équipotentialité ou au réseau de mise à la terre du SPF à l'entrée de la structure.

6.2.4 Composante de risque pour une structure dû à la source S4

R_Z: composante liée aux types de pertes L_1 (R_{Z1}) et L_2 (R_{Z2}), causés par des défaillances des réseaux internes en raison des surtensions induites sur les lignes entrantes et transmises à la structure. Des pertes peuvent généralement se produire dans le cas de structures avec risque d'explosion et dans le cas d'hôpitaux ou d'autres structures dans lesquelles les défaillances des réseaux internes impliquent des risques de blessures sur des êtres humains ou de danger pour l'environnement.

NOTE 1 Toutes les lignes connectées à la structure sont prises en compte dans l'évaluation.

NOTE 2 Les impacts de foudre sur ou à proximité de canalisations métalliques sont considérés comme une source de dommages, sauf si les canalisations sont reliées à une borne d'équipotentialité ou au réseau de mise à la terre du SPF à l'entrée de la structure.

6.2.5 Facteurs qui ont une incidence sur les composantes de risque pour une structure

Les caractéristiques de la structure, les mesures et dispositions prises lors d'un orage sont des facteurs qui ont une incidence sur les composantes de risque pour une structure. Les principaux facteurs sont indiqués dans le Tableau 2.

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Tableau 2 – Facteurs d'influence des composantes de risque

Caractéristiques de la structure ou des réseaux internes – Mesures de protection	R_{AT} [h]	R_{AD} [h]	R_B [h]	R_C [h]	R_M	R_U	R_V	R_W	R_Z
Surface d'exposition	X	X	X	X	X	X	X	X	X
Résistivité de surface du sol	X								
Résistivité du plancher	X					X			
Restrictions physiques, isolation, panneau d'avertissement, équipotentialité du sol	X					X			
Caractéristiques de construction de la structure	X		X						
SPF	X	X	X	X	X[a]	X[b]	X[b]		
Parafoudre d'équipotentialité	X		X			X	X		
Interfaces d'isolement				X[c]	X[c]	X	X	X	X
Système de protection par parafoudres coordonnés[f]				X	X			X	X
Blindage spatial				X	X				
Lignes externes blindées						X	X	X	X
Lignes internes blindées				X	X				
Précautions de cheminement				X	X				
Réseau d'équipotentialité				X					
Précautions incendie			X				X		
Sensibilité au feu			X				X		
Tension de tenue aux chocs				X	X	X	X	X	X
Systèmes d'alerte aux orages[g]	X[d]	X[e]		X	X	X[e]	X[e]	X[e]	X[e]
Présence de personnes	X	X	X	X	X	X	X	X	X

NOTE Le matériel est généralement connecté à deux services différents, par exemple une ligne de puissance et une ligne de transmission de données. Si le matériel n'est connecté qu'à un seul service, le risque peut être surestimé dans le résultat.

[a] Uniquement pour les SPF extérieurs maillés qui servent de blindage (voir le facteur KS1 à l'Annexe B).

[b] En raison des équipotentialités.

[c] Uniquement s'ils appartiennent au matériel.

[d] Uniquement pour les zones à risque externes conformément aux dispositions activées à l'aide d'un système d'alerte aux orages (TWS) conforme à l'IEC 62793. Un TWS doit toujours être actif et fonctionnel, et il convient qu'il émette un message en cas de défaut.

[e] Conformément aux dispositions activées à l'aide d'un système d'alerte aux orages (TWS) conforme à l'IEC 62793.

[f] Principalement pour les structures dans lesquelles une défaillance des réseaux internes met en danger la vie humaine, par exemple dans les structures avec risque d'explosion et dans les hôpitaux.

[g] Les mesures prises doivent être adaptées au cas étudié.

[h] En cas de source de dommages S1, les mesures de protection ne sont efficaces qu'à l'intérieur de structures protégées par un SPF ou de structures à armature continue en métal ou en béton armé qui agit comme un SPF naturel.

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6.3 Composition des composantes de risque

6.3.1 Composition des composantes de risque en fonction de la source des dommages

Le risque R est la somme de ses composantes de risque en fonction de la source de dommages ou du type de perte.

$$R = R_{S1} + R_{S2} + R_{S3} + R_{S4} \quad (1)$$

où

$$R_{S1} = R_{AT} + R_{AD} + R_{B1} + R_{B2} + R_{C1} + R_{C2} \quad (2)$$

$$R_{S2} = R_{M1} + R_{M2} \quad (3)$$

$$R_{S3} = R_{U} + R_{V1} + R_{V2} + R_{W1} + R_{W2} \quad (4)$$

$$R_{S4} = R_{Z1} + R_{Z2} \quad (5)$$

R_{C1}, R_{M1}, R_{W1} et R_{Z1} s'appliquent généralement aux structures qui présentent un risque d'explosion et aux hôpitaux équipés de matériels de réanimation électriques ou à d'autres structures, lorsque les défaillances des réseaux internes impliquent des risques de blessures humaines ou de danger pour l'environnement.

R_{C2}, R_{M2}, R_{W2} et R_{Z2} s'appliquent généralement aux structures avec risque d'explosion.

NOTE 1 Une analyse peut justifier le fait qu'un matériel endommagé par une surtension puisse engendrer un incendie ou une explosion à l'intérieur du bâtiment. Dans ce cas, les composantes de risque correspondantes peuvent également être évaluées dans le cadre de l'appréciation du risque.

NOTE 2 La valeur du risque R obtenue en ajoutant les deux composantes de risque R_M et R_Z est surestimée. Dans les réseaux de puissance internes, la composante de risque R_M est généralement négligeable. Le risque peut être évalué de manière plus exacte en tenant compte du fait qu'un impact au sol a une incidence à la fois sur les réseaux internes par couplage inductif direct et sur la surtension induite sur les lignes connectées. Il en résulte que les composantes R_M et R_Z peuvent coïncider.

6.3.2 Composition des composantes de risque en fonction du type de perte

$$R = R_{L1} + R_{L2} \quad (6)$$

où

$$R_{L1} = R_{AT} + R_{AD} + R_{B1} + R_{C1} + R_{M1} + R_{U} + R_{V1} + R_{W1} + R_{Z1} \quad (7)$$

$$R_{L2} = R_{B2} + R_{C2} + R_{M2} + R_{V2} + R_{W2} + R_{Z2} \quad (8)$$

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R_{C1}, R_{M1}, R_{W1} et R_{Z1} s'appliquent généralement aux structures qui présentent un risque d'explosion et aux hôpitaux équipés de matériels de réanimation électriques ou à d'autres structures, lorsque les défaillances des réseaux internes impliquent des risques de blessures humaines ou de danger pour l'environnement.

R_{C2}, R_{M2}, R_{W2} et R_{Z2} s'appliquent principalement aux structures avec risque d'explosion.

NOTE 1 Une analyse peut justifier le fait qu'un matériel endommagé par une surtension puisse engendrer un incendie ou une explosion à l'intérieur du bâtiment. Dans ce cas, les composantes de risque correspondantes peuvent également être évaluées dans le cadre de l'appréciation du risque.

NOTE 2 La valeur du risque R obtenue en ajoutant les deux composantes de risque R_M et R_Z est surestimée. Dans les réseaux de puissance internes, la composante de risque R_M est généralement négligeable. Le risque peut être évalué de manière plus exacte en tenant compte du fait qu'un impact au sol a une incidence à la fois sur les réseaux internes par couplage inductif direct et sur la surtension induite sur les lignes connectées. Il en résulte que les composantes R_M et R_Z peuvent coïncider.

NOTE 3 Les Équations (7) et (8) permettent d'évaluer séparément la contribution du risque de perte de vies humaines et du risque de perte de biens et de services au risque global.

7 Appréciation du risque

7.1 Procédure de base

La procédure suivante doit être appliquée:

– identification de la structure à évaluer et de ses caractéristiques;
– évaluation du risque R.

7.2 Structure à prendre en compte pour l'appréciation du risque

La structure à prendre en compte comprend:

– la structure elle-même;
– les installations contenues dans la structure;
– le contenu de la structure;
– les personnes qui se trouvent dans la structure, sur le toit de la structure ou dans des zones jusqu'à 3 m de l'extérieur de la structure;
– l'environnement compromis par un dommage sur la structure.

Les lignes à l'extérieur de la structure ne sont pertinentes que dans la mesure où elles peuvent acheminer des courants susceptibles d'endommager la structure.

NOTE La structure à prendre en compte peut être subdivisée en plusieurs zones à risque (voir le 8.3).

7.3 Procédure d'évaluation du besoin de protection pour le risque R

La protection contre la foudre est nécessaire si le risque R est supérieur au niveau de risque tolérable R_T.

$$R > R_T$$

Dans ce cas, des mesures de protection doivent être appliquées afin de réduire le risque R à un degré qui ne dépasse pas le niveau de risque tolérable R_T.

$$R \leq R_T$$

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NOTE 1 Une valeur représentative du risque tolérable est R_T = 10^{-5} [année]$^{-1}$. Des valeurs différentes peuvent être attribuées après une étude approfondie, en tenant compte de la vulnérabilité des êtres humains à l'intérieur et à l'extérieur de la structure étudiée, ainsi que de la criticité de la structure et de son environnement pour le public quant aux dommages physiques.

NOTE 2 Lorsqu'une évaluation du risque n'est pas exigée par ailleurs, la décision d'évaluer la nécessité de réduire ou non le risque R peut être prise par le propriétaire ou le gérant de la structure.

NOTE 3 Si $R \leq R_T$, la protection contre la foudre n'est pas nécessaire pour réduire le risque, mais peut être:

– utile pour réduire la fréquence des dommages aux réseaux internes (voir le 9.4);

– appropriée en vue de réduire de quelque façon que ce soit les pertes (ou l'indisponibilité des services).

Les étapes suivantes doivent être suivies pour déterminer si le risque dépasse le niveau tolérable:

– identification des composantes R_X qui constituent le risque;

– calcul des composantes de risque identifiées R_X;

– calcul du risque total R (voir le 6.3);

– comparaison du risque R à la valeur tolérable R_T.

Si la structure est divisée en zones à risque Z_S (voir le 8.3), le risque R doit être évalué pour chaque zone Z_S.

Le risque R doit être comparé à R_T:

– pour chaque zone à risque de la structure dans une structure découpée en zones;

– pour l'ensemble de la structure dans une structure à une seule zone.

La Figure 1 représente la procédure d'évaluation du besoin de protection pour le risque R.

NOTE 4 En cas de source de dommages S1, les mesures de protection ne sont efficaces qu'à l'intérieur de structures protégées par un SPF ou de structures à armature continue en métal ou en béton armé qui agit comme un SPF naturel.

NOTE 5 Le propriétaire du site est informé lorsque le risque ne peut pas être réduit à un niveau tolérable, malgré la mise en œuvre des mesures de protection les plus efficaces suggérées. Si le risque peut être réduit de manière significative par des mesures préventives temporaires, un TWS conforme à l'IEC 62793 peut être installé.

Il convient de procéder à une évaluation lorsque les dommages causés à une structure par la foudre peuvent également concerner des structures environnantes ou l'environnement (propagation d'un incendie, explosion, émissions chimiques ou radioactives, par exemple).

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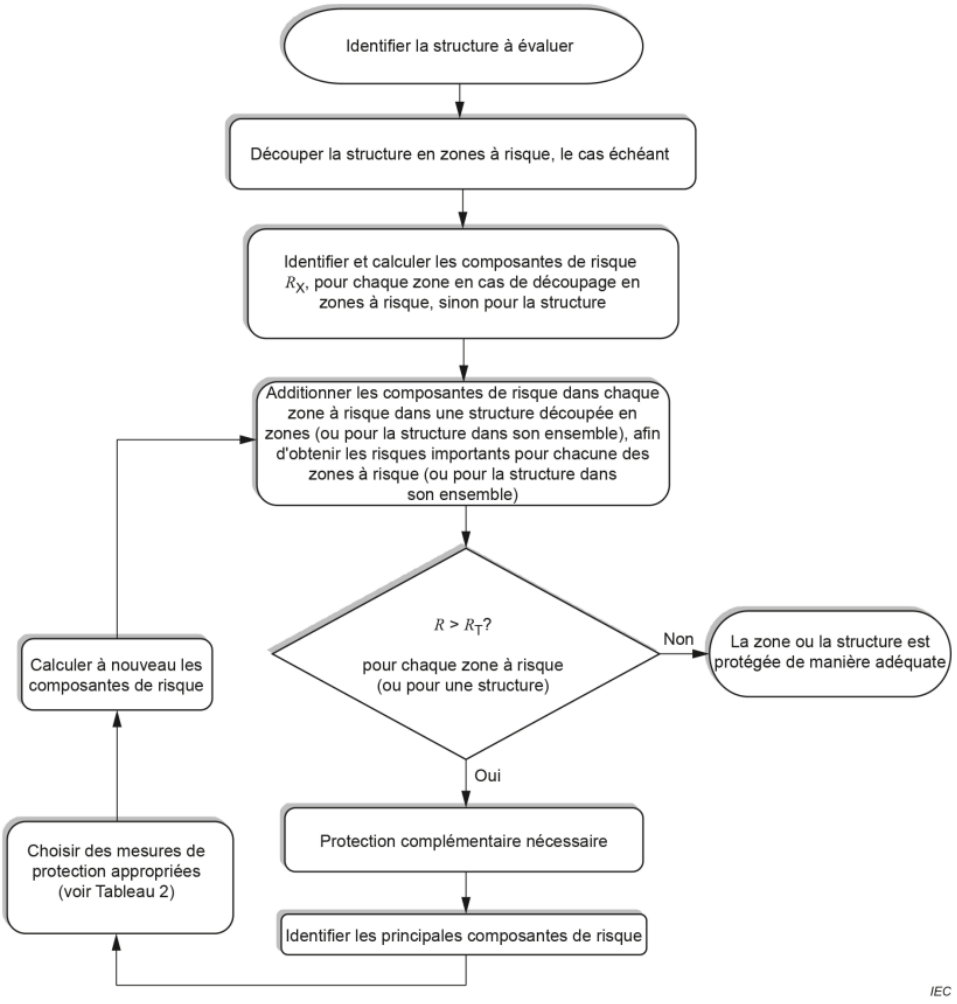


Figure 1 – Procédure de décision du besoin de protection et de choix des mesures de protection pour réduire $R \leq R_T$

8 Évaluation des composantes de risque

8.1 Équation de base

Chaque composante de risque R_{AT}, R_{AD}, R_B, R_C, R_M, R_U, R_V, R_W et R_Z, décrite dans le Tableau 3, peut être exprimée par l'équation générale suivante:

$$R_X = N_X \times P_X \times L_X \quad (9)$$

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où

N_X est le nombre annuel d'événements dangereux (voir aussi l'Annexe A);

P_X est la probabilité de dommages (voir aussi l'Annexe B);

L_X est l'étendue des pertes consécutives (voir aussi l'Annexe C).

Le nombre N_X d'événements dangereux est influencé par la densité de points d'impact au sol de la foudre (N_{SG}) et par les caractéristiques physiques de la structure à protéger, son environnement, les lignes connectées et le sol. N_X doit être obtenu, comme cela est expliqué en détail à l'Annexe A, principalement à partir des données de systèmes de localisation de la foudre (LLS, *Lightning Location System*), lesquels doivent être conformes à l'IEC 62858.

La probabilité de dommages P_X est influencée par les caractéristiques de la structure à protéger, les lignes connectées, la présence de personnes et les mesures de protection fournies.

Les pertes consécutives L_X sont influencées par l'utilisation assignée à la structure.

Si la structure est divisée en zones à risque Z_S (voir le 8.3), chaque composante de risque doit être évaluée pour chaque zone à risque Z_S.

NOTE Lorsque les dommages sur une structure dus à la foudre peuvent également impliquer des structures environnantes ou l'environnement (par exemple, émissions chimiques ou radioactives), les pertes consécutives sont ajoutées à la valeur de L_X ou le concept décrit à l'Annexe E peut être appliqué.

8.2 Évaluation des composantes de risque dû à différentes sources de dommages

Les équations pour calculer les composantes de risque liées à chaque source de dommages sont données dans le Tableau 3.

Les valeurs des paramètres nécessaires au calcul des composantes de risque figurent à l'Annexe A, l'Annexe B et l'Annexe C.

Pour l'évaluation des composantes de risque associées aux impacts de foudre sur une ligne entrante (S3), les éléments suivants doivent être pris en compte:

– si la ligne comporte plusieurs sections (voir le 8.4), les valeurs de R_U, R_V et R_W sont la somme des valeurs R_U, R_V et R_W qui correspondent à chaque section de la ligne. Les sections à prendre en compte sont celles entre la structure et le premier nœud de la distribution. Lorsqu'aucune information relative à la longueur des sections n'est disponible, une longueur de ligne maximale de 1 km pour la somme des lignes de puissance HT et des lignes de puissance BT et une longueur de ligne maximale de 1 km pour les lignes de communication peuvent être admises par hypothèse;

– dans le cas d'une structure qui comporte plusieurs lignes connectées avec des cheminements différents qui viennent alimenter le même réseau interne, les calculs doivent être effectués pour chaque ligne;

– dans le cas d'une structure qui comporte plusieurs lignes connectées avec le même cheminement qui vient alimenter le même appareil, les calculs ne doivent être réalisés que pour la ligne qui donne les valeurs N_L les plus élevées (ligne de communication ou ligne de puissance, ligne non écrantée ou ligne écrantée, ligne de puissance BT ou ligne de puissance HT avec transformateur HT/BT, etc.).

NOTE Dans le cas de lignes qui présentent un chevauchement de la surface d'exposition, la zone de chevauchement n'est prise en compte qu'une seule fois.

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Pour l'évaluation des composantes de risque associées aux impacts de foudre à proximité d'une ligne connectée à la structure (S4), les éléments suivants doivent être pris en compte:

– si la ligne comporte plusieurs sections (voir le 8.4), la valeur de R_Z est la somme des composantes R_Z qui correspondent à chaque section de la ligne. Les sections à prendre en compte sont celles entre la structure et le premier nœud de la distribution. Lorsqu'aucune information relative à la longueur des sections n'est disponible, une longueur de ligne maximale de 1 km pour la somme des lignes de puissance HT et des lignes de puissance BT et une longueur de ligne maximale de 1 km pour les lignes de communication peuvent être admises par hypothèse;

– dans le cas d'une structure qui comporte plusieurs lignes connectées avec des cheminements différents qui viennent alimenter le même réseau interne, les calculs doivent être effectués pour chaque ligne;

– dans le cas d'une structure qui comporte plusieurs lignes connectées avec le même cheminement qui vient alimenter le même réseau interne, les calculs ne doivent être réalisés que pour la ligne qui donne les valeurs N_I les plus élevées (ligne de communication ou ligne de puissance, ligne non écrantée ou ligne écrantée, ligne de puissance BT ou ligne de puissance HT avec transformateur HT/BT, etc.).

Si la structure est divisée en zones à risque Z_S (voir le 8.3), chaque composante de risque doit être évaluée pour chaque zone à risque Z_S.

Tableau 3 – Composantes de risque pour différentes sources de dommages et différents types de pertes

Type de perte	Source de dommages			
	S1 Impact de foudre sur une structure	**S2 Impact de foudre à proximité d'une structure**	**S3 Impact de foudre sur une ligne (entrante)**	**S4 Impact de foudre à proximité d'une ligne**
L_1 Blessures sur êtres vivants	$R_{AT} = N_D \times P_{AT} \times P_P \times L_{AT}$		$R_U = (N_L + N_{DJ}) \times P_U \times P_P \times L_{UT}$	
	$R_{AD} = N_D \times P_{AD} \times P_P \times L_{AD}$			
	$R_{B1} = N_D \times P_B \times P_P \times L_{B1}$		$R_{V1} = (N_L + N_{DJ}) \times P_V \times P_P \times L_{V1}$	
	$R_{C1} = N_D \times P_C \times P_P \times P_e \times L_{C1}$ Voir la note de bas de page "a".	$R_{M1} = N_M \times P_M \times P_P \times P_e \times L_{M1}$ Voir la note de bas de page "a".	$R_{W1} = (N_L + N_{DJ}) \times P_W \times P_P \times P_e \times L_{W1}$ Voir la note de bas de page "a".	$R_{Z1} = N_I \times P_Z \times P_P \times P_e \times L_{Z1}$ Voir la note de bas de page "a".
L_2 Dommages physiques	$R_{B2} = N_D \times P_B \times L_{B2}$		$R_{V2} = (N_L + N_{DJ}) \times P_V \times L_{V2}$	
	$R_{C2} = N_D \times P_C \times P_e \times L_{C2}$ Voir la note de bas de page "b".	$R_{M2} = N_M \times P_M \times P_e \times L_{M2}$ Voir la note de bas de page "b".	$R_{W2} = (N_L + N_{DJ}) \times P_W \times P_e \times L_{W2}$ Voir la note de bas de page "b".	$R_{Z2} = N_I \times P_Z \times P_e \times L_{Z2}$ Voir la note de bas de page "b".

[a] R_{C1}, R_{M1}, R_{W1} et R_{Z1} s'appliquent généralement aux structures avec risque d'explosion et pour les hôpitaux ou autres structures dans lesquelles des défaillances des défaillances des réseaux internes entraînent des dangers mortels immédiats.

[b] R_{C2}, R_{M2}, R_{W2} et R_{Z2} s'appliquent généralement aux structures avec risque d'explosion.

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8.3 Découpage d'une structure en zones à risque Z_S

Pour évaluer chaque composante de risque, une structure peut constituer (ou constitue par hypothèse) une zone simple ou peut être découpée en zones à risque Z_S, chacune possédant ses propres caractéristiques homogènes.

Les zones à risque Z_S sont généralement définies de la manière suivante:

– type de sol ou de plancher;
– compartiments à l'épreuve du feu;
– blindages spatiaux.

D'autres zones à risque peuvent être définies selon:

– la disposition des réseaux internes;
– les mesures de protection existantes ou à prévoir;
– les valeurs des pertes L_X.

Il convient que le découpage de la structure en zones à risque Z_S tienne compte de la faisabilité des mesures de protection les plus appropriées.

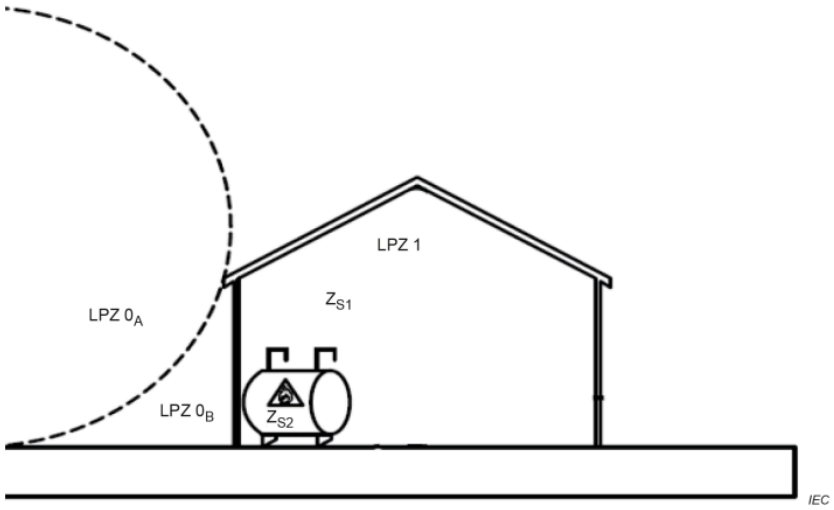
NOTE Il est souligné que les zones à risque Z_S sont définies par le concepteur pour l'appréciation du risque. Elles sont différentes des zones ZPF définies dans l'IEC 62305-1.

La Figure 2 donne un exemple de découpage en zones.

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Légende

LPZ 0_A	impact direct, courant de foudre complet, champ électromagnétique complet
LPZ 0_B	pas d'impact direct, courant de foudre ou induit, champ électromagnétique complet
LPZ 1	pas d'impact direct, courant de foudre limité ou induit, champ électromagnétique H1 atténué (zone où le courant de choc est limité par les interfaces de répartition et d'isolement du courant ou par des SPD disposés à la frontière. Le blindage spatial peut affaiblir le champ électromagnétique de foudre.)
Z_{S1}	exemple de zone n° 1
Z_{S2}	exemple de zone n° 2

Figure 2 – Exemple de découpage en zones

8.4 Découpage d'une ligne en sections S_L

Pour évaluer les composantes de risque dû à un impact sur ou à proximité d'une ligne, il peut être admis par hypothèse que la ligne est une section simple, ou que celle-ci peut être divisée en sections différentes S_L.

Pour toutes les composantes de risque, les sections S_L sont essentiellement définies par:

– le type de ligne (aérienne ou enterrée, C_I);

– les caractéristiques de la ligne (blindée ou non, résistance du blindage);

– d'autres facteurs (C_D, C_E, C_T).

Si plusieurs valeurs pour un paramètre existent dans une section, l'hypothèse retenue doit être la valeur de risque la plus élevée (défavorable).

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8.5 Évaluation des composantes de risque dans une zone d'une structure découpée en zones à risque Z_S

8.5.1 Critères généraux

Pour l'évaluation des composantes de risque et le choix des paramètres pertinents concernés, les règles suivantes s'appliquent:

– les paramètres pertinents pour le nombre N d'événements dangereux doivent être évalués conformément à l'Annexe A;

– les paramètres pertinents pour la probabilité P de dommages doivent être évalués conformément à l'Annexe B.

De plus:

– pour les composantes R_A, R_{B1}, R_{B2}, R_U, R_{V1}, R_{V2}, R_{W1}, R_{W2}, R_{Z1}, et R_{Z2}, seule une valeur doit être fixée dans chaque zone à risque pour chacun des paramètres concernés. Si plusieurs valeurs s'appliquent, la valeur la plus élevée doit être choisie;

– pour les composantes R_{C1}, R_{C2}, R_{M1}, et R_{M2}, si plusieurs réseaux internes sont impliqués dans une zone à risque, les valeurs de P_C et P_M sont données par:

$$P_C = 1 - (1 - P_{C1}) \times (1 - P_{C2}) \times \ldots \times (1 - P_{Cn}) \quad (10)$$

$$P_M = 1 - (1 - P_{M1}) \times (1 - P_{M2}) \times \ldots \times (1 - P_{Mn}) \quad (11)$$

où P_{Cn} et P_{Mn} sont les paramètres qui correspondent au réseau interne n = 1, 2, 3…;

– les paramètres relatifs aux pertes doivent être calculés conformément à l'Annexe C.

À l'exception de P_C et P_M, si un paramètre a plusieurs valeurs dans une zone à risque, la valeur du paramètre qui conduit à la valeur de risque la plus élevée doit être retenue par hypothèse.

NOTE 1 Un réseau interne n'est pas nécessairement connecté directement à un service externe. Il peut par exemple être relié à une ligne de puissance en cuivre et à une ligne de données connectée par l'intermédiaire d'une interface d'isolement.

NOTE 2 Une approche plus simple consiste à utiliser $P_C = P_{C1}$ et $P_M = P_{M1}$ où P_{C1} et P_{M1} font référence au cas le plus défavorable.

8.5.2 Structure à une seule zone

Dans ce cas, une seule zone à risque Z_S définit l'ensemble de la structure. Le risque R est la somme des composantes de risque R_X dans cette zone à risque.

La définition de la structure en une seule zone à risque peut conduire à une dépense plus importante que nécessaire si une mesure de protection onéreuse doit s'étendre à l'ensemble de la structure, même si elle n'est pas essentielle sur la structure tout entière.

8.5.3 Structure à plusieurs zones

Dans ce cas, la structure est découpée en plusieurs zones à risque Z_S. Dans chaque zone à risque, le risque est la somme de toutes les composantes de risque correspondantes de la zone.

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Le découpage de la structure en zones à risque permet au concepteur de prendre en compte les caractéristiques de chaque partie de la structure pour l'évaluation des composantes de risque et de choisir les mesures de protection les plus appropriées à chaque zone à risque, afin de réduire le coût total de la protection contre la foudre.

9 Fréquence des dommages et ses composantes

9.1 Fréquence des dommages

La fréquence des dommages F est la valeur du nombre d'événements qui provoquent des dommages causés par les sources de dommages S des réseaux de la structure à protéger.

Dans le cadre de l'évaluation de la nécessité d'une protection contre la foudre, la fréquence des dommages F doit être prise en compte par rapport à la perte de service L_3.

La fréquence de dommages F est la somme des fréquences partielles des dommages selon la source de dommages. Pour évaluer la fréquence des dommages F, la relation suivante s'applique:

$$F = F_C + F_M + F_W + F_Z \quad (12)$$

où

F_C est la fréquence des dommages dus à des impacts sur la structure (source S1);

F_M est la fréquence des dommages dus à des impacts à proximité de la structure (source S2);

F_W est la fréquence des dommages dus à des impacts sur la ligne (source S3);

F_Z est la fréquence des dommages dus à des impacts à proximité de la ligne (source S4).

La fréquence des dommages F_C fait référence aux défaillances des réseaux internes provoquées par des IEMF et par l'augmentation du potentiel à la terre en raison d'impacts sur la structure, F_M fait référence aux défaillances des réseaux internes provoquées par des IEMF en raison d'impacts sur le sol à proximité de la structure, tandis que les fréquences des dommages F_W et F_Z font référence aux défaillances des réseaux internes provoquées par des surtensions transmises à la structure par les lignes entrantes.

NOTE 1 La valeur de la fréquence des dommages F obtenue en additionnant les deux fréquences partielles des dommages F_M et F_Z peut être surestimée. Le risque peut être évalué de manière plus exacte en tenant compte du fait qu'un impact au sol a une incidence à la fois sur les réseaux internes par couplage inductif direct et sur la surtension induite sur les lignes connectées. Il en résulte que les fréquences partielles des dommages F_M et F_Z peuvent coïncider.

NOTE 2 Dans les réseaux de puissance internes, la composante de fréquence F_M est généralement négligeable.

NOTE 3 La fréquence des dommages causés par des impacts de foudre associée à une structure peut être évaluée pour un matériel. La fréquence des dommages d'un réseau interne ou d'une partie d'un réseau interne correspond dans tous les cas à celle du matériel le plus vulnérable parmi les matériels que l'utilisateur souhaite protéger (par défaut, l'ensemble des matériels).

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9.2 Évaluation de la fréquence partielle des dommages

Chaque fréquence partielle des dommages F_C, F_M, F_W et F_Z, décrite au 9.1, peut être exprimée par l'équation générale suivante:

$$F_X = N_X \times P_X \quad (13)$$

où

N_X est le nombre annuel d'événements dangereux (voir aussi l'Annexe A);

P_X est la probabilité de dommages (voir aussi l'Annexe B);

Les équations pour calculer les fréquences partielles des dommages liées à chaque source de dommages sont données dans le Tableau 4.

Les valeurs des paramètres nécessaires au calcul des fréquences de dommages partielles figurent à l'Annexe A et l'Annexe B. Lorsque des TWS sont concernés, comme cela est décrit à l'Annexe B, ceux-ci doivent être conformes à l'IEC 62793.

Tableau 4 – Fréquences partielles des dommages pour chaque source de dommages

Type de perte	Source de dommages			
	S1 Impact de foudre sur une structure	**S2** Impact de foudre à proximité d'une structure	**S3** Impact de foudre sur une ligne (entrante)	**S4** Impact de foudre à proximité d'une ligne
L_3 perte de service due à une défaillance des réseaux internes	$F_C = N_D \times P_C \times P_e$	$F_M = N_M \times P_M \times P_e$	$F_W = (N_L + N_{DJ}) \times P_W \times P_e$	$F_Z = N_I \times P_Z \times P_e$

9.3 Procédure d'évaluation du besoin de protection pour la fréquence des dommages F

Une protection contre la foudre est nécessaire si la fréquence des dommages F dépasse le niveau tolérable F_T

$$F > F_T$$

Dans ce cas, il convient d'appliquer des mesures de protection afin de réduire la fréquence des dommages F à un degré qui ne dépasse pas le niveau de risque tolérable F_T

$$F \leq F_T$$

NOTE 1 Une valeur représentative du risque tolérable F_T est F_T = 0,1 [année]$^{-1}$ pour les réseaux internes essentiels pour assurer leur fonction en lien avec l'indisponibilité du service exigé, et F_T = 1 [année]$^{-1}$ pour les réseaux internes non essentiels. Les valeurs F_T = 0,1 et F_T = 1 fournies dans le présent document sont des valeurs classiques de la fréquence tolérable des dommages.

NOTE 2 La criticité des systèmes internes pour remplir leurs fonctions (par rapport à l'indisponibilité des services qui peut être tolérée) est prise en compte par le propriétaire ou le gestionnaire de la structure lors de la fixation de la valeur F_T.

NOTE 3 Si $F \leq F_T$, la protection contre la foudre n'est pas nécessaire pour réduire la fréquence des dommages,

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Les étapes suivantes doivent être prises pour évaluer le besoin de protection pour la fréquence des dommages F:

- calcul de la fréquence partielle des dommages F_X;
- calcul de la fréquence totale des dommages F;
- identification de la fréquence tolérable des dommages F_T;
- comparaison de la fréquence des dommages F à la valeur tolérable F_T.

La fréquence des dommages F doit être évaluée pour les réseaux internes ou les matériels à l'intérieur de la structure que le propriétaire souhaite protéger (lorsque la structure est découpée en zones, cela concerne chaque zone où se trouvent des matériels que le propriétaire ou le gestionnaire souhaite protéger). La fréquence F doit être comparée à F_T pour ces réseaux internes ou matériels.

La Figure 3 représente la procédure d'évaluation du besoin de protection pour la fréquence des dommages F.

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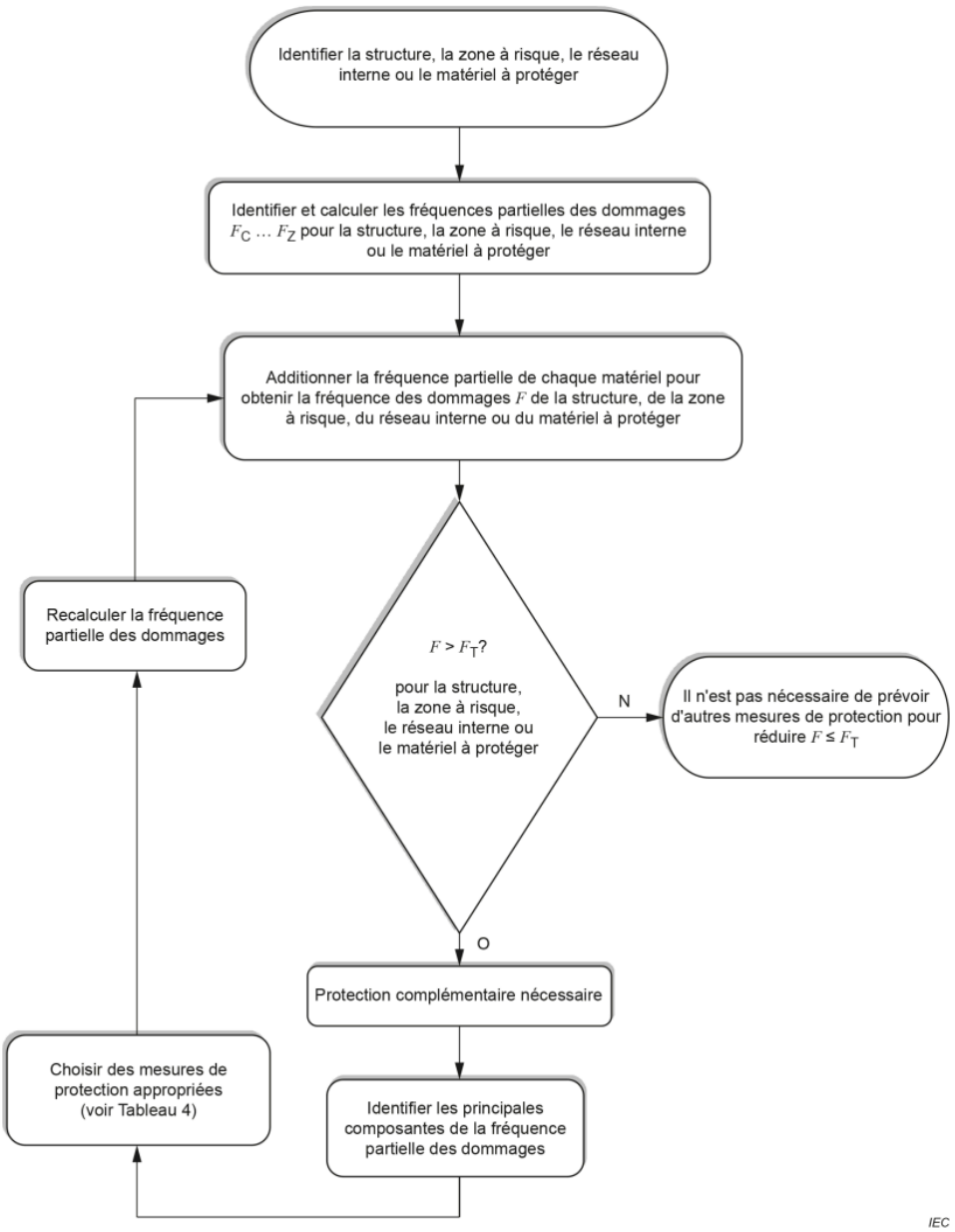


Figure 3 – Procédure de détermination du besoin de protection et de choix des mesures de protection

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9.4 Évaluation de la fréquence partielle des dommages en zones

9.4.1 Critères généraux

Pour l'évaluation de la fréquence partielle des dommages et le choix des paramètres pertinents concernés, les règles suivantes s'appliquent:

– les paramètres pertinents pour le nombre N d'événements dangereux doivent être évalués conformément à l'Annexe A;

– les paramètres pertinents pour la probabilité P de dommages doivent être évalués conformément à l'Annexe B.

De plus:

– pour les fréquences partielles des dommages F_W et F_Z, une seule valeur doit être déterminée dans chaque zone à risque pour chacun des paramètres concernés. Si plusieurs valeurs s'appliquent, la valeur la plus élevée doit être choisie;

– pour les fréquences partielles des dommages F_C et F_M, si plusieurs réseaux internes sont concernés dans une zone à risque, les valeurs de P_C et P_M sont données par:

$$P_C = 1 - (1 - P_{C1}) \times (1 - P_{C2}) \times \ldots \times (1 - P_{Cn}) \quad (14)$$

$$P_M = 1 - (1 - P_{M1}) \times (1 - P_{M2}) \times \ldots \times (1 - P_{Mn}) \quad (15)$$

où P_{Cn} et P_{Mn} sont les paramètres qui correspondent au réseau interne n = 1, 2, 3…

Si un autre paramètre a plusieurs valeurs dans une zone à risque, la valeur du paramètre qui conduit à la valeur de fréquence partielle des dommages la plus élevée doit être retenue par hypothèse, sauf pour P_C et P_M.

NOTE 1 Un réseau interne n'est pas nécessairement connecté directement à un service externe. Il peut par exemple être relié à une ligne de puissance en cuivre et à une ligne de données connectée par l'intermédiaire d'une interface d'isolement.

NOTE 2 Une approche plus simple consiste à utiliser $P_C = P_{C1}$ et $P_M = P_{M1}$ où P_{C1} et P_{M1} font référence au cas le plus défavorable.

9.4.2 Structure à une seule zone

Dans ce cas, une seule zone à risque Z_S qui englobe l'ensemble de la structure est définie. La fréquence des dommages F est la somme des fréquences partielles des dommages F_X dans cette zone à risque.

La définition de la structure en une seule zone à risque peut conduire à des mesures de protection onéreuses, car chaque mesure doit s'étendre à l'ensemble de la structure.

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9.4.3 Structure à plusieurs zones

Dans ce cas, la structure est découpée en plusieurs zones à risque Z_S. La fréquence des dommages F_{zone} pour la zone à risque est la somme des fréquences partielles des dommages $F_{zone/X}$ qui correspondent à toutes les sources de dommages.

Le découpage de la structure en zones à risque permet au concepteur de prendre en compte les caractéristiques de chaque partie de la structure pour l'évaluation de la fréquence partielle des dommages et de choisir les mesures de protection les plus appropriées zone à risque par zone à risque, afin de réduire le coût total de la protection contre la foudre.

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Annexe A
(informative)

Évaluation du nombre annuel N d'événements dangereux

A.1 Généralités

Le nombre annuel moyen N d'événements dangereux dus aux impacts de foudre qui impliquent une structure à évaluer dépend de la densité de points d'impact au sol de la foudre dans la région où se situe la structure et de ses caractéristiques physiques.

La densité de points d'impact au sol de la foudre N_{SG} correspond au nombre d'impacts de foudre par km^2 et par an. Dans de nombreuses régions du monde, cette valeur peut être obtenue à partir des données fournies par des systèmes de localisation de la foudre (LLS) conformes à l'IEC 62858.

Lorsque les valeurs N_{SG} ne sont pas directement disponibles, il est possible de compter les éclairs au moyen des différents points d'impact au sol. Les valeurs de densité de foudroiement au sol N_G peuvent être multipliées par un facteur k pour estimer N_{SG} en fonction de plusieurs facteurs tels que l'emplacement géographique. Il convient d'obtenir ce facteur k auprès du fournisseur national de données de LLS.

$$N_{SG} = k\, N_G \tag{A.1}$$

où

N_{SG} est la densité de points d'impact au sol de la foudre (1 par km^2 et par an).

NOTE 1 Lorsque le fournisseur de données de LLS ne peut pas fournir ce facteur k ou qu'il n'existe pas (par exemple, lorsqu'un pays dispose d'une carte N_G), un facteur de 2 peut être admis par hypothèse.

Dans les régions qui ne comportent pas de systèmes de localisation de la foudre au sol, l'estimation recommandée pour la densité de points d'impact au sol de la foudre est

$$N_{SG} = 0{,}5\, N_T \tag{A.2}$$

où N_T est la densité totale (CG sol + IC nuage) d'éclairs optiques enregistrés par km^2 et par an, obtenue sur le site web de la NASA
http://lightning.nsstc.nasa.gov/data/data_lis-otd-climatology.html [7].

NOTE 2 Dans la plupart des régions du monde, une indication de l'activité de foudre peut être obtenue à partir d'observations des transitoires optiques de la foudre. Les détecteurs sur satellite répondent à tous les types de foudres avec une couverture relativement uniforme. Moyennant un lissage suffisant, les données de densité de transitoires optiques donnent de meilleures estimations de la densité de foudroiement au sol que les observations de l'orage, qui présentent un large éventail de relations entre la densité de foudroiement au sol et les heures ou jours d'orage. Il existe aussi des variations régionales dans le rapport du nombre d'impacts au sol (CG) sur le nombre total d'impacts (CG + IC).

NOTE 3 L'IEC 62858 spécifie comment les données relatives à la foudre sont obtenues et représentées.

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Les événements suivants peuvent être considérés comme dangereux pour une structure dont la protection est envisagée:

– impacts sur la structure;
– impacts sur le sol à proximité de la structure;
– impacts sur une ligne qui entre dans la structure, y compris les impacts sur une autre structure à laquelle la ligne est connectée;
– impacts sur le sol à proximité d'une ligne qui entre dans la structure.

NOTE 4 L'Annexe A fournit des méthodes simplifiées pour calculer le nombre N d'événements dangereux dus à des impacts de foudre qui impliquent une structure à protéger.

A.2 Évaluation du nombre annuel moyen d'événements dangereux N_D dus aux impacts sur une structure et N_{DJ} sur une structure adjacente

A.2.1 Détermination de la surface d'exposition A_D

A.2.1.1 Généralités

Pour des structures isolées en terrain plat, la surface équivalente d'exposition A_D est la zone définie par l'intersection entre la surface du sol et une droite avec une pente de 1/3 qui passe par les parties les plus élevées de la structure (en les touchant à cet endroit) et en tournant autour de celle-ci. La détermination de la valeur de A_D peut être effectuée par une méthode graphique ou mathématique.

A.2.1.2 Structure rectangulaire

Pour une structure rectangulaire isolée de longueur L, de largeur W et de hauteur H sur un sol plat, la surface équivalente d'exposition est égale à:

$$A_D = L \times W + 2 \times (3 \times H) \times (L + W) + \pi \times (3 \times H)^2 \quad \text{(A.3)}$$

où L, W et H sont exprimés en mètres (voir la Figure A.1).

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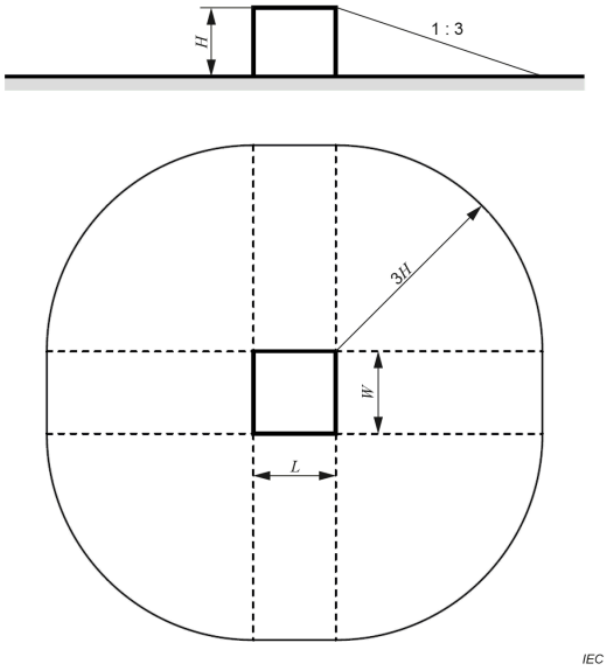


Figure A.1 – Surface d'exposition A_D d'une structure isolée

A.2.1.3 Structure de forme complexe

Si la structure a une forme complexe, par exemple avec toiture élevée saillante (voir la Figure A.2), il convient d'utiliser une méthode graphique pour évaluer A_D (voir la Figure A.3).

Une valeur approximative acceptable de la surface d'exposition est la valeur maximale entre la surface équivalente d'exposition A_{DMIN}, évaluée au moyen de l'Équation (A.3) en tenant compte de la hauteur minimale H_{MIN} de la structure, et la surface d'exposition attribuée à la toiture élevée saillante A_D'. A_D' peut être calculée de la façon suivante:

$$A_D' = \pi \times (3 \times H_P)^2 \quad \text{(A.4)}$$

où H_P est la hauteur de la saillie.

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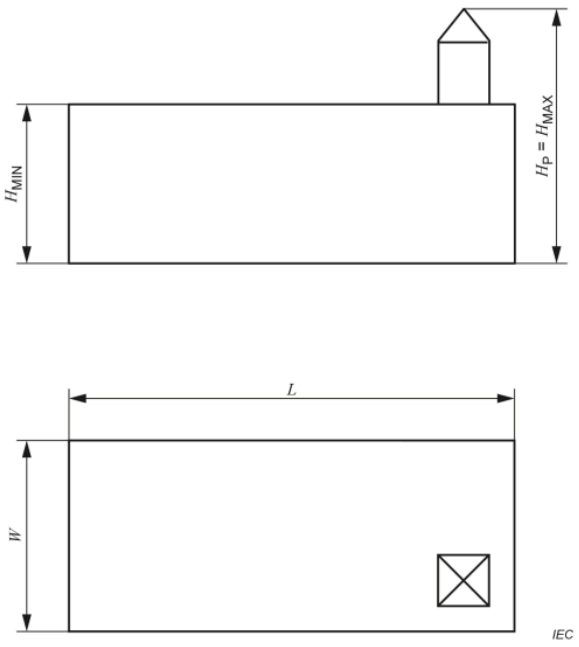


Figure A.2 – Structure de forme complexe

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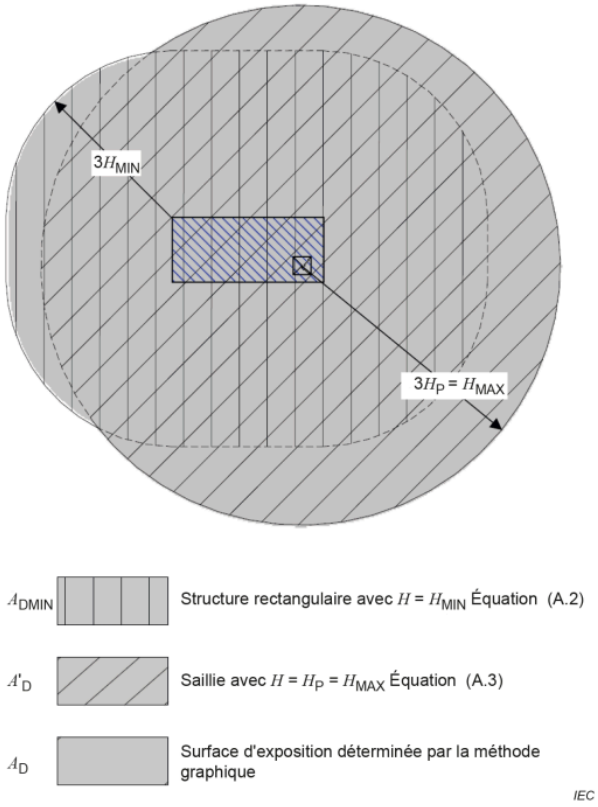


Figure A.3 – Différentes méthodes de détermination de la surface d'exposition d'une structure donnée

A.2.2 Structure qui fait partie d'un bâtiment

Lorsque la structure S à examiner correspond à une seule partie d'un bâtiment B, les dimensions de la structure S peuvent être utilisées dans l'évaluation de A_D si les conditions suivantes sont remplies (voir la Figure A.4):

– la structure S est une partie verticale séparée du bâtiment B, comme cela est représenté sur la Figure A.4;

– le bâtiment B est une structure sans risque d'explosion;

– la propagation d'un incendie entre la structure S et d'autres parties du bâtiment B est atténuée au moyen, par exemple, de parois qui présentent une résistance au feu de 120 min ou au moyen d'autres mesures de protection équivalentes;

NOTE Les réglementations en matière d'incendie peuvent établir différentes valeurs pour la résistance au feu. Les réglementations relatives aux bâtiments peuvent définir la résistance au feu des murs.

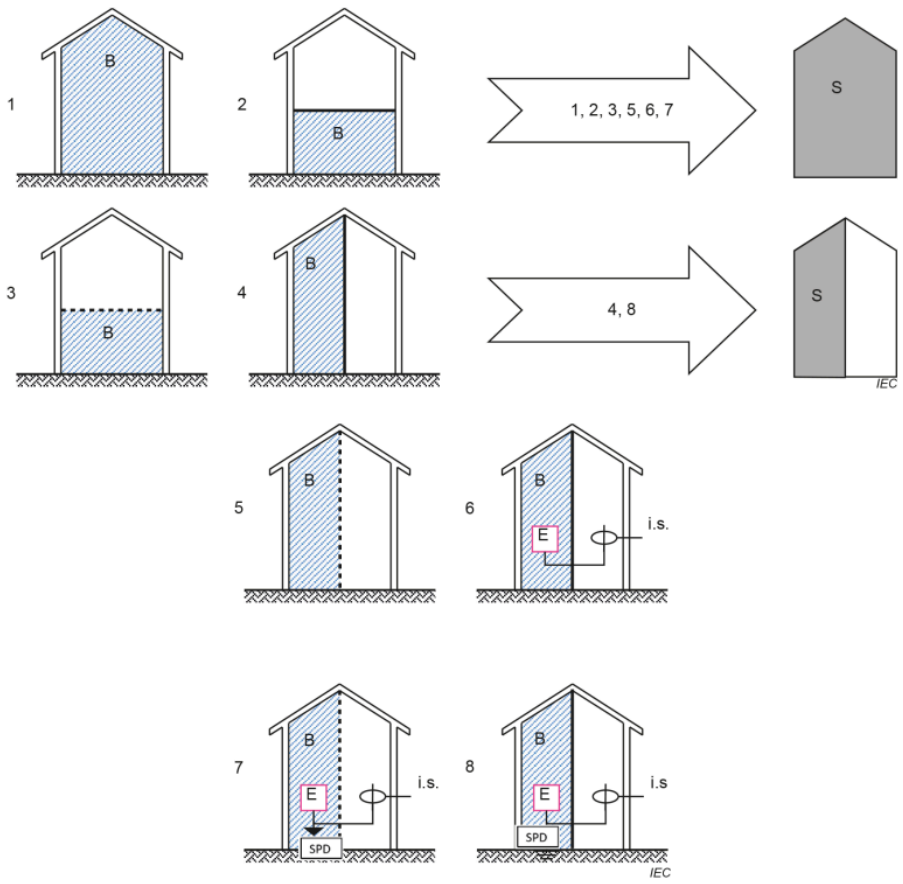
– la propagation des surtensions le long des lignes communes, s'il y en a, est évitée au moyen de SPD installés au point d'entrée de telles lignes dans la structure ou au moyen d'autres mesures de protection équivalentes.

Lorsque ces conditions ne sont pas remplies, il convient d'utiliser les dimensions de l'ensemble du bâtiment B.

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Légende

B bâtiment ou partie de celui-ci pour lequel la protection est envisagée (l'évaluation de A_D est nécessaire)

partie de bâtiment pour laquelle la protection n'est pas envisagée (l'évaluation de A_D n'est pas nécessaire)

S structure à prendre en compte pour l'appréciation du risque (les dimensions de S doivent être utilisées pour l'évaluation de A_D)

découpage avec résistance au feu ≥ 120 min

découpage avec résistance au feu < 120 min

E matériel

i.s. réseau interne

SPD SPD

Figure A.4 – Structure à prendre en compte pour l'évaluation de la surface d'exposition A_D

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A.2.3 Emplacement relatif de la structure

L'emplacement relatif d'une structure, qui dépend des structures environnantes ou de l'exposition de la structure, est pris en compte par un facteur d'emplacement C_D (voir le Tableau A.1).

Une évaluation plus précise de l'influence des objets environnants peut être obtenue en tenant compte de la hauteur relative de la structure par rapport aux objets qui l'entourent ou au sol à une distance de 3 × H de la structure et en formulant l'hypothèse C_D = 1.

Tableau A.1 – Facteurs d'emplacement C_D et C_{DJ} de la structure

Emplacement relatif	C_D ou C_{DJ}
Structure entourée par des objets plus hauts	0,25
Structure entourée par des objets de la même hauteur ou plus faible	0,5
Structure isolée, pas d'autres objets à proximité	1
Structure isolée au sommet d'une colline ou sur un monticule	2

NOTE 1 Une méthode plus complète fondée sur des modèles 3D peut fournir des résultats approfondis, en tenant compte de l'incidence des bâtiments environnants et de l'environnement.

NOTE 2 La méthode courante pour déterminer le coefficient C_D ou C_{DJ} consiste à déterminer l'influence des objets à une distance maximale de 3H du bâtiment concerné (chevauchement des surfaces d'exposition).

NOTE 3 C_D est représentatif d'une surface équivalente d'exposition de la structure; C_D dépend de la hauteur des structures environnantes, de la largeur et, en général, de l'exposition des structures environnantes. Il ne s'agit pas d'un simple calcul géométrique. Cependant, à titre indicatif, C_D = 0,25 peut être pris comme exemple lorsque la surface d'exposition de la structure physique et le sol à une distance maximale de 3 × H sont constamment compris à 75 % dans la surface d'exposition des objets environnants. C_D = 0,5, par exemple, lorsque la surface d'exposition de la structure physique et le sol à une distance maximale de 3 × H sont constamment compris à 50 % dans la surface d'exposition des objets environnants. C_D = 1, par exemple, lorsque la surface d'exposition de la structure physique et le sol à une distance maximale de 3 × H sont marginalement compris dans la surface d'exposition des objets environnants.

A.2.4 Nombre d'événements dangereux N_D pour la structure

N_D peut être évalué comme le produit:

$$N_D = N_{SG} \times A_D \times C_D \times 10^{-6} \quad \text{(A.5)}$$

où

N_{SG} est la densité de points d'impact au sol de la foudre par km^2 et par an;

A_D est la surface équivalente d'exposition de la structure (m^2);

C_D est le facteur d'emplacement de la structure (voir le Tableau A.1).

NOTE Dans les zones qui comportent des structures de grande hauteur isolées, une évaluation plus précise de N_D peut être conseillée. Les comités nationaux peuvent fournir de plus amples informations.

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A.2.5 Nombre d'événements dangereux N_{DJ} pour une structure adjacente

Le nombre annuel moyen d'événements dangereux dus aux impacts sur une structure connectée à l'extrémité d'une ligne, N_{DJ}, peut être évalué comme le produit:

$$N_{DJ} = N_{SG} \times A_{DJ} \times C_{DJ} \times C_T \times 10^{-6} \quad \text{(A.6)}$$

où

N_{SG} est la densité de points d'impact au sol de la foudre par km^2 et par an;

A_{DJ} est la surface équivalente d'exposition de la structure adjacente (m^2);

C_{DJ} est le facteur d'emplacement de la structure adjacente (voir le Tableau A.1);

C_T est le facteur de type de ligne (voir le Tableau A.3).

A.3 Évaluation du nombre annuel moyen d'événements dangereux N_M dus aux impacts à proximité d'une structure

N_M peut être évalué comme le produit:

$$N_M = (1/k) \times N_{SG} \times A_M \times 10^{-6} \quad \text{(A.7)}$$

où

N_{SG} est la densité de points d'impact au sol de la foudre par km^2 et par an;

A_M est la surface équivalente d'exposition pour les impacts à proximité de la structure (m^2).

NOTE 1 Lorsque la densité N_{SG} est obtenue directement par LLS, le facteur k est fourni par le fournisseur de données de LLS. En cas d'indisponibilité, un facteur k = 2 peut être retenu par hypothèse (voir l'Article A.1).

NOTE 2 Dans les réseaux de puissance, les événements dangereux N_M peuvent généralement être ignorés en raison de l'utilisation d'une construction en béton à maillage de barres d'armature dense.

NOTE 3 Le facteur d'environnement C_E peut également avoir une influence sur N_M, par exemple, N_M peut être multiplié par le facteur d'environnement C_E.

La surface équivalente d'exposition A_M s'étend jusqu'à une ligne située à une distance conventionnelle r_M du périmètre de la structure:

$$A_M = 2 \times r_M \times (L + W) + \pi \times r_M{}^2 \quad \text{(A.8)}$$

où

r_M = $350/U_w$ (m);

U_w est la tension de choc assignée en kV du matériel dont le niveau d'isolement est le plus faible.

NOTE 4 Les valeurs habituelles de U_W peuvent être consultées dans le Tableau B.11 et dans le Tableau B.12.

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A.4 Évaluation du nombre annuel moyen d'événements dangereux N_L dus à des impacts sur une ligne

Une ligne peut comprendre plusieurs sections. Pour chaque section de ligne, la valeur de N_L peut être évaluée de la façon suivante:

$$N_L = N_{SG} \times A_L \times C_I \times C_E \times C_T \times 10^{-6} \quad (A.9)$$

où

N_L est le nombre de surtensions d'amplitude supérieure ou égale à 1 kV (1/an) sur la section de ligne;

N_{SG} est la densité de points d'impact au sol de la foudre par km^2 et par an;

A_L est la surface équivalente d'exposition aux impacts sur la ligne (m^2);

C_I est le facteur d'installation de la ligne (voir le Tableau A.2);

C_T est le facteur de type de ligne (voir le Tableau A.3);

C_E est le facteur d'environnement (voir le Tableau A.4)

avec la surface équivalente d'exposition pour les impacts sur une ligne:

$$A_L = 40 \times L_L \quad (A.10)$$

où

L_L est la longueur de la section de ligne (m).

Lorsqu'aucune information relative à la longueur des sections n'est disponible, une longueur de ligne maximale de 1 km pour la somme des lignes de puissance HT et des lignes de puissance BT et une longueur de ligne maximale de 1 km pour les lignes de communication peuvent être admises par hypothèse;

NOTE 1 Plus d'informations sur les surfaces équivalentes d'exposition A_L des lignes de communication peuvent être obtenues dans la Recommandation UIT-T K.47 [8].

NOTE 2 En général, 2 km est une longueur totale maximale réaliste à prendre en compte pour les lignes de puissance.

Tableau A.2 – Facteur d'installation de ligne C_I

Cheminement	C_I
Aérien	1
Enterré	0,3
Câbles enterrés entièrement posés dans un réseau maillé de terre (IEC 62305-4:2024, 5.2).	0,01

NOTE 3 La résistivité du sol a un impact sur la surface d'exposition A_L des sections enterrées. En règle générale, plus la résistivité du sol est importante, plus la surface équivalente d'exposition est grande. Le facteur d'installation du Tableau A.2 est fondé sur ρ = 400 Ωm. Pour ρ > 400 Ωm, l'équation suivante pour une section enterrée peut être utilisée: $A_L = 0{,}6 \times \sqrt{\rho} \times L_L$.

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Tableau A.3 – Facteur de type de ligne C_T

Installation	C_T
Ligne de puissance BT, de communication ou de transmission de données, ou ligne de puissance HT avec autotransformateur HT/BT	1
Ligne de puissance HT (avec transformateur HT/BT à enroulements séparés)	0,2

NOTE 5 D'autres valeurs peuvent être attribuées au facteur de type de ligne C_T après une étude approfondie. Des valeurs plus faibles sont possibles pour C_T.

Tableau A.4 – Facteur d'environnement C_E

Environnement	C_E
Rural	1
Suburbain	0,5
Urbain	0,1
Urbain avec des bâtiments de hauteur supérieure à 20 m	0,01

NOTE 6 Les valeurs données à C_E réduisent le nombre d'événements dangereux causés par les sources S3 et S4 en raison de la protection des structures environnantes.

NOTE 7 D'autres valeurs peuvent être attribuées au facteur d'environnement C_E après une étude approfondie.

A.5 Évaluation du nombre annuel moyen d'événements dangereux N_I dus à des impacts à proximité d'une ligne

Une ligne peut comprendre plusieurs sections. Pour chaque section de ligne, la valeur de N_I peut être évaluée comme suit:

$$N_I = (1/k) \times N_{SG} \times A_I \times C_I \times C_E \times C_T \times 10^{-6} \quad \text{(A.11)}$$

où

N_I est le nombre annuel de surtensions d'amplitude supérieure à U_W sur la section de ligne;

N_{SG} est la densité de points d'impact au sol de la foudre par km^2 et par an;

A_I est la surface équivalente d'exposition pour les impacts sur le sol à proximité de la ligne (m^2);

C_I est le facteur d'installation (voir le Tableau A.2);

C_T est le facteur de type de ligne (voir le Tableau A.3);

C_E est le facteur d'environnement (voir le Tableau A.4).

NOTE 1 Lorsque la densité N_{SG} est obtenue directement par LLS, le facteur k est fourni par le fournisseur de données de LLS. En cas d'indisponibilité, un facteur k = 2 peut être retenu par hypothèse (voir l'Article A.1).

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La surface équivalente d'exposition A_I des impacts à proximité d'une ligne s'étend à une ligne située à une distance conventionnelle r_I de la ligne:

$$A_I = 2 \times r_I \times L_L \quad \text{(A.12)}$$

où

L_L est la longueur de la section de ligne (m);

r_I = 2 000/$U_w^{1,8}$;

U_w est la tension assignée de choc en kV du matériel.

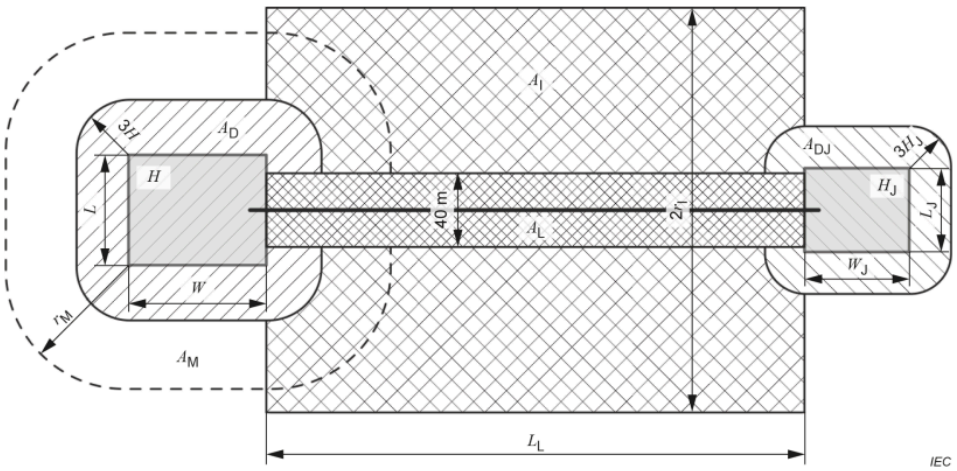
Lorsqu'aucune information relative à la longueur des sections n'est disponible, une longueur de ligne maximale de 1 km pour la somme des lignes de puissance HT et des lignes de puissance BT et une longueur de ligne maximale de 1 km pour les lignes de communication peuvent être admises par hypothèse;

NOTE 2 Une évaluation plus précise de A_I peut être trouvée dans la publication Electra n° 161 [9] et n° 162 [10], 1995 pour les lignes de puissance et dans la Recommandation UIT-T K.46 [11] pour les lignes de communication.

NOTE 3 En général, 2 km est une longueur totale maximale réaliste à prendre en compte pour les lignes de puissance.

A.6 Représentation des surfaces équivalentes d'exposition

La Figure A.5 représente la relation entre les cinq surfaces d'exposition A_D, A_{DJ}, A_M, A_L et A_I, respectivement spécifiées en A.2.1.2, en A.2.1.3, à l'Article A.3, à l'Article A.4 et à l'Article A.5. Il convient de noter que les zones ne sont pas représentées à l'échelle par rapport aux dimensions habituelles.



NOTE La figure représente la surface d'exposition d'une distance latérale spécifique.

Figure A.5 – Surfaces équivalentes d'exposition A_D, A_{DJ}, A_M, A_L et A_I

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Annexe B
(informative)

Évaluation de la probabilité de dommages P_X

B.1 Généralités

Les probabilités données dans la présente Annexe B sont valables si les mesures de protection sont conformes à:

– l'IEC 62305-3 pour les mesures de protection qui réduisent les blessures sur des êtres humains et les dommages physiques;

– l'IEC 62305-4 pour les mesures de protection qui réduisent les défaillances des réseaux internes.

D'autres valeurs peuvent être choisies si cela est justifié.

Les valeurs des probabilités P_X inférieures à 1 ne peuvent être choisies que si la mesure ou la caractéristique est valable pour la structure entière ou une zone à risque de la structure (Z_S) à protéger et pour tous les matériels associés.

Il convient que les valeurs des probabilités P_X tiennent compte de la probabilité P_{TWS} si les dispositions de protection correspondantes fournies sont activées à l'aide d'un système d'alerte aux orages (TWS) conforme à l'IEC 62793, où P_{TWS} est la probabilité qu'un TWS ne détecte pas un phénomène de foudre dans la zone cible.

NOTE 1 P_{TWS} = valeur maximale entre le taux de défaillance d'alerte (FTWR, *Failure to Warn Ratio*) et 1 − la probabilité qu'un délai de x minutes soit obtenu (POD_x). Le FTWR et POD_x figurent généralement sur la fiche produit du fabricant ou sont communiqués par le fournisseur de service. Il peut être admis par hypothèse que P_{TWS} = 1 si le fabricant ne déclare pas la valeur de FTWR ou POD_x.

NOTE 2 Pour les mesures de protection et les valeurs de réduction obtenues au moyen d'un TWS, voir l'IEC 62305-1 et l'IEC 62793. Si aucune mesure préventive temporaire ne s'applique ou si aucun TWS n'est prévu, il peut être admis par hypothèse que P_{TWS} = 1. Si l'avertissement donné par le TWS n'accorde pas suffisamment de temps pour prendre ces mesures, il peut être admis par hypothèse que P_{TWS} = 1.

Il convient que les valeurs des facteurs à utiliser pour évaluer la probabilité P_X de dommages soient fixées par le concepteur du système de protection contre la foudre. Les valeurs de facteurs dans une structure données dans la présente Annexe B sont des valeurs types. D'autres valeurs peuvent être attribuées après une étude approfondie.

La probabilité P_X que les mesures de protection réduisent les défaillances des réseaux internes dépend de la probabilité P_{SPD} d'un système de protection par parafoudres coordonnés. En fonction du niveau de protection contre la foudre (NPF) choisi, un système de protection par parafoudres coordonnés doit:

– résister au courant de foudre prévu au point d'installation;

– limiter la valeur de surtension à l'entrée du matériel à une valeur inférieure ou égale à la tension de choc assignée (U_W).

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La probabilité P_{SPD} qui correspond au système de protection par parafoudres coordonnés dépend:

– de la probabilité P_Q que la valeur de la charge prévue, associée au courant qui passe par le SPD à son point d'installation, dépasse la valeur tolérée par le SPD;
– de la probabilité P_{Up} que la valeur de tension résiduelle au niveau du parafoudre dépasse le niveau de protection exigé U_{pr} afin de réduire la valeur de surtension à l'entrée du matériel à une valeur inférieure ou égale à la tension de choc assignée (U_w)du matériel.

Alors la probabilité P_{SPD} est donnée par:

$$P_{SPD} = 1 - (1 - P_Q)(1 - P_{Up}) \quad \text{(B.1)}$$

La probabilité P_Q fait référence aux premiers coups de foudre positif et négatif, tandis que la probabilité P_{Up} fait référence aux impacts suivants des éclairs négatifs.

NOTE 3 Les réseaux internes peuvent comprendre des matériels montés à l'extérieur, à condition qu'ils ne soient pas exposés à un coup de foudre direct, selon la classe de SPF choisie.

B.2 Probabilité P_{AT} qu'un impact sur une structure provoque des tensions dangereuses de contact et de pas

Les valeurs de probabilité P_{AT} d'apparition de dommages causés par des tensions de contact et de pas en raison d'impacts sur une structure dépendent des mesures de protection prévues:

$$P_{AT} = P_{LPS} \times P_{am} \times r_t \times P_{TWS} \quad \text{(B.2)}$$

où

P_{LPS} est la probabilité, en fonction du NPF, que les mesures protègent les zones exposées de la structure contre les impacts directs. Les valeurs de P_{LPS} sont données dans le Tableau B.3;

P_{TWS} est la probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible;

NOTE 1 L'objet d'un message d'alerte créé par un TWS est d'assurer une évacuation immédiate et complète de la zone exposée. Si cette évacuation n'est pas assurée ou si aucun TWS n'est prévu, ou si le fabricant ne déclare pas le FTWR, il est admis par hypothèse que $P_{TWS} = 1$ (voir aussi l'IEC 62305-1 et l'IEC 62793 pour les restrictions d'application d'un TWS).

P_{am} est la probabilité qu'un impact sur une structure provoque des dommages dus à des tensions de contact et de pas selon les différentes mesures de protection prises. Les valeurs de P_{am} sont données dans le Tableau B.1;

r_t est le facteur de réduction en fonction du type de surface du sol ou du plancher. Les valeurs de r_t sont données dans le Tableau B.2.

NOTE 2 Les mesures de protection ne réduisent efficacement P_{AT} qu'à l'intérieur de structures protégées par un SPF ou de structures à armature continue en métal ou en béton armé qui agit comme un SPF naturel.

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Tableau B.1 – Valeurs de probabilité P_{am} qu'un impact sur une structure provoque des dommages dus à des tensions de contact et de pas selon les différentes mesures de protection prises

Mesure de protection	P_{am}
Pas de mesures de protection	1
Panneau d'avertissement	10^{-1}
Isolation électrique (par exemple, au moins 3 mm de polyéthylène réticulé) des parties exposées (par exemple, conducteurs de descente)	10^{-2}
Sol équipotentiel efficace réalisé au moyen d'un réseau de prises de terre maillé[a]	10^{-2}
SPF naturel, voir la Note 3	10^{-3}
Restrictions d'accès	0
[a] Mesure de protection efficace contre les tensions de pas uniquement.	

Si plusieurs mesures de protection ont été prises, la valeur de P_{am} est le produit des valeurs correspondantes.

NOTE 3 Il peut être admis par hypothèse que P_{am} = 0,001 lorsque la structure:

- est équipée d'une armature métallique complète (voir l'IEC 62305-3:2024, 8.1 et 8.2);
- est en béton armé coulé sur place, les tiges de renfort étant reliées conformément à l'IEC 62305-3 et vérifiées conformément à la méthode décrite dans l'IEC 62305-3:2024, Annexe D;
- est prévue avec un réseau de prises de terre maillé, sans installation métallique accessible qui peut faire partie de la trajectoire du courant de foudre.

Tableau B.2 – Facteur de réduction r_t en fonction du type de surface du sol ou du plancher

Type de surface[a]	Résistance de contact[b] kΩ	r_t
Agricole, béton	≤ 1	10^{-2}
Marbre, céramique	1–10	10^{-3}
Gravier, moquette, tapis	10–100	10^{-4}
Asphalte, linoléum, bois	≥ 100	10^{-5}
NOTE Une attention particulière est prise lorsque les couches de protection isolantes au sol sont mouillées ou recouvertes d'une pellicule d'eau.		
[a] Une couche en matériau isolant, par exemple en asphalte de 5 cm d'épaisseur, réduit généralement le danger à un niveau tolérable. Dans de tels cas, il peut être admis par hypothèse que r_t = 0.		
[b] Résistance de contact selon la définition IEV 581-23-08. Valeurs mesurées entre une électrode de 400 cm^2 comprimée avec une force uniforme de 750 N et un point où la tension n'est pas modifiée par une injection de courant.		

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B.3 Probabilité P_{AD} qu'un impact entraîne des dommages sur une personne exposée qui se tient sur la structure

Les valeurs de probabilité P_{AD} qu'un éclair frappe une personne sur la structure dépendent de la position de la personne dans la zone exposée, du niveau de protection contre la foudre (NPF) des mesures prises pour protéger les zones exposées de la structure contre les impacts directs et des mesures de protection complémentaires prévues:

$$P_{AD} = P_{TWS} \times P_{am} \times P_O \times P_{LPS} \quad \text{(B.3)}$$

où

P_{TWS} est la probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible;

NOTE 1 L'objet d'un message d'alerte créé par un TWS est d'assurer une évacuation immédiate et complète de la zone exposée. Si cette évacuation n'est pas assurée ou si aucun TWS n'est prévu, ou si le fabricant ne déclare pas le FTWR, il est admis par hypothèse que $P_{TWS} = 1$ (voir aussi l'IEC 62305-1:2024, 7.1 pour les restrictions d'application d'un TWS).

NOTE 2 Lorsqu'un TWS est utilisé, la probabilité P_{am} peut être ignorée.

P_{am} est la probabilité qu'un impact sur une structure provoque des dommages dus à des tensions de contact et de pas selon les différentes mesures de protection prises. Les valeurs de P_{am} sont données dans le Tableau B.1;

P_O est le facteur de probabilité en fonction de la position d'une personne dans la zone exposée, où P_O est par hypothèse égal à 1 lorsque la personne est exposée (et égal à 0 lorsqu'il n'y a personne);

P_{LPS} est la probabilité, en fonction du NPF, que les mesures protègent les zones exposées de la structure contre les impacts directs. Les valeurs de P_{LPS} sont données dans le Tableau B.3;

NOTE 3 La probabilité P_{LPS} peut être incluse dans l'Équation (B.3) uniquement lorsque des personnes se trouvent dans la zone protégée du SPF.

P_{am} est la probabilité qu'un impact sur une structure provoque des dommages dus à des tensions de contact et de pas.

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Tableau B.3 – Valeurs de probabilité P_{LPS} qui dépend des mesures destinées à protéger les zones exposées de la structure contre les impacts directs et à réduire les dommages physiques

Caractéristiques de la structure	Classe de SPF	P_{LPS}
Structure ou zones exposées non protégées	-	1
Structure ou zones exposées protégées par un SPF	IV	0,2
	III	0,1
	II	0,05
	I	0,02
Structure protégée par un SPF I avec armature continue en métal ou en béton armé qui agit comme réseau de conducteurs de descente naturels		0,01
Structure protégée par un SPF I avec toiture métallique et dispositif de capture, avec la possibilité d'inclure des composants naturels, qui assure une protection complète des matériels sur le toit contre les coups de foudre directs et armature continue en métal ou en béton armé qui agit comme réseau de conducteurs de descente naturels		0,001

NOTE 4 Des valeurs de P_{LPS} autres que celles données dans le Tableau B.3 sont possibles si elles reposent sur une évaluation approfondie en tenant compte des exigences de dimensionnement et les critères d'interception définis dans l'IEC 62305-1.

NOTE 5 Les caractéristiques du SPF, y compris celles du parafoudre pour la liaison équipotentielle de foudre, sont indiquées dans l'IEC 62305-3.

NOTE 6 Le niveau de protection du SPF peut être différent pour la protection des zones exposées de la structure contre les impacts directs ou pour réduire les dommages physiques.

NOTE 7 Pour plus d'informations, voir l'IEC 62305-3:2024, 8.1 et 8.2.

B.4 Probabilité P_B qu'un impact sur une structure entraîne des dommages physiques par incendie ou explosion

La probabilité P_B qu'un impact sur une structure entraîne des dommages physiques par incendie ou explosion est donnée par:

$$P_B = P_S \times P_{LPS} \times r_f \times r_p \quad \text{(B.4)}$$

où

P_S est la probabilité qu'un impact sur une structure provoque un étincelage dangereux. Les valeurs de P_S sont données dans le Tableau B.4;

P_{LPS} est la probabilité qui dépend des mesures de protection prises pour réduire les dommages physiques. Les valeurs de P_{LPS} sont données dans le Tableau B.3;

r_p est le facteur de réduction en fonction des dispositions prises pour réduire les conséquences d'un incendie. Les valeurs de r_p sont données dans le Tableau B.5;

r_f est le facteur de réduction en fonction du risque d'incendie ou d'explosion de la structure. Les valeurs de r_f sont données dans le Tableau B.6.

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Tableau B.4 – Valeurs de probabilité P_S qu'un impact sur une structure provoque un étincelage dangereux

Type de structure	P_S
Bois et maçonnerie	1
Armature en béton armé à continuité électrique ou structure métallique interconnectée	0,5
NOTE 1 Si aucun SPF n'est installé ou si le SPF n'est pas installé conformément à l'IEC 62305-3, le Tableau B.4 donne la valeur de P_S. Si un SPF est installé conformément à l'IEC 62305-3, P_S = 1 et l'effet bénéfique sur le SPF est pris en compte par P_{LPS}. NOTE 2 En cas de présence de parties métalliques qui font particulièrement saillie et non raccordées à l'armature de la structure, P_S = 1 peut être adopté. NOTE 3 Lorsque les parois et la toiture ne sont pas du même type, une valeur plus élevée pour P_S peut être envisagée. NOTE 4 En ce qui concerne les armatures, la valeur de 0,5 n'est valable que si l'armature est suffisamment raccordée et connectée à la disposition de mise à la terre.	

Tableau B.5 – Facteur de réduction r_p en fonction des dispositions prises pour réduire les conséquences d'un incendie

Dispositions	r_p
Pas de disposition	1
Une des dispositions suivantes: extincteurs, installations d'extinction fixes déclenchées manuellement[a], installations manuelles d'alarme, prises d'eau, compartiments étanches, voies d'évacuation protégées	0,5
Une des dispositions suivantes: installations d'extinction fixes déclenchées automatiquement, installations d'alarme automatiques[b]	0,2
NOTE Ces dispositions ne sont valables que si elles sont disponibles et opérationnelles au moment où un phénomène de foudre survient. En cas de doute, la valeur r_p = 1 est suggérée. Dans certains pays, il n'est pas possible d'utiliser d'autres valeurs que r_p = 1, sauf si un SPF est prévu. [a] Ces dispositions ne sont efficaces que si elles sont mises en œuvre par des personnes formées à cet effet et aptes à les appliquer. [b] Seulement si elles sont protégées contre les surtensions ou d'autres dommages et si les pompiers peuvent intervenir en moins de 10 min.	

Les dispositions prises pour réduire les conséquences d'un incendie, comme cela est décrit dans le Tableau B.5, n'empêchent pas la survenue d'un incendie dû à la foudre. Si des mesures d'atténuation des incendies sont utilisées dans le calcul du risque de foudre (r_p différent de 1), il convient d'en informer l'utilisateur. Si l'utilisateur n'en est pas informé, il convient d'appliquer r_p = 1.

Dans les zones avec risque d'explosion, r_p = 1 dans tous les cas, sauf si des dispositions sont prises pour s'assurer qu'une explosion ne peut pas se produire à la suite d'un incendie dans la zone explosive.

Dans les zones où se trouvent des batteries lithium-ion, il convient d'appliquer r_p = 1. Un faible volume de telles batteries peut être ignoré (un ordinateur portable, par exemple).

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Tableau B.6 – Facteur de réduction r_f en fonction du risque d'incendie ou d'explosion de la structure

Risque	Niveau de risque	r_f
Explosion	Zones 0, 20 et explosif solide	1
	Zones 1, 21	10^{-1}
	Zones 2, 22	10^{-3}
Incendie	Élevé	10^{-1}
	Ordinaire	10^{-2}
	Faible	10^{-3}
Explosion ou incendie	Aucun	0
NOTE Des exemples de charges calorifiques pour différents types de structures peuvent être consultés dans d'autres documents, par exemple l'EN 1991-1-2 [12].		

NOTE 1 Dans le cas d'une structure avec possibilité d'explosion, les valeurs de r_f correspondent aux valeurs suggérées représentatives du cas le plus défavorable pour les calculs de la protection contre la foudre en l'absence de données d'entrée communiquées par le propriétaire de l'installation ou toute autre source appropriée. Dans la mesure où la probabilité de conditions dangereuses et les conséquences d'un incendie peuvent varier d'un site à l'autre, l'application des définitions des Zones 1 et 21 et des Zones 2 et 22 d'autres principes issus de l'IEC 60079 et de la série ISO/IEC 80079 permettrait de déterminer ces valeurs à partir des données d'entrée communiquées par les propriétaires d'installations ou toutes autres sources appropriées pour l'application considérée. Les normes et codes applicables à l'application constituent des exemples de sources appropriées.

NOTE 2 En présence de différentes conditions, le cas le plus défavorable est utilisé.

NOTE 3 Il peut être admis par hypothèse que les structures qui présentent un risque d'incendie élevé sont des structures en matériaux combustibles, des structures dont le toit est en matériaux combustibles ou des structures qui ont une charge calorifique spécifique supérieure à 800 MJ/m^2.

NOTE 4 Il peut être admis par hypothèse que les structures qui présentent un risque d'incendie ordinaire sont des structures qui ont une charge calorifique spécifique comprise entre 800 MJ/m2 et 400 MJ/m^2.

NOTE 5 Il peut être admis par hypothèse que les structures qui présentent un faible risque d'incendie sont des structures qui ont une charge calorifique spécifique inférieure à 400 MJ/m^2 ou des structures qui ne contiennent qu'une faible quantité de matériaux combustibles.

NOTE 6 La charge calorifique spécifique est le rapport entre l'énergie de la quantité totale de matériaux combustibles dans une structure et la surface globale de la structure.

NOTE 7 Pour les besoins du présent document, les structures associées à des zones dangereuses ou à des matériaux explosifs solides ne sont par hypothèse pas des structures avec risque d'explosion si l'une des conditions suivantes est remplie:

- la durée de présence des substances explosives est inférieure à 0,1 h/an;
- le volume de l'atmosphère explosive engendre une zone d'étendue négligeable;
- la zone dangereuse ne peut pas être frappée directement par un éclair et l'étincelage dangereux dans la zone dangereuse est évité. Cette condition est remplie dans les cas suivants:

  Pour les zones dangereuses protégées par des abris métalliques, si l'abri formé par un dispositif de capture naturel agit en toute sécurité sans problème de perforation ou de point chaud, et si les réseaux internes à l'intérieur de l'abri, le cas échéant, sont protégés contre les surtensions afin d'éviter un étincelage dangereux.

  Pour les zones dangereuses situées dans des structures, si celles-ci sont à l'intérieur de structures protégées par un SPF ou de structures à armature continue en métal ou en béton armé qui agissent comme un SPF naturel, qui satisfont aux exigences d'équipotentialité de l'IEC 62305-3 et si les réseaux internes de la zone, le cas échéant, sont protégés contre les surtensions afin d'éviter un étincelage dangereux.

NOTE 8 Les définitions et critères associés aux zones dangereuses et aux zones d'étendue négligeable figurent dans l'IEC 60079-10-1 [3] et l'IEC 60079-10-2 [4].

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B.5 Probabilité P_C qu'un impact sur une structure entraîne des défaillances des réseaux internes

Un système de protection par parafoudres coordonnés est approprié comme mesure de protection pour réduire P_C.

La probabilité P_C qu'un impact sur une structure entraîne des défaillances des réseaux internes est donnée par:

$$P_C = P_{SPD} \times C_{LD} \quad \text{(B.5)}$$

P_{SPD} dépend de la conformité du système de protection par parafoudres coordonnés à l'IEC 62305-4 et des caractéristiques des réseaux internes. Les valeurs de P_{SPD} sont indiquées dans le Tableau B.7 et dans le Tableau B.8;

C_{LD} est un facteur associé aux conditions de blindage, de mise à la terre et d'isolation de la ligne à laquelle est connecté le réseau interne. Les valeurs de C_{LD} sont données dans le Tableau B.9.

NOTE 1 Un système de protection par parafoudres coordonnés n'est efficace pour réduire P_C que dans les structures protégées par un SPF ou dans les structures à armature continue en métal ou en béton armé qui agit comme un SPF naturel, lorsque les exigences d'équipotentialité de l'IEC 62305-3 sont remplies, quelle que soit la classe de SPF.

NOTE 2 Si le toit est considéré comme une zone du bâtiment, les mesures de protection sont définies comme pour les autres zones. Si une protection contre les impacts directs est exigée, le matériel sur le toit est protégé par le SPF et les parafoudres sont conçus selon la source de dommages S1 (couplage résistif et couplage inductif) dans le Tableau B.7 ou dans le Tableau B.8 comme approche simple.

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Tableau B.7 – Valeurs types de P_{SPD} pour les parafoudres sur le réseau basse tension qui servent de protection contre les sources de dommages S1, S2, S3, S4

NPF	Impacts directs et indirects sur la ligne				Impact à proximité de la structure		Impact sur la structure		Impact sur la structure	
	Source de dommages S3[a]		Source de dommages S4[a]		Source de dommages S2[a]		Source de dommages S1[a] (couplage inductif)		Source de dommages S1[b] (couplage résistif)	
	kA 10/350 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 10/350 µs	P_{SPD}
Absence de parafoudre		1		1		1		1		1
III à IV	5	0,05	0,3	0,05	0,1	0,05	5	0,05	12,5	0,05
II	7,5	0,02	0,45	0,02	0,15	0,02	7,5	0,02	18,75	0,02
I	10	0,01	0,6	0,01	0,2	0,01	10	0,01	25	0,01
Meilleur que le NPF I			2,5[c d]	10^{-4}	2,5[c]	10^{-4}				
			3,75[c d]	5×10^{-5}	3,75[c]	5×10^{-5}				
			5[c d]	10^{-5}	5[c]	10^{-5}				

NOTE 1 Le NPF nécessaire pour les parafoudres peut être différent du NPF du SPF.

NOTE 2 Pour les lignes blindées, la valeur des courants peut être divisée par deux.

[a] Pour obtenir des informations sur les valeurs de courant et les conditions spécifiques, voir l'IEC 62305-1:2024, Tableau E.1.

[b] Les valeurs de courant se réfèrent à une seule ligne de service (n = 1) à conducteurs trois phases + neutre (n' = 4); facteur de répartition k_e = 0,5. Pour plus d'informations, voir l'IEC 62305-1:2024, Article E.2.

[c] Parafoudre d'utilisation courante.

[d] Les valeurs de S4 dans le Tableau E.1 de l'IEC 62305-1:2024 définies pour NPF I à IV sont indiquées dans les lignes "meilleur que le NPF I" du présent tableau.

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Tableau B.8 – Valeurs types de P_{SPD} pour les parafoudres sur le réseau de communication qui servent de protection contre les sources de dommages S1, S2, S3, S4

NPF	Impacts directs et indirects sur la ligne				Impact à proximité de la structure		Impact sur la structure		Impact sur la structure	
	Source de dommages S3[a]		Source de dommages S4[a]		Source de dommages S2[a e]		Source de dommages S1[a d] (couplage inductif)		Source de dommages S1[b] (couplage résistif)	
	kA 10/350 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 8/20 µs	P_{SPD}	kA 10/350 µs	P_{SPD}
Absence de parafoudre		1		1		1		1		1
III à IV	1	0,05	0,3	0,05	0,1	0,05	5	0,05	1,25[f]	0,05
II	1,5	0,02	0,45	0,02	0,15	0,02	7,5	0,02	1 875[f]	0,02
I	2	0,01	0,6	0,01	0,2	0,01	10	0,01	2,5[f]	0,01
Meilleur que le NPF I			2,5[c]	10^{-4}	2,5[c]	10^{-4}				
			3,75[c]	5×10^{-5}	3,75[c]	5×10^{-5}				
			5[c]	10^{-5}	5[c]	10^{-5}				

NOTE 1 Le NPF nécessaire pour les parafoudres peut être différent du NPF du SPF.

NOTE 2 Voir la Recommandation UIT-T K.67 [13] pour plus d'informations.

NOTE 3 Valeurs pour les lignes aériennes non blindées. Pour les lignes enterrées, les valeurs des courants peuvent être divisées par deux. Pour les lignes blindées, les valeurs des courants peuvent être divisées par deux.

[a] Pour obtenir des informations sur les valeurs de courant et les conditions spécifiques, voir l'IEC 62305-1:2024, Tableau E.2.

[b] Des informations plus précises sont données dans l'Article E.2 de l'IEC 62305-1:2024.

[c] Parafoudre d'utilisation courante.

[d] L'acheminement dans les conducteurs en boucle et leur distance par rapport au courant induit compromet les valeurs des surintensités prévues. Les valeurs du Tableau E.2 de l'IEC 62305-1:2024 font référence à des conducteurs en boucle court-circuités et non blindés avec différents acheminements dans de grands bâtiments (zone de boucle de l'ordre de 50 m^2, largeur = 0,5 m), à 1 m de distance par rapport à la paroi de la structure, dans une structure non blindée (k_C = 1). Pour des caractéristiques de boucle et de structure différentes, il convient de multiplier les valeurs par les facteurs K_{S1}, K_{S2}, K_{S3} (voir l'Article B.6).

[e] L'acheminement dans les conducteurs en boucle et leur distance par rapport au courant induit compromet les valeurs des surintensités prévues. Les valeurs du Tableau E.2 de l'IEC 62305-1:2024 font référence à des conducteurs en boucle court-circuités et non blindés avec différents acheminements (zone de boucle de l'ordre de 50 m^2, largeur = 0,5 m), à 350 m de distance par rapport au coup de foudre, dans une structure non blindée. Pour des caractéristiques de boucle et de structure différentes, il convient de multiplier les valeurs par les facteurs K_{S1}, K_{S2}, K_{S3} (voir l'Article B.6).

[f] Des informations plus précises sont données dans l'Article E.2 de l'IEC 62305-1:2024.

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Les valeurs de probabilité P_{SPD} données dans le Tableau B.7 et dans le Tableau B.8 se réfèrent au cas où P_{Up} est négligeable par rapport à P_Q. Dans ce cas, P_{SPD} = P_Q. Les valeurs de P_{SPD} données dans le Tableau B.7 et dans le Tableau B.8 peuvent être obtenues au moyen d'un système comportant deux SPD. Pour certaines applications, l'installation de deux SPD peut ne pas être possible. Il est nécessaire de comparer le niveau de protection U_p et les paramètres de courant de décharge I_{imp} afin d'évaluer l'efficacité d'un système de parafoudres.

Des valeurs de probabilité P_{SPD} autres que celles indiquées dans le Tableau B.7 et dans le Tableau B.8 peuvent être utilisées si elles sont suffisantes pour réduire le risque R et la fréquence des dommages F au-dessous des valeurs tolérables.

NOTE 3 Les caractéristiques de la ligne en amont du système de SPD et du circuit interne en aval de ce système ont une forte influence sur la valeur de la probabilité P_{SPD} qu'un appareil protégé par un système de SPD soit endommagé. L'indisponibilité d'informations quant au choix approprié d'un système de parafoudres dont la probabilité P_{Up} est négligeable représente un problème complexe. Les règles simplifiées données à titre de recommandation générale à l'Annexe C de l'IEC 62305-4:2024 peuvent être utilisées comme première approximation. Dans ce cas, les valeurs de P_{SPD} obtenues sont supérieures à celles indiquées dans le Tableau B.7 et dans le Tableau B.8.

NOTE 4 Des informations complémentaires sur le choix d'un système SPD qui donne la probabilité exigée P_{SPD} peuvent être fournies après une étude approfondie.

NOTE 5 Les valeurs indiquées dans le Tableau B.7 et dans le Tableau B.8 s'appliquent aux cas courants. Les valeurs de P_{SPD} fondées sur une analyse plus approfondie peuvent être déterminées selon l'Annexe D.

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Tableau B.9 – Valeurs des facteurs C_{LD} et C_{LI} en fonction des conditions de blindage, de mise à la terre et d'isolation

Type de ligne extérieure	Connexion à l'entrée	C_{LD}	C_{LI}
Ligne aérienne non blindée	Non définie	1	1
Ligne enterrée non blindée	Non définie	1	1
Ligne de puissance à neutre mis à la terre en plusieurs emplacements	Aucun	1	0,2
Ligne enterrée blindée (de puissance ou de communication)	Blindage non relié à la borne d'équipotentialité à laquelle le matériel est connecté	1	0,3
Ligne aérienne blindée (de puissance ou de communication)	Blindage non relié à la borne d'équipotentialité à laquelle le matériel est connecté	1	0,1
Ligne enterrée blindée (de puissance ou de communication)	Blindage relié à la borne d'équipotentialité à laquelle le matériel est connecté	1	0
Ligne aérienne blindée (de puissance ou de communication)	Blindage relié à la borne d'équipotentialité à laquelle le matériel est connecté	1	0
Câble de protection contre la foudre ou câblage dans des conduits ou canalisations métalliques de câble de protection contre la foudre	Blindage relié à la borne d'équipotentialité à laquelle le matériel est connecté	0	0
Pas de ligne extérieure ou ligne optique	Pas de connexion à des lignes métalliques extérieures	0	0
Tout type	Connexion à une interface d'isolement selon l'IEC 62305-4[a]	0	0

[a] Pour ce matériel, les valeurs de C_{LD} et C_{LI} sont indiquées dans le présent tableau en fonction du type de ligne extérieure et de connexion à l'entrée. C_{LD} = 0 uniquement si l'interface d'isolement est protégée par un parafoudre ou s'il est démontré par des essais que la tenue aux chocs de l'interface d'isolement est appropriée. Dans le cas contraire, C_{LD} = 1. Voir aussi la Note 5.

NOTE 6 Une interface d'isolement fait partie d'un réseau interne et sa probabilité de défaillance peut être évaluée en fonction de sa tension de tenue. Un parafoudre qui protège l'interface d'isolement, s'il est fourni, protège même le matériel en aval lorsque le réseau interne entre l'interface d'isolement et le matériel est blindé. Lorsque le réseau interne n'est pas blindé et que la tension induite dans cette boucle, calculée selon le NPF exigé, est supérieure à la tension de choc assignée du matériel, un parafoudre supplémentaire peut être utilisé pour protéger le matériel en aval.

NOTE 7 Dans l'évaluation de la probabilité P_C, les valeurs de C_{LD} données dans le Tableau B.9 se réfèrent aux réseaux internes blindés. La valeur de C_{LD} d'un réseau interne non blindé qui n'est pas connecté à des lignes extérieures ou à des lignes optiques, ou qui est connecté à des lignes extérieures qui comportent des câbles de protection contre la foudre ou à des systèmes qui comportent des câblages dans des conduits ou canalisations métalliques de câble de protection contre la foudre, reliés à la borne d'équipotentialité à laquelle le matériel est connecté, est égale à la probabilité selon laquelle la tension induite U_I est inférieure ou égale à la tension de choc assignée U_w du réseau interne ($U_I \leq U_w$). Pour l'évaluation de la tension induite U_I, voir l'IEC 62305-4:2024, Annexes A et H. Dans les autres cas, il est admis par hypothèse que C_{LD} = 1.

B.6 Probabilité P_M qu'un impact à proximité d'une structure entraîne des défaillances des réseaux internes

Un SPF maillé, des écrans, des précautions de cheminement, une tension de tenue améliorée, des interfaces d'isolement et des systèmes de protection par parafoudres coordonnés sont appropriés comme mesures de protection pour réduire P_M.

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La probabilité P_M de défaillance des réseaux internes due à un impact à proximité d'une structure dépend des MPF adoptées (voir l'IEC 62305-4).

Si aucun système de protection par parafoudres coordonnés conforme aux exigences de l'IEC 62305-4 n'est prévu, la valeur de P_M est égale à la valeur de P_{MS}.

Si un système de protection par parafoudres coordonnés conforme à l'IEC 62305-4 est prévu, la valeur de P_M est donnée par:

$$P_M = P_{SPD} \times P_{MS} \quad \text{(B.6)}$$

Pour les réseaux internes dont les matériels ne satisfont pas aux normes de produits applicables en matière de résistivité ou de niveau de tension de tenue, il convient de formuler l'hypothèse $P_M = 1$.

P_{SPD} dépend du système de protection par parafoudres coordonnés, de la surface de boucle du circuit du parafoudre et de l'appareil à protéger. Les valeurs de P_{SPD} sont indiquées dans le Tableau B.7 et dans le Tableau B.8.

NOTE 2 En raison des très faibles valeurs de charge prévisible qui circulent dans le parafoudre par rapport à ce à quoi un parafoudre habituel choisi peut résister, P_{SPD} est la probabilité que la valeur de la tension résiduelle dépasse le niveau de protection exigé qui correspond au courant qui circule dans le parafoudre (P_{Up}); cette probabilité dépend de la surface de boucle A du circuit du parafoudre et de l'appareil, et de la tension de choc assignée U_W de l'appareil à protéger. Des règles simplifiées sont données à titre de recommandation générale dans l'IEC 62305-4:2024, Annexe C.

Les valeurs de P_{MS} sont obtenues à partir du produit:

$$P_{MS} = (K_{S1} \times K_{S2} \times K_{S3})^2 \quad \text{(B.7)}$$

où

K_{S1} prend en compte l'efficacité de l'écran de la structure, du SPF ou d'autres écrans à la frontière de la ZPF 0/1;

K_{S2} prend en compte l'efficacité des écrans internes de la structure à la frontière de la ZPF X/Y (X > 0, Y > 1);

K_{S3} prend en compte les caractéristiques du câblage interne (voir le Tableau B.10).

NOTE 3 Dans l'Équation (B.6), K_{S4} (qui était lié à la tension de tenue aux chocs du réseau à protéger dans les éditions précédentes du présent document) est égal à 1, car la tension de tenue est déjà prise en compte dans le calcul de N_M.

NOTE 4 $K_{S3} = S/50$,

où

$S = w \times l$ est la surface de boucle;

w (m) est la largeur du circuit interne;

l (m) est la longueur du circuit interne.

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Dans une ZPF, à une distance de sécurité de l'écran de limite au moins égale à la largeur de maille w_m, les facteurs K_{S1} et K_{S2} pour le SPF ou pour les blindages spatiaux maillés peuvent être évalués comme suit:

$$K_{S1} = 0{,}12 \times w_{m1} \quad \text{(B.8)}$$

$$K_{S2} = 0{,}12 \times w_{m2} \quad \text{(B.9)}$$

où w_{m1} (m) et w_{m2} (m) sont les largeurs de maille du blindage spatial maillé ou des conducteurs de descente maillés de type SPF, ou encore la distance de séparation entre les colonnes métalliques de la structure ou entre les armatures en béton armé qui font office de SPF naturel.

Pour les blindages électromagnétiques métalliques continus d'une épaisseur supérieure ou égale à 0,1 mm, $K_{S1} = K_{S2} = 10^{-4}$.

NOTE 5 Lorsqu'il est prévu un réseau d'équipotentialité maillé conforme à l'IEC 62305-4, les valeurs de K_{S1} et K_{S2} peuvent être divisées par deux.

Si une boucle d'induction est active à proximité des conducteurs blindés à la frontière d'une ZPF, à une distance du blindage plus faible que la distance de sécurité, les valeurs de K_{S1} et K_{S2} sont plus élevées. Par exemple, pour les distances comprises entre 0,1 w_m et 0,2 w_m par rapport au blindage, il convient de doubler les valeurs de K_{S1} et K_{S2}.

Pour une cascade de ZPF, la valeur finale K_{S2} est le produit des valeurs correspondantes K_{S2} de chaque ZPF.

NOTE 6 La valeur maximale de K_{S1} et de K_{S2} est limitée à 1.

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Tableau B.10 – Valeur du facteur K_{S3} en fonction du câblage interne

Type de câblage interne	K_{S3} [a]
Câble non blindé – Pas de précaution de cheminement afin d'éviter des boucles[b]	1
Câble non blindé – Précaution de cheminement afin d'éviter des boucles de grande taille[c]	0,5
Câble non blindé – Précaution d'acheminement afin d'éviter des boucles de grande taille[d]	0,2
Câble non blindé – Précaution d'acheminement afin d'éviter des boucles[e]	0,01
Câbles blindés et câbles acheminés par des conduits métalliques[f]	0,000 1

[a] Données relatives à des circuits de 100 m de longueur. Pour les circuits plus courts, les valeurs de K_{S3} peuvent être réduites proportionnellement.

[b] Conducteurs en boucle avec différents acheminements (espacement entre conducteurs sous tension et conducteur PE ≥ 0,5 m) dans de grands bâtiments (surface de boucle de l'ordre de 50 m^2).

[c] Conducteurs en boucle acheminés dans le même conduit (espacement entre conducteurs sous tension et conducteur PE ≤ 0,25 m) ou conducteurs en boucle avec différents acheminements dans de petits bâtiments (surface de boucle de l'ordre de 25 m^2).

[d] Conducteurs en boucle acheminés dans le même conduit (espacement entre conducteurs sous tension et conducteur PE ≤ 0,1 m) ou conducteurs en boucle avec différents acheminements dans de petits bâtiments (surface de boucle de l'ordre de 10 m^2).

[e] Conducteurs en boucle acheminés dans le même câble (espacement entre conducteurs sous tension et conducteur PE de l'ordre de 0,005 m) (surface de boucle de l'ordre de 0,5 m^2).

[f] Blindages et conduits métalliques reliés à une borne d'équipotentialité aux deux extrémités, et matériel connecté à la même borne d'équipotentialité.

B.7 Probabilité P_U qu'un impact sur une ligne entraîne des dommages dus à des tensions de contact

Les valeurs de probabilité P_U qu'un impact sur une ligne entraîne des dommages dus à des tensions de contact à l'intérieur de la structure dépendent des caractéristiques du blindage de la ligne, de la tension de tenue aux chocs des réseaux internes connectés à la ligne, des mesures de protection telles que les restrictions physiques ou les panneaux d'avertissement et des interfaces d'isolement ou des parafoudres prévus pour le réseau d'équipotentialité à l'entrée de la ligne conformément à l'IEC 62305-3.

NOTE 1 Un système de protection par parafoudres coordonnés conforme à l'IEC 62305-4 n'est pas nécessaire pour réduire P_U. Dans ce cas, des SPD conformes à l'IEC 62305-3 sont suffisants.

Les valeurs de P_U sont données par:

$$P_U = P_{am} \times P_{EB} \times P_{LD} \times P_{TWS} \times C_{LD} \times r_t \quad \text{(B.10)}$$

où

P_{am} dépend des mesures de protection contre les tensions de contact, telles que restrictions physiques ou panneaux d'avertissement. Les valeurs de P_{am} sont données dans le Tableau B.1;

P_{TWS} est la probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible;

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NOTE 2 L'objet d'un message d'alerte créé par un TWS est d'assurer une évacuation immédiate et complète de la zone exposée. Si cette évacuation n'est pas assurée ou si aucun TWS n'est prévu, ou si le fabricant ne déclare pas le FTWR, il est admis par hypothèse que $P_{TWS} = 1$ (voir aussi l'IEC 62305-1:2024, 7.1 pour les restrictions d'application d'un TWS).

NOTE 3 La déconnexion est une option qui peut être utilisée dans le cadre d'une évaluation au cas par cas, compte tenu de la tension générée en l'absence de protection contre les tensions de choc. La déconnexion peut être valable pour les chocs en provenance des lignes (directs ou induits). Voir l'IEC 62305-1 pour plus d'informations.

P_{LD} est la probabilité de défaillances des réseaux internes dues à un impact sur la ligne connectée en fonction des caractéristiques de la ligne. Les valeurs de P_{LD} sont données dans le Tableau B.11 et dans le Tableau B.12;

NOTE 4 Les valeurs de P_{LD} peuvent être calculées à l'aide des équations suivantes:

$P_{LD} = P(I)$

$I = U_w/(4 \times R_s \times \sqrt{\rho} \times 10^{-3})$

où

I est le courant de crête des premiers coups de foudre positif et négatif (kA);

R_s est la résistance par unité de longueur de la gaine (Ω/km);

ρ est la résistivité du sol (Ω · m).

P_{EB} dépend de la liaison équipotentielle conforme à l'IEC 62305-3. Les valeurs de P_{EB} sont indiquées dans le Tableau B.13;

NOTE 5 $P_{EB} = P_Q$

C_{LD} est un facteur qui dépend des conditions de blindage, de mise à la terre et d'isolement de la ligne. Les valeurs de C_{LD} sont données dans le Tableau B.9;

r_t est le facteur de réduction en fonction du type de surface du sol ou du plancher. Les valeurs de r_t sont données dans le Tableau B.2.

NOTE 6 Lorsqu'un ou plusieurs SPD conformes à l'IEC 62305-3 sont prévus pour la liaison équipotentielle à l'entrée de la ligne, la mise à la terre et l'équipotentialité réalisées conformément à l'IEC 62305-4 peuvent améliorer la protection.

Tableau B.11 – Valeur de la probabilité P_{LD} en fonction de la résistance R_S de l'écran du câble et de la tension de tenue aux chocs U_W du matériel

Conditions de cheminement, de blindage et de mise à la terre		Tension de tenue U_W en kV							
		0,35	0,5	1	1,5	2,5	4	6	12
		P_{LD}							
Ligne aérienne ou enterrée, non blindée ou blindée, dont le blindage n'est pas relié à la borne d'équipotentialité à laquelle le matériel est connecté		1	1	1	1	1	1	1	1
Câble blindé aérien ou enterré, dont le blindage est relié à la borne d'équipotentialité à laquelle le matériel est connecté	5 Ω/km < R_S ≤ 20 Ω/km	1	1	1	1	0,95	0,9	0,8	0,4
	1 Ω/km < R_S ≤ 5 Ω/km	1	1	0,9	0,8	0,6	0,3	0,1	0,02
	R_S ≤ 1 Ω/km	1	0,85	0,6	0,4	0,2	0,04	0,02	0,005

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Tableau B.12 – Valeur de la probabilité P_{LD} en fonction de la résistance R_S de l'écran du câble et de la tension de tenue aux chocs supérieure U_W du matériel

Conditions de cheminement, de blindage et de mise à la terre		Tension de tenue U_W en kV					
		16	20	40	60	75	95
		P_{LD}					
Ligne aérienne ou enterrée, non blindée ou blindée, dont le blindage n'est pas relié à la borne d'équipotentialité à laquelle le matériel est connecté		1	1	1	1	1	1
Câble blindé aérien ou enterré, dont le blindage est relié à la borne d'équipotentialité à laquelle le matériel est connecté	5 Ω/km < R_S ≤ 20 Ω/km	0,3	0,15	0,03	0,01	0,007	0,005
	1 Ω/km < R_S ≤ 5 Ω/km	0,01	0,007	0,001 5	0,001	4×10^{-4}	2×10^{-4}
	R_S ≤ 1 Ω/km	0,002	0,001 5	4×10^{-4}	$1,5 \times 10^{-4}$	10^{-4}	$0,7 \times 10^{-4}$

NOTE 7 En zone suburbaine et urbaine, une ligne de puissance BT utilise généralement un câble non blindé enterré tandis qu'une ligne de communication utilise un câble blindé enterré (avec un nombre minimal de 20 conducteurs, une résistance de blindage de 5 Ω/km et un diamètre du fil de cuivre de 0,6 mm). Dans les zones rurales, une ligne de puissance BT et une ligne de communication utilisent chacune un câble non blindé aérien (diamètre du fil de cuivre: 1 mm). Une ligne de puissance HT enterrée utilise généralement un câble blindé de résistance de blindage de l'ordre de 1 Ω/km à 5 Ω/km. Les informations fournies par la présente note peuvent être améliorées après une étude plus approfondie.

NOTE 8 Des valeurs inférieures à celles indiquées dans le Tableau B.11 et dans le Tableau B.12 peuvent être attribuées à la probabilité P_{LD} lorsque l'écran de la ligne est relié aux deux extrémités au même système de mise à la terre.

Tableau B.13 – Valeurs types de probabilité P_{EB} qui correspondent au NPF pour lequel le parafoudre est conçu pour protéger contre la source de dommages S3

NPF	Lignes de puissance kA 10/350 µs	Lignes de communication kA 10/350 µs	P_{EB}
Absence de parafoudre			1
III à IV	5	1	0,05
II	7,5	1,5	0,02
I	10	2	0,01
NOTE Pour obtenir des informations sur les valeurs de courant et les conditions spécifiques, voir l'IEC 62305-1:2024, Tableaux E.1 et E.2.			

NOTE 9 Des valeurs de P_{EB} inférieures à celles du Tableau B.13 sont possibles si les valeurs de I_{imp} et de I_n pour lesquelles les parafoudres sont conçus sont supérieures à celles qui sont exigées pour le NPF I.

B.8 Probabilité P_V qu'un impact sur une ligne entraîne des dommages physiques par incendie ou explosion

Les valeurs de probabilité P_V qu'un impact sur une ligne qui entre dans la structure entraîne des dommages physiques par incendie ou explosion dépendent des caractéristiques du blindage de la ligne, de la tension de tenue aux chocs des réseaux internes connectés à la ligne et des interfaces d'isolement ou des parafoudres prévus pour le réseau d'équipotentialité

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NOTE 1 Un système de protection par parafoudres coordonnés conforme à l'IEC 62305-4 n'est pas nécessaire pour réduire P_V. Dans ce cas, des SPD conformes à l'IEC 62305-3 sont suffisants.

La valeur de P_V est donnée par:

$$P_V = P_{EB} \times P_{LD} \times P_{TWS} \times C_{LD} \times r_f \times r_p \quad \text{(B.11)}$$

où

P_{LD} est la probabilité de défaillances des réseaux internes dues à un impact sur la ligne connectée en fonction des caractéristiques de la ligne. Les valeurs de P_{LD} sont données dans le Tableau B.11 et dans le Tableau B.12;

P_{TWS} est la probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible;

NOTE 2 L'objet d'un message d'alerte créé par un TWS est d'assurer une évacuation immédiate et complète de la zone exposée. Si cette évacuation n'est pas assurée ou si aucun TWS n'est prévu, ou si le fabricant ne déclare pas le FTWR, il est admis par hypothèse que $P_{TWS} = 1$ (voir aussi l'IEC 62305-1:2024, 7.1 pour les restrictions d'application d'un TWS).

NOTE 3 La déconnexion est une option qui peut être utilisée dans le cadre d'une évaluation au cas par cas, compte tenu de la tension générée en l'absence de protection contre les tensions de choc. La déconnexion peut être valable pour les chocs en provenance des lignes (directs ou induits). Voir l'IEC 62305-1 pour plus d'informations.

P_{EB} dépend de la liaison équipotentielle conforme à l'IEC 62305-3. Les valeurs de P_{EB} sont données dans le Tableau B.13;

C_{LD} est un facteur qui dépend des conditions de blindage, de mise à la terre et d'isolement de la ligne. Les valeurs de C_{LD} sont données dans le Tableau B.9;

r_p est le facteur de réduction en fonction des dispositions prises pour réduire les conséquences d'un incendie. Les valeurs de r_p sont données dans le Tableau B.5;

r_f est le facteur de réduction en fonction du risque d'incendie ou d'explosion de la structure. Les valeurs de r_f sont données dans le Tableau B.6.

NOTE 4 Lorsqu'un coup de foudre frappe directement un service extérieur enterré, ce service peut être endommagé (dommages mécaniques, incendie, etc.) ou le câble peut être perforé en plusieurs endroits sur sa longueur, ce qui entraîne une détérioration sur le long terme (corrosion, par exemple). Ces dommages n'entrent pas dans le domaine d'application du présent document, qui examine uniquement l'incidence des services sur la structure à l'étude.

B.9 Probabilité P_W qu'un impact sur une ligne entraîne des défaillances des réseaux internes

Les valeurs de probabilité P_W qu'un impact sur une ligne qui entre dans la structure entraîne des défaillances des réseaux internes dépendent des caractéristiques du blindage de la ligne, de la tension de tenue aux chocs des réseaux internes connectés à la ligne et des interfaces d'isolement ou du système de protection par parafoudres coordonnés installé.

La valeur de P_W est donnée par:

$$P_W = P_{SPD} \times P_{TWS} \times P_{LD} \times C_{LD} \quad \text{(B.12)}$$

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où

P_{SPD} dépend du système de protection par parafoudres coordonnés. Les valeurs de P_{SPD} sont données dans le Tableau B.7 et dans le Tableau B.8;

P_{TWS} est la probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible;

NOTE L'objet d'un message d'alerte créé par un TWS est d'assurer une évacuation immédiate et complète de la zone exposée. Si cette évacuation n'est pas assurée ou si aucun TWS n'est prévu, ou si le fabricant ne déclare pas le FTWR, il est admis par hypothèse que $P_{TWS} = 1$ (voir aussi l'IEC 62305-1:2024, 7.1 pour les restrictions d'application d'un TWS).

P_{LD} est la probabilité de défaillances des réseaux internes dues à un impact sur la ligne connectée en fonction des caractéristiques de la ligne. Les valeurs de P_{LD} sont données dans le Tableau B.11 et dans le Tableau B.12;

C_{LD} est un facteur qui dépend des conditions de blindage, de mise à la terre et d'isolement de la ligne. Les valeurs de C_{LD} sont données dans le Tableau B.9.

B.10 Probabilité P_Z qu'un impact à proximité d'une ligne entrante entraîne des défaillances des réseaux internes

Les valeurs de probabilité P_Z de défaillances des réseaux internes dues à un impact de foudre à proximité d'une ligne qui entre dans la structure dépendent des caractéristiques du blindage de la ligne et des interfaces d'isolement ou du système de protection par parafoudres coordonnés.

La valeur de P_Z est donnée par:

$$P_Z = P_{SPD} \times P_{TWS} \times C_{LI} \quad \text{(B.13)}$$

où

P_{SPD} dépend du système de protection par parafoudres coordonnés. Les valeurs de P_{SPD} sont données dans le Tableau B.7 et dans le Tableau B.8;

P_{TWS} est la probabilité qu'un système d'alerte aux orages (TWS) ne détecte pas un phénomène de foudre dans la zone cible;

NOTE Si un TWS génère un message d'alerte, il n'est considéré comme efficace que si la déconnexion immédiate et complète des lignes de distribution extérieures est assurée. Si cette déconnexion n'est pas assurée ou si aucun TWS n'est prévu, il peut être admis par hypothèse que $P_{TWS} = 1$.

C_{LI} est un facteur qui dépend des conditions de blindage, de mise à la terre et d'isolement de la ligne. Les valeurs de C_{LI} sont données dans le Tableau B.9.

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B.11 Probabilité P_P qu'une personne se trouve à un emplacement dangereux

La probabilité P_P qu'une personne se trouve à un emplacement dangereux dépend du temps t_z en heures par an pendant lequel les personnes sont présentes à cet emplacement dangereux:

$$P_P = t_z / 8\,760 \quad \text{(B.14)}$$

NOTE 1 Lorsque la valeur de t_z est inconnue, le rapport t_z/8 760 = 1.

NOTE 2 Lorsqu'un TWS permet l'évacuation temporaire d'une zone, t_z est multiplié par P_{TWS}.

B.12 Probabilité P_e qu'un matériel soit exposé à un événement provoquant des dommages

La probabilité P_e qu'un matériel non endommagé soit exposé à un événement qui provoque des dommages dépend du temps t_e en heures par année d'exposition du matériel à l'événement qui provoque des dommages.

$$P_e = t_e / 8\,760 \quad \text{(B.15)}$$

NOTE 1 Lorsque la valeur de t_e est inconnue, le rapport t_e/8 760 = 1.

NOTE 2 Dans le cas d'une zone explosive P_e peut être calculé en tant que $P_e = (t_e / 8\,760) \times r_f$ (r_f faisant référence au temps de présence maximal d'une atmosphère explosive divisé par 8 760) lors du calcul des composantes de risque. Cela ne s'applique pas au calcul de la fréquence des dommages, pour lequel seule la probabilité P_e est utilisée.

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Annexe C
(informative)

Évaluation des pertes L_X

C.1 Généralités

L_X représente l'étendue moyenne des pertes dues à un événement dangereux, exprimée de manière relative par rapport à l'étendue maximale des pertes dans la zone à risque concernée de la structure à protéger.

Il convient de choisir les valeurs de L_X en fonction du type de structure, d'après sa fonction ou son contenu, ou les deux, de l'incidence sur la population de la perte de la structure (coûts des mesures d'urgence destinées à limiter les dommages, coûts entraînés par la perte de la structure et de la production, coûts de reconstruction et frais généraux que la société doit supporter, par exemple).

Il convient que les valeurs des pertes L_X soient estimées et fixées par le concepteur de la protection contre la foudre (ou par le propriétaire de la structure). Les valeurs moyennes des pertes L_X dans une structure données dans la présente Annexe C sont des valeurs types. D'autres valeurs peuvent être attribuées après une étude approfondie.

NOTE 1 Lorsque les dommages sur une structure dus à la foudre peuvent également impliquer des structures environnantes ou l'environnement (propagation d'un incendie, explosion, émissions chimiques ou radioactives, par exemple), une évaluation plus approfondie de L_X qui tient compte de ces pertes complémentaires peut être effectuée. Voir l'Annexe E.

NOTE 2 Il est rare que la perte de vies humaines ne soit pas du tout prise en compte, car du personnel est présent (au moins pendant certaines périodes) dans la plupart des structures (équipe de maintenance ou personnel de sécurité, par exemple). La présence humaine est presque constante dans d'autres structures telles que les édifices patrimoniaux nationaux ou les bâtiments de bureaux qui accueillent des employés et des visiteurs.

Il est souligné que le risque global relatif à une structure ou une application donnée est la plupart du temps constitué de plusieurs composantes de risque. Toutefois, pour calculer uniquement le risque de perte de vies humaines (blessures permanentes comprises), l'une ou les deux pertes relatives moyennes suivantes peuvent être fixées à la valeur 0:

L_{F2} est le rapport type moyen des dommages physiques provoqués par un incendie ou une explosion;

L_{O2} est le rapport type moyen des dommages physiques provoqués par une défaillance des réseaux internes.

De la même manière, pour calculer uniquement le risque en prenant pour hypothèse qu'il n'existe aucun risque de perte de vies humaines (blessures permanentes comprises), il est admis de fixer une ou plusieurs des pertes relatives moyennes suivantes à la valeur 0:

L_T est le rapport type moyen du nombre de personnes blessées par des tensions de contact et de pas;

L_D est le rapport type moyen du nombre de personnes blessées par un coup de foudre direct;

L_{F1} est le rapport type moyen du nombre de personnes blessées par un incendie ou une explosion;

L_{O1} est le rapport type moyen du nombre de personnes blessées par une défaillance des réseaux internes.

Les autres paramètres sont calculés en fonction de l'application.

C.2 Pertes relatives moyennes par événement dangereux

Les pertes L_X se réfèrent à l'étendue relative moyenne d'un type particulier de perte pour un événement dangereux dû à un impact de foudre, compte tenu de son étendue et de ses effets consécutifs.

La valeur des pertes L_X varie avec la cause du dommage (D_{1D}, D_{1T}, D_2 et D_3).

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Il convient de déterminer les pertes L_X pour chaque zone à risque qui compose la structure ou pour la structure dans son ensemble.

Les valeurs des pertes L_X pour chaque zone à risque ou pour la structure peuvent être déterminées conformément au Tableau C.1 et au Tableau C.2.

Tableau C.1 – Valeurs des pertes pour chaque zone

Pertes types
$L_{AT} = L_{UT} = L_T$
$L_{AD} = L_D$
$L_{B1} = L_{V1} = L_{F1}$
$L_{B2} = L_{V2} = L_{F2}$
$L_{C1} = L_{M1} = L_{W1} = L_{Z1} = L_{O1}$
$L_{C2} = L_{M2} = L_{W2} = L_{Z2} = L_{O2}$

où

L_T est le rapport type moyen entre le nombre de personnes blessées par des tensions de contact et de pas du fait d'un événement dangereux et le nombre total de personnes dans la zone à risque ou la structure (voir le Tableau C.2);

L_D est le rapport type moyen entre le nombre de personnes blessées par un coup de foudre direct du fait d'un événement dangereux et le nombre total de personnes exposées dans la zone à risque ou la structure (voir le Tableau C.2);

L_{F1} est le rapport type moyen entre le nombre de personnes blessées par un incendie ou une explosion du fait d'un événement dangereux et le nombre total de personnes dans la zone à risque ou la structure (voir le Tableau C.2);

L_{F2} est le rapport type moyen entre les dommages physiques provoqués par un incendie ou une explosion du fait d'un événement dangereux et l'étendue maximale des dommages dans la zone à risque ou la structure (voir le Tableau C.2);

L_{O1} est le rapport type moyen entre le nombre de personnes blessées par une défaillance des réseaux internes du fait d'un événement dangereux et le nombre total de personnes dans la zone à risque ou la structure (voir le Tableau C.2);

L_{O2} est le rapport type moyen entre le nombre de dommages physiques provoqués par une défaillance des réseaux internes du fait d'un événement dangereux et l'étendue maximale des dommages dans la zone à risque ou la structure (voir le Tableau C.2).

NOTE 1 La valeur moyenne type des pertes peut être considérée comme la valeur moyenne des pertes dues à un événement dangereux qui provoque des dommages.

NOTE 2 En ce qui concerne L_{F1} ou L_{O1} et L_{F2} ou $L_{O2,}$ les niveaux de pertes peuvent être différents pour les personnes et pour la structure, ce qui signifie par exemple que pour un hôpital, la valeur L_{F1} peut être choisie dans la première ligne et la valeur L_{F2} dans la deuxième ligne du Tableau C.2, et inversement pour un musée.

NOTE 3 Il est admis d'utiliser $L_{F1} = L_{F2}$ en choisissant la valeur la plus élevée parmi les deux valeurs suggérées dans le Tableau C.2.

NOTE 4 L_T, L_D, L_{F1}, L_{O1} se réfèrent aux êtres humains, tandis que L_{F2} et L_{O2} se réfèrent aux structures et aux réseaux internes.

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Tableau C.2 – Valeurs moyennes types de L_T, L_D, L_{F1}, L_{F2}, L_{O1} et L_{O2}

Type de structures ou de zones à risque	L_T	L_D	L_{F1}	L_{F2}	L_{O1}	L_{O2}
Structures ou zones à risque hautement essentielles ou à pertes très élevées[a]	10^{-2}	10^{-2} – 10^{-1}	10^{-2} – 2×10^{-1}	10^{-2} – 2×10^{-1}	10^{-3} – 10^{-2}	10^{-3} – 10^{-2}
Structures ou zones à risque essentielles ou à pertes élevées[b]			10^{-2} – 10^{-1}	10^{-2} – 10^{-1}	10^{-4} – 10^{-3}	10^{-4} – 10^{-3}
Structures ou zones à risque à pertes normales[c]			5×10^{-3} – 5×10^{-2}	5×10^{-3} – 5×10^{-2}	10^{-5} – 5×10^{-4} [e]	10^{-5} – 5×10^{-4} [e]
Structures ou zones à risque à faibles pertes[d]			2×10^{-3} – 2×10^{-2}	2×10^{-3} – 2×10^{-2}	10^{-5} – 10^{-4} [e]	10^{-5} – 10^{-4} [e]

[a] Telles que les structures ou les zones à risque avec risque d'explosion, les structures ou les zones à risque équipées de matériels de réanimation électriques ou autres structures, lorsque les défaillances des réseaux internes impliquent des risques de blessures sur des êtres humains ou de danger pour l'environnement (blocs opératoires et unités de soins intensifs dans les hôpitaux, par exemple).

[b] Telles que les structures ou les zones à risque liées aux personnes à mobilité réduite (bloc chambres dans les hôpitaux et les prisons, par exemple), les structures ou les zones à risque équipées de matériels essentiels à la réalisation de certains processus (salle de contrôle dans les structures industrielles, centrale électrique, centre de télécommunications, par exemple) et les structures ou les zones à risque avec un patrimoine culturel (musée, par exemple).

[c] Telles que les structures ouvertes au public (églises, hôtels, écoles, bureaux, bâtiments civils ouverts au public, installations de loisirs, supermarchés, par exemple).

[d] Telles que les bâtiments privés (immeuble d'appartements, ferme, par exemple).

[e] Cela s'applique uniquement lorsque le risque d'explosion ou les défaillances des réseaux internes impliquent des risques de blessures sur des êtres humains ou de danger pour l'environnement (par exemple, défaillance d'un matériel en raison d'un choc qui entraîne un rejet d'eau polluée dans la rivière ou lorsque l'incendie d'un matériel provoqué par un choc peut se propager dans la structure qui comporte des systèmes photovoltaïques ou des tensions en courant continu). En général, les structures ou les zones à risque qui présentent un tel risque sont classées comme étant à pertes très élevées ou à pertes élevées.

Une évaluation plus approfondie peut être nécessaire pour les valeurs de perte (L_{F1}, L_{F2}, L_{O1}, L_{O2}). Les valeurs les plus élevées pour les pertes indiquées dans le Tableau C.2 sont recommandées comme valeurs par défaut. D'autres valeurs peuvent être utilisées en s'appuyant sur une étude ou une expérience spécifique, en particulier si des valeurs inférieures aux valeurs minimales suggérées indiquées dans le Tableau C.2 sont utilisées.

Lorsque des dommages sur une structure dus à la foudre impliquent des structures environnantes ou l'environnement (par exemple, émissions chimiques ou radioactives), il convient de tenir compte des pertes complémentaires L_E pour évaluer les pertes totales (L_{BT} et L_{VT}).

$$L_{BT} = L_B + L_E \quad \text{(C.1)}$$

$$L_{VT} = L_V + L_E \quad \text{(C.2)}$$

où L_E est le rapport type moyen des pertes à l'extérieur de la structure du fait d'un événement dangereux sur l'étendue maximale des pertes dans la zone.

NOTE 5 L_E peut être évalué à l'aide de l'Annexe E.

NOTE 6 Des facteurs d'environnement peuvent également être pris en compte, s'ils sont traités comme une zone

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Annexe D
(informative)

Évaluation de P_{SPD}

D.1 Généralités

Les valeurs indiquées dans le Tableau B.7 et dans le Tableau B.8 s'appliquent aux cas courants. Les valeurs de P_{SPD} fondées sur une analyse plus approfondie peuvent être déterminées selon la présente Annexe D.

La présente Annexe D explique comment le facteur de probabilité P_{SPD} d'un système de protection par parafoudres coordonnés peut être déterminé. Elle est destinée aux applications particulières dans lesquelles des valeurs de P_{SPD} autres que celles données dans le Tableau B.7 et dans le Tableau B.8 sont utilisées.

L'évaluation des valeurs de P_{SPD} par rapport aux différentes sources de dommages (à savoir S1, S2, S3 et S4) est réalisée au moyen de graphiques obtenus à l'aide d'un outil de calcul qui tient compte de l'effet de propagation entre le parafoudre et le matériel à protéger dans le circuit, de la tension induite dans ce même circuit et de la chute de tension dans les câbles de connexion du parafoudre.

Les graphiques font référence à des installations types et à la tension de choc assignée définie du matériel, c'est-à-dire 2,5 kV pour l'accès d'alimentation et 1,5 kV pour l'accès de signalisation d'un matériel. Cela fait office de recommandation quant à l'obtention de P_{SPD} pour d'autres cas à l'aide d'une méthode similaire.

La probabilité P_X que les mesures de protection réduisent les défaillances des réseaux internes dépend de la probabilité P_{SPD} d'un système de protection par parafoudres coordonnés.

Une défaillance d'un matériel protégé par un système de parafoudre peut se produire si:

a) la charge associée au courant I_{SPD} qui traverse le parafoudre dépasse la valeur tolérée par le parafoudre; ou
b) la tension de protection U_p dépasse le niveau de protection exigé U_{pr} du parafoudre afin de réduire la valeur de surtension à l'entrée du matériel à une valeur inférieure ou égale à la tension de choc assignée (U_w) du matériel.

La probabilité qu'une surtension n'endommage pas un matériel protégé par un système de protection par parafoudres coordonnés correspond à la probabilité qu'aucune des conditions (a) et (b) ne se produise.

Soit:

– P_Q: probabilité associée à la source de dommages à l'origine du courant décrit dans la condition (a);
– P_{Up}: probabilité associée à la source de dommages à l'origine de la condition (b).

Alors la probabilité P_{SPD} est donnée par:

$$P_{SPD} = 1 - (1 - P_Q) \times (1 - P_{Up}) \quad \text{(D.1)}$$

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La probabilité P_{SPD} peut être simplifiée comme suit lorsque la probabilité P_Q se réfère aux premiers coups de foudre positif et négatif et que la probabilité P_{Up} se réfère aux impacts suivants des éclairs négatifs (cas le plus défavorable), et lorsque P_Q et P_{Up} sont nettement inférieures à 1:

$$P_{SPD} = P_Q + 0{,}9 \times P_{Up} \quad \text{(D.2)}$$

D.2 Valeurs de P_Q

D.2.1 Valeurs de probabilité des premiers coups de foudre négatif et positif

Les valeurs de probabilité de la charge peuvent être calculées avec les distributions log-normales de la charge du premier coup négatif de courte durée (P_{Q-}, moyenne m = 4,69 et dispersion σ = 0,383) et du premier coup positif de courte durée (P_{Q+}, moyenne m = 17,3, dispersion σ = 0,57) données à l'Annexe A de l'IEC 62305-1:2024, et en combinant les probabilités associées à une valeur de charge donnée, en estimant que 90 % des coups sont négatifs et que 10 % sont positifs. La Figure D.1 montre ce calcul (P_Q).

D.2.2 Source de dommages S1

D'après l'Annexe E de l'IEC 62305-1:2024, la charge de la source de dommages S1 à l'origine du courant de choc I_{imp} dans le parafoudre peut être calculée comme suit:

$$Q = I_{imp} \times n \times n' / k_e \quad \text{(D.3)}$$

où

k_e = $n' \times R_s / (n' \times R_s + R_c)$;

n est le nombre de services qui entrent dans la structure;

n' est le nombre de conducteurs du service concerné;

R_s est la résistance des blindages par unité de longueur du service blindé;

R_c est la résistance des conducteurs par unité de longueur du service;

k_e = 1 pour les conducteurs non blindés.

La valeur de la charge donnée par l'Équation (D.3) est utilisée pour lire, sur la Figure D.1, la probabilité P_Q du courant de choc I_{imp} du parafoudre.

EXEMPLE n = 2 services et n' = 4 conducteurs non blindés, I_{imp} = 10 kA, l'Équation (D.3) donne Q = 80 C et la probabilité P_Q = 0,012 peut être estimée sur la Figure D.1, tandis que lorsque n = 1, pour le même courant de 10 kA, l'Équation (D.3) donne Q = 40 °C et la probabilité P_Q = 0,033 peut être estimée sur la Figure D.1.

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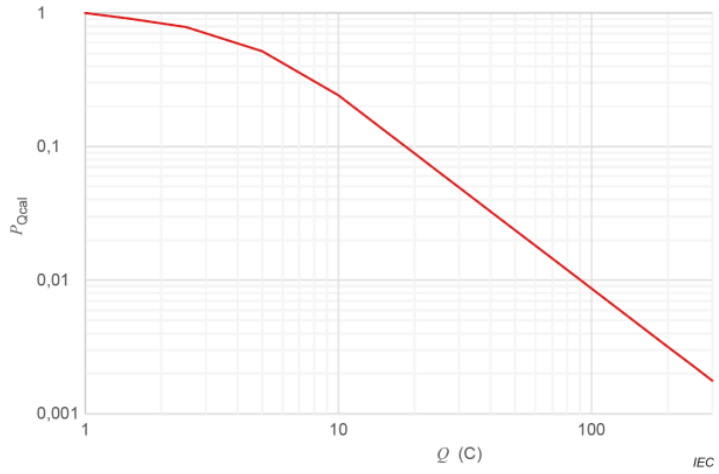


Figure D.1 – Probabilité de charge des premiers coups de foudre négatif et positif

D.2.3 Source de dommages S3

D'après l'Annexe E de l'IEC 62305-1:2024, la charge de la source de dommages S3 à l'origine du courant de choc I_{imp} dans le parafoudre peut être calculée comme suit:

$$Q = 2{,}5 \times n' \times I_{imp} / k_e \qquad \text{(D.4)}$$

La valeur de la charge donnée par l'Équation (D.4) est utilisée pour lire, sur la Figure D.1, la probabilité P_Q du courant de choc I_{imp} du parafoudre.

EXEMPLE 1 n' = 2 conducteurs non blindés. Pour une ligne de communication, lorsque I_{imp} = 10 kA, l'Équation (D.4) donne Q = 50 C et la Figure D.1 donne P_{Q1} = 0,024. Pour une ligne de communication, lorsque I_{imp} = 2,5 kA, l'Équation (D.4) donne Q = 12,5 °C et la Figure D.1 donne P_Q = 0,175.

Dans le cas spécifique d'une ligne de communication à deux conducteurs (une paire), appelée ci-après "ligne de communication conventionnelle", il est courant que la longueur (l_1) de la section des deux conducteurs qui entre dans la structure soit égale à environ 10 % de la longueur totale (environ 4 km à 5 km de longueur totale, en règle générale), alors que les autres sections comportent de nombreuses paires, par exemple plusieurs centaines. Dans ce cas, la valeur de probabilité P_Q peut être évaluée spécifiquement en lien avec la section des deux conducteurs de la manière suivante:

$$P_Q = 0{,}1 \times P_{Q1} \qquad \text{(D.5)}$$

où P_{Q1} est la probabilité de la charge donnée par l'Équation (D.4).

EXEMPLE 2 n' = 2 conducteurs non blindés. Pour une ligne de communication conventionnelle, lorsque I_{imp} = 1 kA, l'Équation (D.4) donne Q = 5 C et la Figure D.1 donne P_{Q1} = 0,52, et il est alors possible d'utiliser l'Équation (D.5) qui donne P_Q = 0,052.

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D.2.4 Sources de dommages S2 et S4

D'après les valeurs de courant induit imputables à la source de dommages S2 ou S4 données dans le Tableau B.7 et dans le Tableau B.8 ou dans le Tableau E.2 et dans le Tableau E.3 de l'IEC 62305-1:2024, et étant donné que les parafoudres types utilisés ont une valeur de courant nominal de décharge I_n = 5 kA, les valeurs de probabilité P_{QM} et P_{QZ} sont d'environ 10^{-4} à 10^{-5} (quasiment négligeables).

D.3 Niveau de protection par parafoudre

D.3.1 Généralités

Pour les besoins du présent document, les parafoudres à coupure de tension et à limitation de tension sont définis comme suit:

– parafoudre à coupure de tension: parafoudre qui présente une impédance élevée en l'absence de choc, mais qui peut chuter rapidement en réponse à un choc de tension;

– parafoudre à limitation de tension: parafoudre qui présente une impédance élevée en l'absence de choc, mais qui diminue de manière continue avec un courant et une tension de choc croissants.

D.3.2 Source de dommages S1

D.3.2.1 Un parafoudre à limitation de tension

La valeur P_{Up} est obtenue pour un courant de 1 kA (comme P_{Up} concerne les coups suivants) et la tension résiduelle à 1 kA est appelée U_p' ci-après.

NOTE 1 Cette valeur peut être obtenue à partir de la fiche technique du parafoudre et, en cas d'indisponibilité, une approximation courante consiste à prendre la tension résiduelle à 5 kA et à la réduire de 200 V.

Les valeurs de P_{Up} en fonction de la tension résiduelle à 1 kA (U_p') sont indiquées sur la Figure D.2 pour différentes valeurs de paramètre k_{1i}, lorsque U_w = 2,5 kV, l_c = 0,5 m, $n \times n' \geq 8$ et $k_r > 1$.

où

k_{1i} = $w \times k_c \times l_{eq} / d$;

l_{eq} = $l_v + k_o \times l_o$ [m] (voir l'Annexe H de l'IEC 62305-4:2024);

l_v et l_o sont les longueurs (m) de la boucle d'induction entre le parafoudre et le matériel qui sont respectivement parallèle et orthogonale aux conducteurs de descente;

l_o' = $k_o \times l_o = [l_o \times w \times \ln(d + l_o) / d]/[l_o \times \ln(d + w) / d]$ [m];

w est la largeur (m) du réseau interne;

k_c est la répartition du courant entre les conducteurs de descente;

d est la distance (m) entre la boucle d'induction et le conducteur de descente le plus proche;

k_r est le coefficient de réflexion;

k_0 est le rapport entre les tensions induites dans une boucle orthogonale et dans une boucle parallèle au conducteur de descente.

NOTE2 Selon le Tableau B.10, un câble blindé peut être représenté par w = 0,000 05 m.

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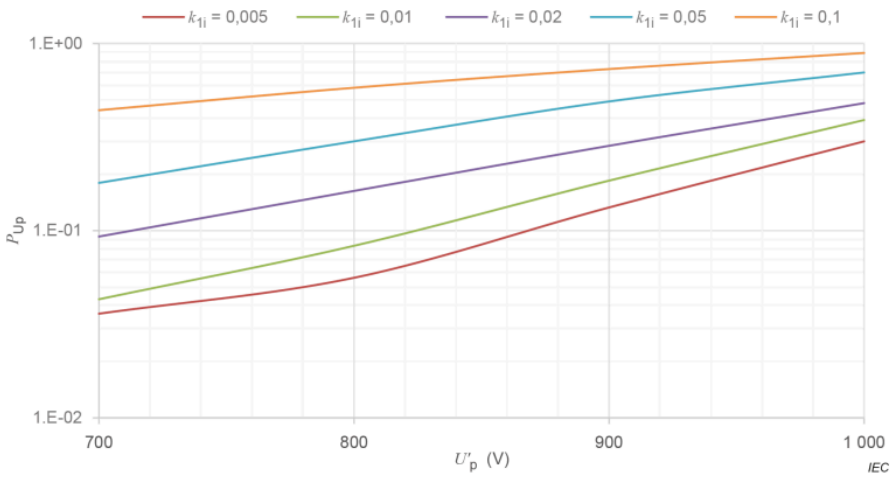


Figure D.2 – Probabilité P_{Up} en fonction de la tension résiduelle U_p' 1 kA du parafoudre

EXEMPLE n = 2, n' = 4, w = 0,005 m, k_c = 0,44, d = 1 m, l_v = 6 m, l_o = 44 m, l_c = 0,5 m, U_w = 2,5 kV. Dans ce cas, l_o' = 3,8 m, l_{eq} = 9,8 m, k_{1i} = 0,02 et, en choisissant un parafoudre à limitation de tension avec U_p' = 900 V, la Figure D.2 indique P_{Up} ≈ 0,3.

D.3.2.2 Un parafoudre à coupure de tension

Les parafoudres à coupure de tension sont généralement utilisés sur les lignes de communication à l'entrée de la structure et les niveaux de protection des tubes à décharge de gaz (GDT, *Gas Discharge Tubes*) sont habituellement de 700 V ou 550 V.

La Figure D.3 indique les valeurs de P_{Up} en fonction de différentes valeurs de paramètre k_{1i} pour les deux valeurs U_p habituelles des GDT, à savoir 700 V et 550 V, lorsque U_w = 1,5 kV, l_c = 0,5 m, k_r > 1, n' ≥ 20 conducteurs.

NOTE Les valeurs U_p sont données pour 1 kV/µs (voir l'EC 61643-21).

EXEMPLE n = 2, n' = 20, w = 0,1 m, k_c = 0,1, d = 2 m, l_v = 5 m, l_o = 21 m, l_c = 0,5 m, U_w = 1,5 kV. Dans ce cas, l_{eq} = 10 m, k_{1i} = 0,05 et, en choisissant un parafoudre à coupure de tension avec U_p = 550 V, la Figure D.3 indique P_{Up} ≈ 0,3.

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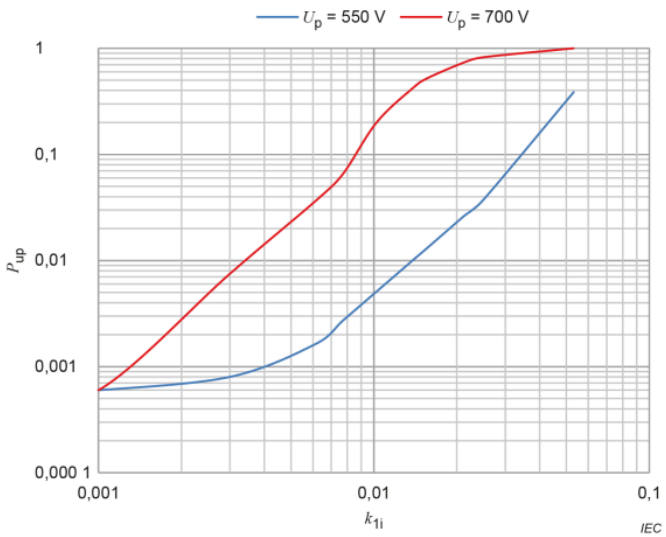


Figure D.3 – Probabilité P_{Up} en fonction de k_{1i}

D.3.2.3 Association d'un parafoudre à limitation de tension et d'un parafoudre à coupure de tension

Lorsque la puissance est répartie conformément au réseau TT, un parafoudre soumis à des essais de classe I peut être installé en amont du DDR. Cependant, la protection contre les contacts directs nécessite alors l'installation d'un parafoudre à coupure de tension entre les conducteurs de neutre et les conducteurs PE (N-PE) en complément des parafoudres à limitation de tension entre les conducteurs de neutre et les conducteurs de phases. Dans ce cas, il est admis de prendre pour hypothèse que la valeur de P_{Up} est la valeur la plus élevée de celles liées aux parafoudres à limitation de tension ou à coupure de tension.

En ce qui concerne les installations types où U_w = 2,5 kV et U_p = 1,5 kV du parafoudre à coupure de tension, une protection avec un parafoudre ne peut être obtenue que lorsque k_r = 1, c'est-à-dire lorsque la distance entre le parafoudre et le matériel à protéger est inférieure à 10 m et que l'endommagement du matériel n'entraîne aucun danger pour les personnes. Dans ce cas, la valeur de P_{Up} est celle liée au parafoudre à limitation de tension; les valeurs de P_{Up} pour une installation type sont indiquées dans le Tableau D.1 en fonction du niveau de protection à 1 kA du parafoudre à limitation de tension.

Tableau D.1 – Valeurs de P_{Up} du parafoudre à limitation de tension en cas d'association entre un parafoudre à limitation de tension et un parafoudre à coupure de tension

n	n'	w m	d m	L_v m	L_o m	L_a m	k_c	k_r	U_p' kV	P_{Up}
2	4	0,005	1	2	8	10	0,44	1	0,8	0,005
									1	0,007
									1,2	0,009
Lorsque w = 0,1 m, il convient de multiplier les valeurs de P_{Up} par un facteur de 60.										

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Lorsque k_r > 1, un second parafoudre à limitation de tension doit être installé pour protéger l'accès d'alimentation du matériel.

D.3.2.4 Deux parafoudres à limitation de tension

Lorsque la valeur de probabilité P_{SPD} nécessaire ne peut pas être atteinte par un seul parafoudre à l'entrée du service dans la structure, il convient d'installer un second parafoudre à limitation de tension (SPD2), qui peut résister à une charge coordonnée avec celle du premier parafoudre.

La probabilité P_{SPD} de ce système de protection par parafoudres coordonnés est obtenue en additionnant la probabilité P_Q du premier parafoudre et la probabilité P_{Up} du second parafoudre selon l'Équation (D.2).

Ces valeurs de P_{Up} en fonction du niveau de protection à 1 kA (U_p') du SPD2 sont indiquées sur la Figure D.4 pour différentes valeurs de paramètre k_{1i}, lorsque U_w = 2,5 kV, l_c = 0,5 m, $n \times n' \geq 8$ et k_r > 1.

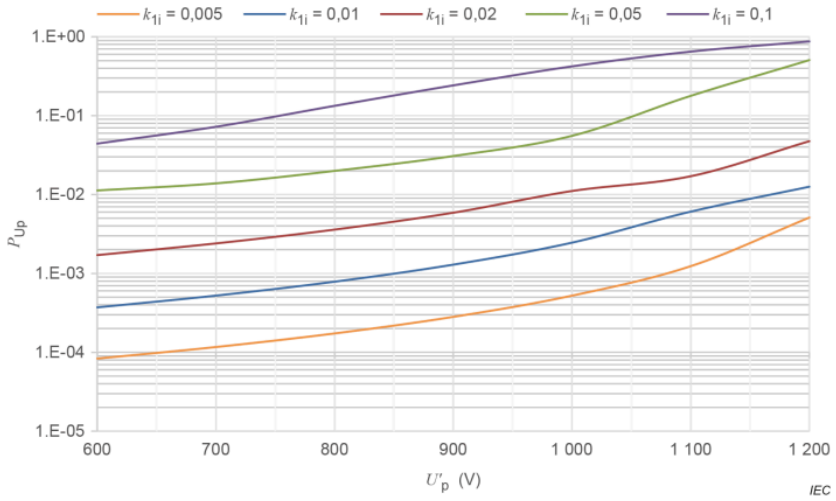


Figure D.4 – Probabilité P_{Up} en fonction de la tension résiduelle U_p' à 1 kA du SPD2

D.3.2.5 Deux parafoudres: un parafoudre à coupure de tension et un parafoudre à limitation de tension

Lorsque la valeur de probabilité P_{SPD} exigée ne peut pas être atteinte par un seul parafoudre à coupure de tension à l'entrée du service dans la structure, un second parafoudre à limitation de tension (SPD2), qui peut résister à une charge coordonnée avec celle du premier parafoudre, doit être installé.

La probabilité P_{SPD} de ce système de protection par parafoudres coordonnés est obtenue en additionnant la probabilité P_Q du premier parafoudre et la probabilité P_{Up} du second parafoudre selon l'Équation (D.2).

Ces valeurs de P_{Up} en fonction de la tension résiduelle à 1 kA (U_p') du SPD2 sont indiquées sur la Figure D.5 pour différentes valeurs de paramètre k_{1i}, lorsque U_w = 1,5 kV, l_c = 0,5 m,

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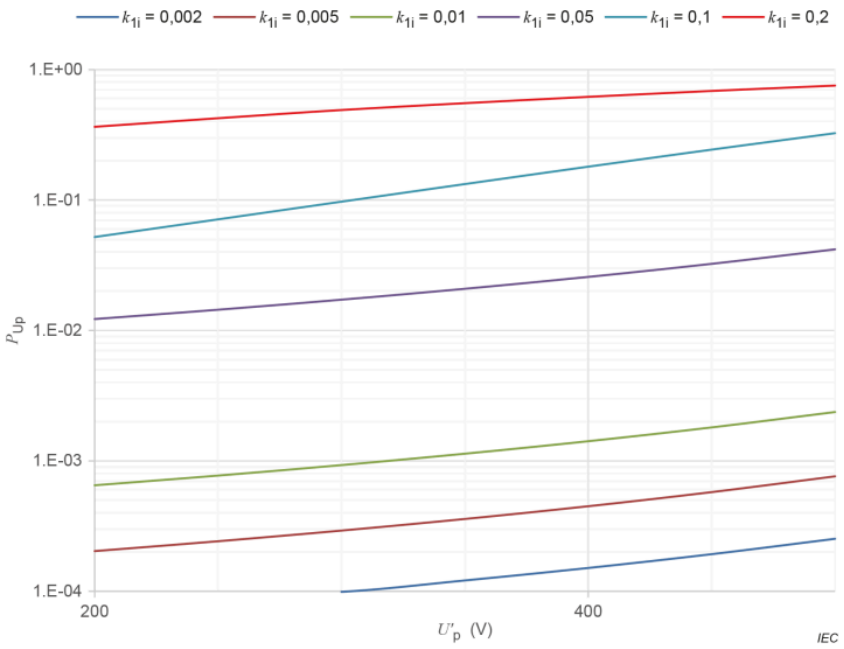


Figure D.5 – Probabilité P_{Up} en fonction de la tension résiduelle U_p' à 1 kA du SPD2

D.3.3 Source de dommages S3

D.3.3.1 Un parafoudre à limitation de tension

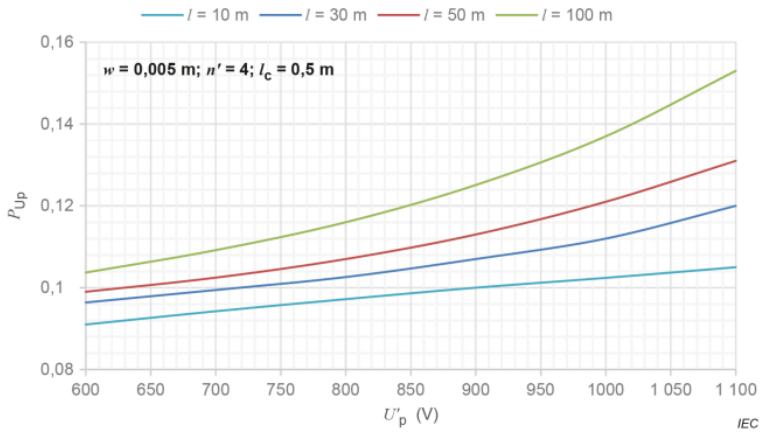
Les valeurs de P_{Up} en fonction de la tension résiduelle à 1 kA (U_p') sont indiquées sur la Figure D.6 pour différentes valeurs de longueur d'installation interne (l), lorsque U_w = 2,5 kV, l_c = 0,5 m, n'= 4, k_r > 1, w = 0,005 m et la longueur de ligne extérieure l_l est égale à 500 m.

EXEMPLE n' = 4, w = 0,1 m, l_v = 20 m, l_o = 80 m, l = 100 m, l_c = 0,5 m, U_w = 2,5 kV. En choisissant un parafoudre à limitation de tension avec U_p' = 900 V, la Figure D.6 indique P_{Up} ≈ 0,125 lorsque w = 0,005 m et que n' = 4 conducteurs. Néanmoins, la Note 3 de la Figure D.6 indique que cette valeur est multipliée par 1,4 lorsque w = 0,1 m, ce qui donne P_{Up} ≈ 0,125 × 1,4 = 0,175.

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NOTE 1 Pour d'autres longueurs de ligne extérieure (l_l), les valeurs de P_{Up} sont multipliées par le facteur 500/l_l.

NOTE 2 Lorsque n' = 2, les valeurs de P_{Up} sont multipliées par 1,4 (valeurs approximatives).

NOTE 3 Lorsque w = 0,1 m, les valeurs de P_{Up} sont multipliées par 1,4 (valeurs approximatives).

Figure D.6 – Probabilité P_{Up} en fonction de la tension résiduelle à 1 kA (U_p')

D.3.3.2 Un parafoudre à coupure de tension

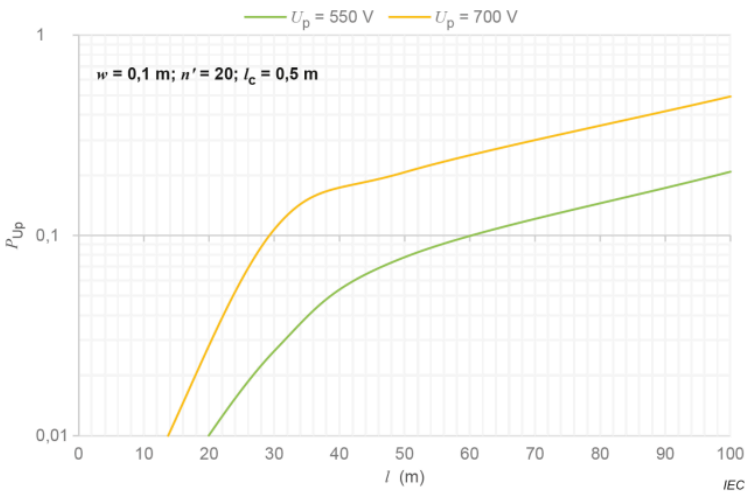
Les valeurs de P_{Up} n fonction de différentes valeurs de longueur d'installation interne (l), pour deux niveaux de protection types des GDT, lorsque U_w = 1,5 kV, l_c = 0,5 m, w = 0,1 m, k_r > 1 et la longueur de ligne extérieure l_l = 500 m, sont indiquées sur la Figure D.7 pour n' = 20 conducteurs et sur la Figure D.8 pour n' = 2 conducteurs.

NOTE Il a été admis par hypothèse que la longueur interne du circuit est verticale à 20 % et horizontale à 80 % (par exemple, pour l = 30 m, le circuit est vertical sur 6 m et horizontal sur 24 m).

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NOTE 1 Pour d'autres longueurs de ligne extérieure (l_l), les valeurs de P_{Up} sont multipliées par le facteur 500/l_l.

NOTE 2 Lorsque w = 0,005 m et n' = 20, la valeur approximative de P_{Up} est de 0,003 4 avec l_l = 500 m pour les deux valeurs de U_p (550 V et 700 V). Cette valeur ne varie pas de manière significative lorsque l'installation interne est blindée.

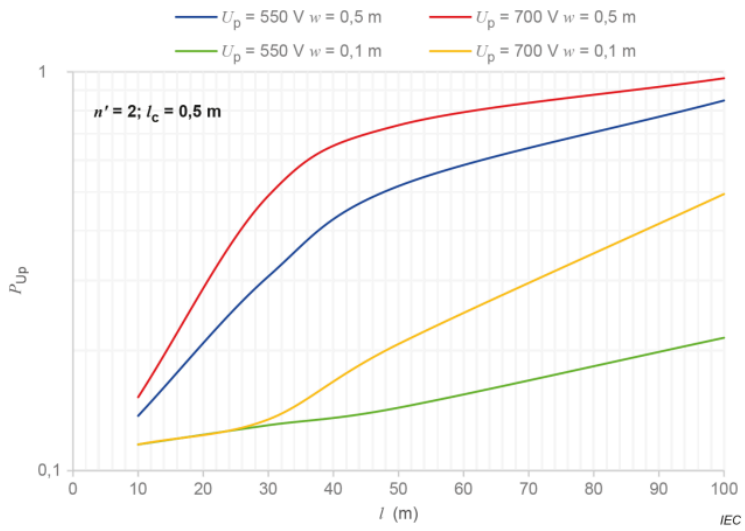
Figure D.7 – Probabilité P_{Up} en fonction de différentes longueurs de circuit interne

EXEMPLE 2 conducteurs non blindés, longueur de ligne extérieure de 500 m, U_w = 1,5 kV, l_c = 0,5 m, w = 0,1 m et l = 30 m. Lorsque des GDT avec U_p = 550 V sont installés, la Figure D.8 indique P_{Up} = 0,134.

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NOTE 1 Pour d'autres longueurs de ligne extérieure (l_l), les valeurs de P_{Up} sont multipliées par le facteur 500/l_l.

NOTE 2 Lorsque w = 0,5 m et n' = 20, les valeurs de P_{Up} ne varient pas de manière significative.

NOTE 3 Lorsque w = 0,005 m et n' = 2, la valeur approximative de P_{Up} est de 0,12 pour l_l = 500 m et pour les deux valeurs de U_p (550 V et 700 V). Cette valeur ne varie pas de manière significative lorsque l'installation interne est blindée.

Figure D.8 – Probabilité P_{Up} en fonction de différentes longueurs de circuit interne

D.3.3.3 Parafoudre à limitation de tension et parafoudre à coupure de tension

Lorsque la puissance est répartie conformément au réseau TT, un parafoudre soumis à des essais de classe I peut être installé en amont du DDR. Cependant, la protection contre les contacts directs nécessite alors l'installation d'un parafoudre à coupure de tension entre les conducteurs de neutre et les conducteurs PE (N-PE) en complément des parafoudres à limitation de tension entre les conducteurs de neutre et les conducteurs de phases. Dans ce cas, il est admis de prendre pour hypothèse que la valeur de P_{Up} est la valeur la plus élevée de celles liées aux parafoudres à limitation de tension ou à coupure de tension.

En ce qui concerne les installations types où U_w = 2,5 kV et U_p = 1,5 kV du parafoudre à coupure de tension, une protection avec un seul parafoudre ne peut être obtenue que lorsque k_r = 1, c'est-à-dire lorsque la distance entre le parafoudre et le matériel à protéger est inférieure à 10 m et que l'endommagement du matériel n'entraîne aucun danger pour les personnes. Dans ce cas, la valeur de P_{Up} est celle liée au parafoudre à limitation de tension, et les valeurs de P_{Up} pour une installation type sont indiquées dans le Tableau D.2 en fonction du niveau de protection à 1 kA du parafoudre à limitation de tension.

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Tableau D.2 – Valeurs de P_{Up} du parafoudre à limitation de tension

n'	w m	l_v m	l_o m	l m	k_r	U_p' kV	P_{Up}
4	0,1	2	8	10	1	0,8	0,05
						1	0,07
						1,2	0,1
Lorsque w = 0,005 m, il convient de multiplier les valeurs de P_{Up} par un facteur de 0,8.							

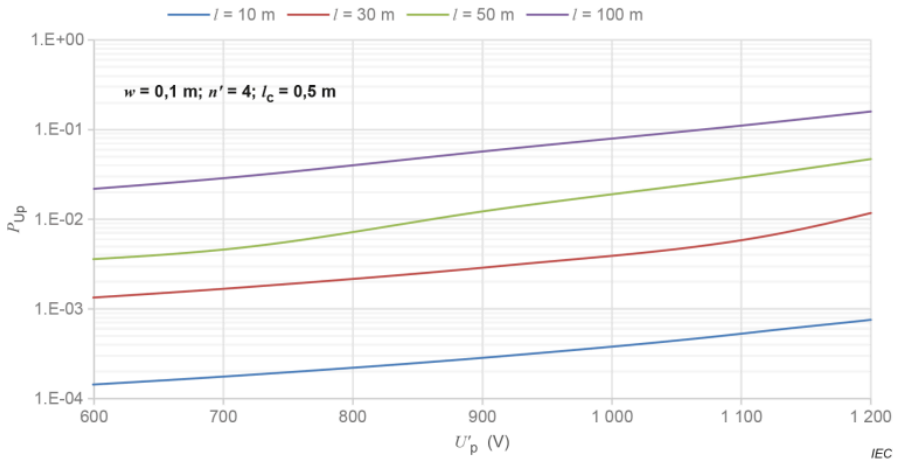
Lorsque k_r > 1, un second parafoudre à limitation de tension doit être installé pour protéger l'accès d'alimentation du matériel.

D.3.3.4 Deux parafoudres à limitation de tension

Lorsque la valeur de probabilité P_{SPD} nécessaire ne peut pas être atteinte par un seul parafoudre à l'entrée du service dans la structure, un second parafoudre à limitation de tension (SPD2), qui peut résister à une charge coordonnée avec celle du premier parafoudre, doit être installé.

La probabilité P_{SPD} de ce système de protection par parafoudres coordonnés est obtenue en additionnant la probabilité P_Q du premier parafoudre et la probabilité P_{Up} du second parafoudre selon l'Équation (D.2).

Ces valeurs de P_{Up} en fonction du niveau de protection à 1 kA (U_p') du SPD2 sont indiquées sur la Figure D.9 pour différentes longueurs d'installation interne (l), lorsque U_w = 2,5 kV, l_c = 0,5 m, w = 0,1 m, n' = 4 et k_r > 1.



NOTE 1 Pour d'autres longueurs de ligne extérieure (l_l), les valeurs de P_{Up} sont multipliées par le facteur 500/l_l.

NOTE 2 Lorsque n' = 2, les valeurs de P_{Up} sont multipliées par 1,4 (valeurs approximatives).

NOTE 3 Lorsque w = 0,005 m, les valeurs de P_{Up} deviennent quasiment négligeables.

Figure D.9 – Probabilité P_{Up} en fonction de la tension résiduelle U_p' à 1 kA du SPD2

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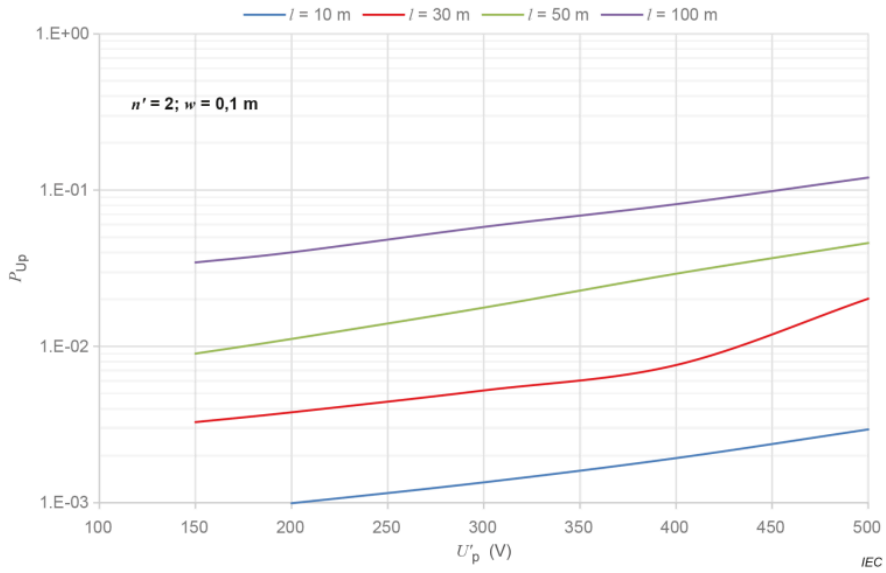
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D.3.4 Parafoudres coordonnés en énergie: un parafoudre à coupure de tension et un parafoudre à limitation de tension en aval

Lorsque la valeur de probabilité P_{SPD} nécessaire ne peut pas être atteinte par un seul parafoudre à l'entrée du service dans la structure, un second parafoudre à limitation de tension (SPD2), qui peut résister à une charge coordonnée avec celle du premier parafoudre, doit être installé.

La probabilité P_{SPD} de ce système de protection par parafoudres coordonnés est obtenue en additionnant la probabilité P_Q du premier parafoudre et la probabilité P_{Up} du second parafoudre selon l'Équation (D.2).

Ces valeurs de P_{Up} en fonction du niveau de protection à 1 kA (U_p') du SPD2 sont indiquées sur la Figure D.10 pour différentes longueurs d'installation interne (l), lorsque U_w = 1,5 kV, l_c = 0,5 m, w = 0,1, n' = 2 et k_r > 1, sur la Figure D.11 lorsque w = 0,5 m avec n' = 2 ou 20 conducteurs et sur la Figure D.12 lorsque w = 0,1 et n' = 20 conducteurs.



NOTE 1 Pour d'autres longueurs de ligne extérieure (l_l), les valeurs de P_{Up} sont multipliées par le facteur 500/l_l.

NOTE 2 Lorsque n' = 4, les valeurs de P_{Up} sont multipliées par 0,7 (valeurs approximatives).

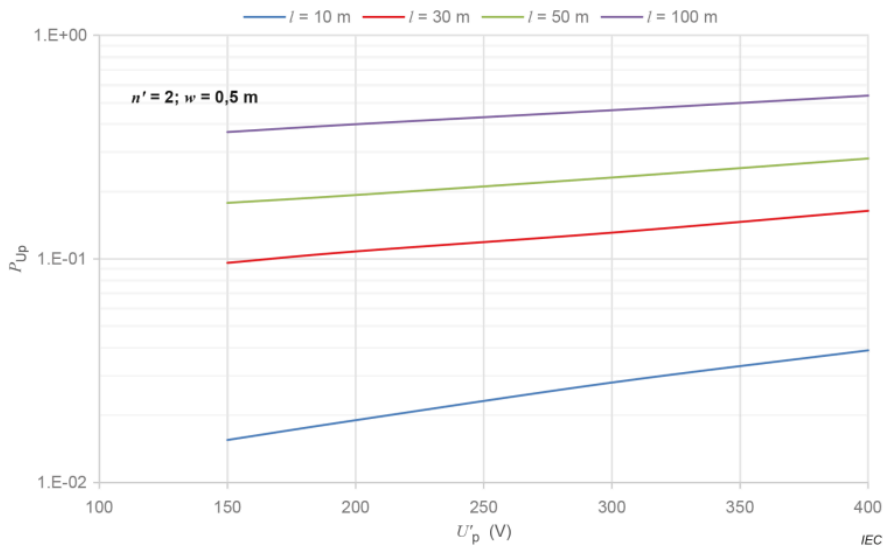
NOTE 3 Lorsque w = 0,005 m et n' = 2, les valeurs de P_{Up} deviennent quasiment négligeables (P_{Up} = 0,000 4 lorsque U_p' = 400 V et P_{Up} = 0,000 2 lorsque U_p' = 200 V pour une longueur maximale de 100 m).

Figure D.10 – Probabilité P_{Up} en fonction de la surface de boucle interne pour n' = 2 et w = 0,1 m

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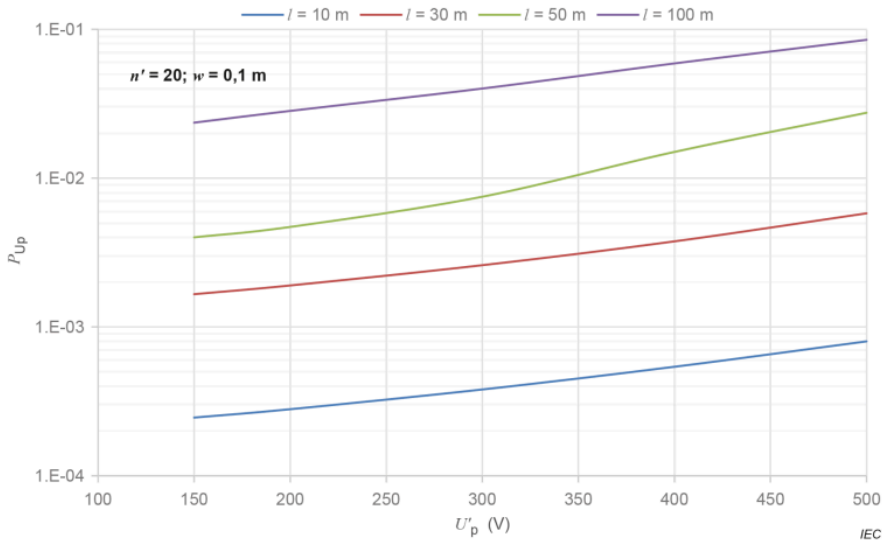
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NOTE 1 Pour d'autres longueurs de ligne extérieure (ll), les valeurs de P_{Up} sont multipliées par le facteur 500/ll.

NOTE 2 Des résultats similaires à ceux de la Figure D.11 peuvent être obtenus lorsque n' = 20 avec w = 0,5 m.

Figure D.11 – Probabilité P_{Up} en fonction de la surface de boucle interne pour n' = 2 et w = 0,5 m



NOTE 1 Pour d'autres longueurs de ligne extérieure (l_l), les valeurs de P_{Up} sont multipliées par le facteur 500/l_l.

NOTE 2 Lorsque w = 0,005 m, les valeurs de P_{Up} deviennent négligeables.

Figure D.12 – Probabilité P_{Up} en fonction de la surface de boucle interne pour n' = 20 et w = 0,1 m

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D.4 Source de dommages S4

D.4.1 Un parafoudre à limitation de tension

La Figure D.13 représente l'évaluation de P_{Up} en fonction du niveau de protection à 1 kA (U_p') pour une surface de boucle interne différente en fonction du niveau de protection à 1 kA (U_p'), lorsque U_w = 2,5 kV, l_c = 0,5 m, n' = 4 et k_r est pratiquement égal à 1.

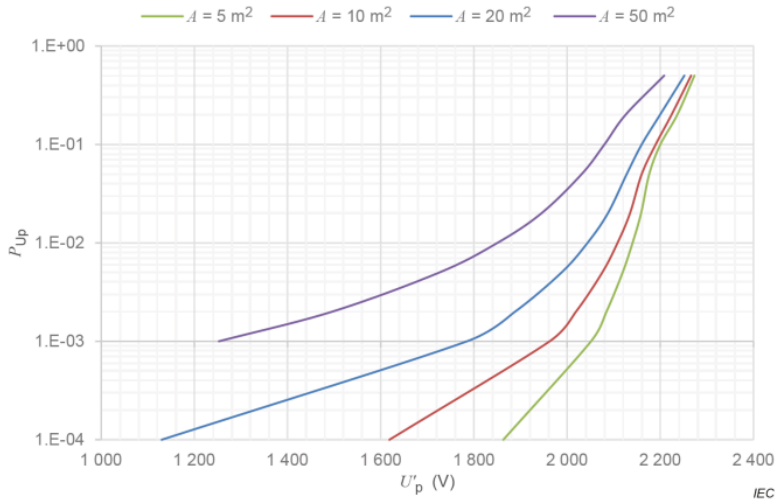


Figure D.13 – Probabilité P_{Up} en fonction du niveau de protection U_p' à 1 kA du parafoudre pour une surface de boucle interne différente

EXEMPLE La Figure D.13 indique que lorsque w = 0,1 m et l = 100 m, la probabilité P_{Up} est d'environ 0,000 1 pour U_p' = 1,6 kV. Un parafoudre soumis à des essais de classe II avec I_n = 5 kA et U_p' ≤ 1,6 kV donne une probabilité P_{SPD} = 0,000 1 par rapport à la source de dommages S4.

D.4.2 Un parafoudre à coupure de tension

Le parafoudre à coupure de tension est généralement utilisé sur les lignes de communication à l'entrée de la structure et les niveaux de protection des GDT sont habituellement de 700 V ou 550 V.

La Figure D.14 donne l'évaluation de P_{Up} en fonction d'une surface de boucle interne différente pour les deux valeurs U_p habituelles des GDT, à savoir 700 V et 550 V lorsque U_w = 1,5 kV, l_c = 0,5 m et k_r > 1.

EXEMPLE La Figure D.14 indique que lorsque U_w = 1,5 kV, w = 0,5 m et l = 100 m, la probabilité P_{Up} est d'environ 0,004 pour U_p' = 0,7 kV, et P_{Up} = 0,002 pour U_p' = 0,55 kV.

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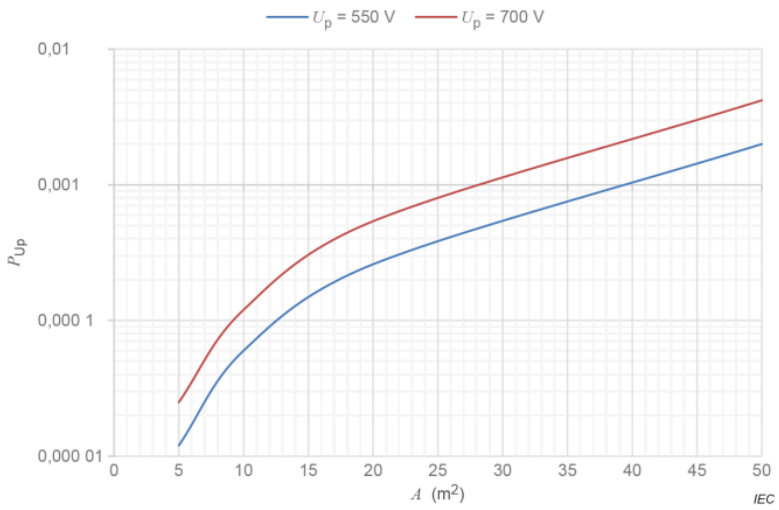


Figure D.14 – Probabilité P_{Up} en fonction d'une surface de boucle interne différente pour deux niveaux de protection types des GDT

D.5 Source de dommages S2

Un parafoudre installé à l'extrémité de la boucle interne, à partir du matériel à protéger, ne peut pas protéger ce matériel, car la tension induite dans la boucle entre le parafoudre et le matériel n'est pas réduite et est égale à la tension de choc assignée du matériel (U_w).

Une protection peut être obtenue en installant un parafoudre à limitation de tension plus près du matériel afin de réduire les dimensions de la boucle d'induction. Il peut même s'agir d'un second parafoudre coordonné avec le premier situé à l'extrémité à partir du matériel à protéger.

Lorsque les dimensions de la boucle d'origine, $S = w \times l$ (m²), et les dimensions de la boucle entre ce parafoudre et le matériel, $S^* = w_1 \times l_1$ (m²) sont définies, la valeur de P_{Up} est donnée par:

$$P_{Up} = [S^*/(U_w - -)]^2$$

où

U (V) est le niveau de protection U_p du parafoudre à coupure de tension ou la tension résiduelle à 1 kA (U_p') d'un parafoudre à limitation de tension.

Les valeurs de P_{Up} correspondent aux valeurs de P_{SPD}, car les valeurs de P_Q sont généralement négligeables lorsque le courant nominal de décharge I_n est égal ou supérieur à 2,5 kA.

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Annexe E
(informative)

Étude approfondie des pertes complémentaires L_E liées à l'environnement

E.1 Généralités

La présente Annexe E est destinée aux applications particulières. Pour la plupart des structures, il n'est pas nécessaire de calculer un risque pour l'environnement, mais si nécessaire, il est possible d'utiliser la présente Annexe E comme recommandation.

L'Annexe E décrit une méthode simple qui consiste à définir les pertes complémentaires L_E pour prendre en compte les dommages sur une structure qui peuvent impliquer des structures environnantes ou l'environnement. S'il est nécessaire d'étudier de manière plus approfondie les dommages causés à une structure environnante ou à l'environnement, le concept suivant, décrit à l'Annexe E, peut être utilisé pour calculer la perte complémentaire L_E. Avec ce concept, l'incidence des différentes caractéristiques et conditions de la structure frappée par la foudre et de son environnement sur les pertes complémentaires subies par l'environnement peut être estimée de manière plus précise.

Les conditions suivantes sont valables:

– Les composantes de risque R_{AT}, R_{AD} et R_U ne sont pas prises en compte pour l'environnement, car elles ne s'appliquent qu'à la structure frappée par la foudre en soi;
– Les types de pertes suivants s'appliquent à l'environnement:

  L_1: pertes dues à des blessures sur des êtres humains dans l'environnement;

  L_2: pertes dues à des dommages physiques à l'environnement.

E.2 Calcul des composantes de risque

Les composantes de risque qui s'appliquent à l'environnement sont calculées d'après les équations indiquées dans le Tableau E.1.

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Tableau E.1 – Composantes de risque pour différentes sources de dommages et différents types de pertes qui s'appliquent aux dommages à l'environnement

Type de perte	Source de dommages			
	S1 Impact de foudre sur une structure	S2 Impact de foudre à proximité d'une structure	S3 Impact de foudre sur une ligne (entrante)	S4 Impact de foudre à proximité d'une ligne
L_1 Blessures sur êtres vivants	$R_{B1E} = N_D \times P_B \times P_{PE} \times L_{B1E}$		$R_{V1E} = (N_L + N_{DJ}) \times P_V \times P_{PE} \times L_{V1E}$	
	$R_{C1E} = N_D \times P_C \times P_{PE} \times P_e \times L_{C1E}$ Voir la note de bas de page "a".	$R_{M1E} = N_M \times P_M \times P_{PE} \times P_e \times L_{M1E}$ Voir la note de bas de page "a".	$R_{W1E} = (N_L + N_{DJ}) \times P_W \times P_{PE} \times P_e \times L_{W1E}$ Voir la note de bas de page "a".	$R_{Z1E} = N_I \times P_Z \times P_{PE} \times P_e \times L_{Z1E}$ Voir la note de bas de page "a".
L_2 Dommages physiques	$R_{B2E} = N_D \times P_B \times L_{B2E}$		$R_{V2E} = (N_L + N_{DJ}) \times P_V \times L_{V2E}$	
	$R_{C2E} = N_D \times P_C \times P_e \times L_{C2E}$ Voir la note de bas de page "b".	$R_{M2E} = N_M \times P_M \times P_e \times L_{M2E}$ Voir la note de bas de page "b".	$R_{W2E} = (N_L + N_{DJ}) \times P_W \times P_e \times L_{W2E}$ Voir la note de bas de page "b".	$R_{Z2E} = N_I \times P_Z \times P_e \times L_{Z2E}$ Voir la note de bas de page "b".

[a] R_{C1E}, R_{M1E}, R_{W1E} et R_{Z1E} s'appliquent principalement aux structures avec risque d'explosion et pour les hôpitaux ou autres structures dans lesquelles des défaillances des réseaux internes entraînent des dangers mortels immédiats.

[b] R_{C2E}, R_{M2E}, R_{W2E} et R_{Z2E} s'appliquent principalement aux structures avec risque d'explosion.

où les relations générales sont données ci-dessous:

$$L_{B1E} = L_{V1E} = L_{F1E} \quad \text{(E.1)}$$

$$L_{C1E} = L_{M1E} = L_{W1E} = L_{Z1E} = L_{O1E} \quad \text{(E.2)}$$

$$P_{PE} = t_{zE} / 8\,760 \quad \text{(E.3)}$$

$$L_{B2E} = L_{V2E} = L_{F2E} \quad \text{(E.4)}$$

$$L_{C2E} = L_{M2E} = L_{W2E} = L_{Z2E} = L_{O2E} \quad \text{(E.5)}$$

où

L_{F1E} est le rapport type moyen entre le nombre de personnes blessées par un incendie ou une explosion du fait d'un événement dangereux et le nombre total de personnes dans la zone environnante (voir le Tableau E.3);

L_{O1E} est le rapport type moyen entre le nombre de personnes blessées par une défaillance des réseaux internes du fait d'un événement dangereux et le nombre total de personnes

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L_{F2E} est le rapport type moyen entre les dommages physiques provoqués par un incendie ou une explosion du fait d'un événement dangereux et l'étendue maximale des dommages dans la zone environnante (voir le Tableau E.4);

L_{O2E} est le rapport type moyen entre les dommages physiques provoqués par une défaillance des réseaux internes du fait d'un événement dangereux et l'étendue maximale des dommages dans la zone environnante (voir le Tableau E.4);

t_{zE} est le temps de présence des personnes à un emplacement potentiellement dangereux dans la zone environnante (voir le Tableau E.2).

Tous ces paramètres sont fondés sur des scénarios et il convient de les évaluer de manière précise. Lorsqu'un scénario ne justifie pas une composante, il convient alors de considérer cette composante comme égale à zéro. Par exemple, si un choc induit à l'intérieur d'une structure ne peut pas générer de scénario qui entraîne lui-même des dommages sur des biens à l'extérieur de la structure, il convient de considérer L_{M2E} comme égal à 0.

Tous les autres paramètres donnés dans les équations du Tableau E.1 sont utilisés et calculés comme cela est décrit à l'Annexe A et à l'Annexe B et dans la partie principale du présent document.

Si les valeurs de t_{ZE} sont inconnues, il convient de prendre pour hypothèse t_{ZE}/8 760 = 1 lorsque des zones résidentielles constamment occupées par des personnes peuvent se trouver aux alentours de la structure.

Sinon, les valeurs suggérées dans le Tableau E.2 peuvent être utilisées. Ces valeurs peuvent être modifiées après une étude approfondie.

Tableau E.2 – Type de perte L1: Valeurs types suggérées pour la durée de présence de personnes t_{zE}/8 760 associée dans différents environnements, limitées selon le Tableau E.3

Type d'environnement	t_{zE}/8 760[a]
Site de travail	0,25
Site de travail avec plusieurs périodes d'activité	1,0
Structures ouvertes au public	0,5
Zones d'activités (industries et autres activités généralement non ouvertes au public)	0,75
Résidences	1
Routes	1
Voies ferrées	0,25
Voies fluviales	0,1
Voies piétonnes	0,75
Terrains ouverts et zones très peu fréquentées (champs, prairies, forêts, terrains vagues, marécages, etc.)	0,25
Zones peu fréquentées (jardins et zones horticoles, vignobles, zones de pêche, gares de triage, etc.)	0,25
Zones normalement ou souvent fréquentées (parkings, parcs, bains surveillés, terrains sportifs)	0,5
Cas particuliers (fréquentation sporadique)	0,1

[a] En cas d'environnements "mixtes" qui présentent plusieurs valeurs, il convient d'utiliser la valeur la plus élevée.

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Pour L_{F1E} et L_{O1E}, les valeurs indiquées dans le Tableau E.3 sont des propositions. Des calculs plus précis peuvent être effectués. Lorsqu'il n'existe aucun risque pour les zones environnantes, il convient de prendre pour hypothèse $L_{F1E} = L_{O1E} = 0$.

Tableau E.3 – Type de perte L1: Valeurs moyennes types de L_{F1E} et L_{O1E} à l'extérieur de la structure

Valeurs de L_{F1E} et L_{O1E} Scénario	Risque environnemental – Qui reste à l'intérieur des clôtures du site		Risque environnemental – Qui s'étend à l'extérieur des clôtures du site	
	L_{F1E} [g]	L_{O1E} [g]	L_{F1E}	L_{O1E}
Explosion et surpression[a]	0,25	0,025	0,5	0,05
Flux thermique[b]	0,05	0,005	0,1	0,01
Fumées toxiques[c]	0,1	0,01	1,0	0,1
Pollution des sols[c]	0,1	0,01	0,5	0,05
Pollution des eaux[c]	0,25[d]	0,025	2,5	0,25
Matières radioactives[c e f]	0,5	0,05	5	0,5

[a] La surpression dépasse une valeur de 5 kPa.

[b] La puissance thermique par zone dépasse une valeur de 3 kW/m^2.

[c] Ces valeurs maximales peuvent être réduites en fonction de la quantité du polluant, du danger qu'il représente et de la sensibilité de l'environnement.

[d] Uniquement si la pollution peut atteindre la nappe phréatique, l'eau douce, la mer ou les océans.

[e] Il est possible que cette disposition ne s'applique pas lorsqu'une étude spécifique qui comprend tous les scénarios a été élaborée.

[f] Ne s'applique pas aux sources scellées utilisées par exemple dans les dispositifs de mesure ou le matériel médical.

[g] Dans le cas d'un TWS, les valeurs de L_{F1E} et L_{O1E} à l'intérieur des clôtures du site sont multipliées par (1 – P_{TWS}).

Pour L_{F2E} et L_{O2E}, les valeurs indiquées dans le Tableau E.4 sont des propositions. Des calculs plus précis peuvent être effectués. Lorsqu'il n'existe aucun risque pour les zones environnantes, il convient de prendre pour hypothèse $L_{F2E} = L_{O2E} = 0$.

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Tableau E.4 – Type de perte L2: Valeurs moyennes types de L_{F2E} et L_{O2E} à l'extérieur de la structure

Scénario	Risque environnemental	
	L_{F2E}	L_{O2E}
Explosion et surpression[a]	0,5	0,05
Flux thermique[b]	0,1	0,01
Fumées toxiques[c]	0,5	0,05
Pollution des sols[c]	0,2	0,02
Pollution des eaux[c]	0,5[d]	0,05
Matières radioactives[c e f]	1	0,1

[a] La surpression dépasse une valeur de 14 kPa.

[b] La puissance thermique par zone dépasse une valeur de 8 kW/m^2.

[c] Ces valeurs maximales peuvent être réduites en fonction de la quantité du polluant, du danger qu'il représente et de la sensibilité de l'environnement.

[d] Uniquement si la pollution peut atteindre le lit d'eau, l'eau douce, la mer ou les océans.

[e] Il est possible que cette disposition ne s'applique pas lorsqu'une étude spécifique qui comprend tous les scénarios a été élaborée.

[f] Ne s'applique pas aux sources scellées utilisées par exemple dans les dispositifs de mesure ou le matériel médical.

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Annexe F
(informative)

Études de cas

F.1 Généralités

La présente Annexe F fournit des études de cas qui portent sur une maison, un immeuble de bureaux et un hôpital en vue d'indiquer le risque et la fréquence des dommages:

– la façon de procéder à des calculs avec la valeur des paramètres et de déterminer la nécessité d'une protection;
– la contribution des différentes composantes à la valeur globale;
– l'effet des différentes mesures de protection pour réduire à la fois le risque et la fréquence des dommages.

NOTE La présente Annexe F fournit des hypothèses pour tous les cas. Elle est destinée à donner des informations sur l'évaluation des risques et des fréquences de dommages afin d'étayer les principes contenus dans le présent document. Il ne s'agit pas de traiter les aspects propres aux conditions rencontrées dans toutes les installations ou tous les réseaux.

Par souci de simplification, certains facteurs sont donnés comme suit:

$R_B = R_{B1} + R_{B2}$

$R_C = R_{C1} + R_{C2}$

$R_M = R_{M1} + R_{M2}$

$R_V = R_{V1} + R_{V2}$

$R_W = R_{W1} + R_{W2}$

$R_Z = R_{Z1} + R_{Z2}$

Dans les tableaux, le tiret (–) signifie "non applicable".

Les valeurs de risque et de fréquence calculées dans les tableaux sont fixées à 3 décimales. Les valeurs inférieures sont donc exprimées par ≈ 0.

En raison des valeurs arrondies utilisées pour le calcul, les résultats des valeurs calculées peuvent être légèrement différents.

F.2 Maison

F.2.1 Données et caractéristiques pertinentes

NOTE Dans cet exemple, les indices supplémentaires P, T et D, qui représentent respectivement les lignes de puissance, de communication et de données, ont été ajoutés aux paramètres existants.

La maison ne dispose d'aucune protection contre la foudre existante et est située dans une région plate sans structures environnantes. La densité de points d'impact au sol de la foudre est N_{SG} = 8 (nombre d'impacts par km^2 et par an). La maison est habitée durant six mois de l'année. L'hypothèse retenue est que personne ne se trouve à l'extérieur de la maison pendant un orage.

Cette maison est desservie par une ligne de puissance aérienne basse tension et une ligne téléphonique aérienne. Aucune partie conductrice externe n'est reliée à la maison.

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Les données relatives aux lignes entrantes et aux réseaux internes connectés à ces lignes sont données dans le Tableau F.2 pour la ligne de puissance et dans le Tableau F.3 pour la ligne de communication. La dernière colonne indique les emplacements où les valeurs choisies peuvent être consultées ou le procédé utilisé pour déterminer une valeur. Dans le Tableau F.1, la source de données de LSS ne peut pas fournir la valeur de k, aussi la valeur par défaut de 2 est utilisée. La structure ne fournit aucune protection contre les IEMF, aussi la valeur par défaut de K_{S1} est choisie. Aucun système d'alerte aux orages (TWS) n'est utilisé dans la structure. Lorsqu'aucune justification ni aucune référence à des articles spécifiques n'est donnée, les valeurs ont été choisies à titre d'exemple.

Tableau F.1 – Maison: caractéristiques de l'environnement et de la structure

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Densité de points d'impact au sol de la foudre (nombre de points d'impact par km^2 et par an)		N_{SG}	8,0	
Facteur qui lie N_G à N_{SG}		k	2	Article A.1
Dimensions de la structure (m)		L, W, H	15, 20, 6	
Facteur d'emplacement de la structure	Structure isolée	C_D	1	Tableau A.1
Matériau de construction	Maçonnerie	P_S	1	Tableau B.4
Blindage de la structure	Aucun	K_{S1}	1	Article B.6
Facteur d'environnement	Rural	C_E	1	Tableau A.4
SPF	Aucun	P_{LPS}	1	Tableau B.3
TWS	Aucun	P_{TWS}	1	Article B.1

Tableau F.2 – Maison: ligne de puissance

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Longueur (m)[a]		L_L	1 000	Article A.4
Facteur d'installation	Aérien	C_{IP}	1	Tableau A.2
Facteur de type de ligne	Ligne BT	C_{TP}	1	Tableau A.3
Facteur d'environnement	Rural	C_{EP}	1	Tableau A.4
Blindage, mise à la terre, isolation	Aucun	C_{LDP}	1	Tableau B.9
		C_{LIP}	1	
Liaison équipotentielle	Aucun	P_{EBP}	1	Tableau B.13
Structure adjacente	Aucun	L_J, W_J, H_J	–	
Facteur d'emplacement de la structure	Aucun	C_{DJ}	–	Tableau A.1
Tension de tenue du réseau interne (kV)		U_{WP}	2,5	
Nombre de conducteurs	Conducteurs trois phases + neutre	n_P	4	Tableau B.7
	Paramètre résultant	P_{LDP}	1	Tableau B.11
Distance latérale pour $S2$ (m)	U_{WP} est supérieur à U_{WT}	r_{MP}	-	Non utilisée, voir l'Équation (A.8) et le Tableau F.3
Distance latérale pour $S4$ (m)		r_{IP}	384	2 000/$U_{WP}^{1,8}$, voir l'Équation (A.12)

[a] La longueur L_L de la section de ligne étant inconnue, l'hypothèse retenue est L_L = 1 000 m (Article A.4).

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Tableau F.3 – Maison: ligne de communication

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Longueur (m)		L_L	800	Article A.4
Facteur d'installation	Aérien	C_{IT}	1	Tableau A.2
Facteur de type de ligne	Ligne de communication	C_{TT}	1	Tableau A.3
Facteur d'environnement	Rural	C_{ET}	1	Tableau A.4
Blindage, mise à la terre, isolation	Aucun	C_{LDT}	1	Tableau B.8
		C_{LIT}	1	
Liaison équipotentielle	Aucun	P_{EBT}	1	Tableau B.13
Structure adjacente	Aucun	L_J, W_J, H_J	–	La baie de communication à l'autre extrémité de la ligne est de trop faibles dimensions pour être prise en compte
Facteur d'emplacement de la structure	Structure isolée	C_{DJ}	–	Tableau A.1
Tension de tenue du réseau interne (kV)		U_{WT}	1,5	
Nombre de conducteurs		n_T	2	Tableau B.8
	Paramètre résultant	P_{LDT}	1	Tableau B.11
Distance latérale pour S2 (m)	U_{WT} est inférieur à U_{WP}	r_{MT}	233	$350/U_{WT}$, voir l'Équation (A.8)
Distance latérale pour S4 (m)		r_{IT}	964	$2\,000/U_{WT}^{1,8}$, voir l'Équation (A.12)

F.2.2 Calcul du nombre annuel prévisible d'événements dangereux

Les calculs sont donnés dans le Tableau F.4 pour les surfaces équivalentes d'exposition et dans le Tableau F.5 pour le nombre prévisible d'événements dangereux.

Tableau F.4 – Maison: surfaces équivalentes d'exposition de la structure et des lignes

	Symbole	Résultat m²	Référence
Structure	A_D	$2,58 \times 10^3$	A.2.1.2, Équation (A.3)
	A_M	$1,87 \times 10^5$	Article A.3, Équation (A.8)
Ligne de puissance	A_{LP}	$4,00 \times 10^4$	Article A.4, Équation (A.10)
	A_{IP}	$7,69 \times 10^5$	Article A.5, Équation (A.12)
Ligne de communication	A_{LT}	$3,20 \times 10^4$	Article A.4, Équation (A.10)
	A_{IT}	$1,54 \times 10^6$	Article A.5, Équation (A.12)

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Tableau F.5 – Maison: nombre annuel prévisible d'événements dangereux

	Symbole	Résultat 1/an	Référence
Structure	N_D	$2{,}06 \times 10^{-2}$	A.2.4, Équation (A.5)
	N_M	$7{,}5 \times 10^{-1}$	Article A.3, Équation (A.7)
Ligne de puissance	N_{LP}	$3{,}2 \times 10^{-1}$	Article A.4, Équation (A.9)
	N_{IP}	3,07	Article A.5, Équation (A.11)
Ligne de communication	N_{LT}	$2{,}56 \times 10^{-1}$	Article A.4, Équation (A.9)
	N_{IT}	6,17	Article A.5, Équation (A.11)

F.2.3 Évaluation des risques

Il convient en premier lieu d'identifier les zones à risque qui peuvent composer la structure. Pour chaque zone à risque, le risque R et la fréquence des dommages F causés aux réseaux internes sont évalués.

Ceci entraîne:

a) la nécessité de déterminer le risque R et de le comparer au risque tolérable $R_T = 10^{-5}$ (7.3). Si nécessaire, il convient de choisir des mesures de protection adaptées pour atténuer ce risque.

   Les composantes de risque sont évaluées conformément au Tableau 3;

b) la nécessité de déterminer la fréquence de dommages F et de la comparer à la fréquence de dommages tolérable F_T (9.3). Dans le cas présent, la fréquence tolérable des dommages a été fixée par le propriétaire du bâtiment à la valeur $F_T = 10^{-1}$. Par conséquent, il convient de choisir des mesures de protection adaptées pour réduire cette fréquence des dommages, si nécessaire. Les composantes de la fréquence des dommages sont évaluées conformément au Tableau 4.

Dans cet exemple, seul le risque est calculé. La fréquence des dommages est traitée dans les autres exemples.

F.2.4 Définition des zones à risque dans la maison

Les principales zones à risque suivantes peuvent être définies comme suit:

Z_1 (extérieur du bâtiment);

Z_2 (intérieur du bâtiment) est définie en tenant compte des éléments suivants:

- les deux réseaux internes (de puissance et de communication) couvrent tout le bâtiment;
- il n'y a pas de blindages spatiaux;
- la structure constitue un compartiment unique à l'épreuve du feu;
- par hypothèse, les pertes sont constantes dans tout le bâtiment et correspondent aux valeurs moyennes types du Tableau C.2.

Les valeurs de durée de présence annuelle des personnes dans chacune des zones à risque et les composantes de risque à prendre en compte sont indiquées dans le Tableau F.6. Le temps passé à l'extérieur du bâtiment est si limité que pour les besoins de cet exemple, il est admis par hypothèse que personne ne se trouve à l'extérieur du bâtiment (Z_1 est donc ignorée).

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Tableau F.6 – Maison: durée de présence des personnes et composantes de risque dans les zones à risque

Zone à risque	Durée de présence heures/année	Composantes de risque								
		R_{AT}	R_{AD}	R_B	R_C	R_M	R_U	R_V	R_W	R_Z
Z_2 (intérieur du bâtiment)	4 380	X		X			X	X		

Pour la zone Z_1, étant donné que personne ne se trouve à l'extérieur du bâtiment, le risque de choc qui frappe des personnes $R_{AT} = 0$. Par hypothèse également, il n'y a pas de réseaux électriques à l'extérieur du bâtiment et donc la fréquence des dommages $F = 0$.

Les paramètres définis pour la zone Z_2 sont indiqués dans le Tableau F.7.

Tableau F.7 – Maison: valeurs pour la zone Z_2 (intérieur du bâtiment)

Paramètre d'entrée		Commentaire	Symbole	Valeur	Référence
Type de plancher		Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)		Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée		Non applicable	P_o	0	Article B.3
Risque d'incendie		Faible	r_f	10^{-3}	Tableau B.6
Protection contre l'incendie		Aucun	r_p	1	Tableau B.5
Facteur relatif aux personnes dans la zone		t_z/8 760 = 4 380/8 760	P_P	0,5	Équation (B.14)
Facteur relatif aux matériels dans la zone		t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Blindage de la zone		Aucun	K_{S2}	1	Équation (B.9)
Réseau interne de puissance	Câblage interne	Conducteurs non blindés acheminés dans le même conduit	K_{S3P}	2×10^{-1}	Tableau B.10
	Facteur de tension de tenue (kV)		U_{WP}	2,5	
	Réseau SPD	Aucun	P_{SPD}	1	Tableau B.7
Réseau interne de communication	Câblage interne	Conducteurs non blindés avec différents acheminements	K_{S3T}	1	Tableau B.10
	Facteur de tension de tenue (kV)		U_{WT}	1,5	
	Réseau SPD	Aucun	P_{SPD}	1	Tableau B.8
Type de zone en fonction des pertes		Zone à faibles pertes	-	-	Tableau C.2

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Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	
	Personnes blessées par incendie	L_{F1}	2×10^{-2}	
	Dommages physiques causés par un incendie	L_{F2}	2×10^{-2}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	10^{-1}	

F.2.5 Appréciation du risque

Le risque R peut être exprimé selon l'Équation (1). Les composantes impliquées sont indiquées dans le Tableau F.6 et les valeurs de risque dans le Tableau F.8.

Tableau F.8 – Maison: risque pour la structure non protégée (valeurs × 10^{-5})

Symbole	Z_2
R_{AT}	≈ 0
R_B	0,062
R_U	0,003
R_V	1,728
R	1,793
R_T	1

Comme le risque R est supérieur à la valeur tolérable $R_T = 10^{-5}$, une protection contre la foudre de la structure est exigée pour atténuer le risque.

F.2.6 Risque – Choix de mesures de protection

Selon le Tableau F.8, la principale contribution à la valeur de risque est donnée par la composante R_V (impact sur des lignes) et réduire cette composante peut être suffisant pour faire passer le risque au-dessous du niveau tolérable.

Pour réduire le risque R à une valeur tolérable, il convient d'examiner les mesures de protection qui impliquent les composantes R_V. Des parafoudres de NPF IV installés sur les lignes de puissance et les lignes téléphoniques au point d'entrée dans la maison (liaison équipotentielle) constituent des mesures appropriées. D'après le Tableau F.7, ces mesures permettent de réduire la valeur de P_{EB} (en raison des parafoudres sur les lignes connectées) de 1 à 0,05 et les valeurs de P_V par le même facteur. L'insertion de ces valeurs dans les équations permet d'obtenir de nouvelles valeurs des composantes de risque, comme cela est indiqué dans le Tableau F.9, qui indique que le risque total se situe désormais au-dessous du niveau tolérable.

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Tableau F.9 – Maison: composantes de risque pour la structure protégée (valeurs × 10^{-5})

Symbole	Z_2
R_{AT}	≈ 0
R_B	0,062
R_U	≈ 0
R_V	0,086
R	0,149
R_T	1

F.2.7 Conclusions

Le risque R peut être réduit au-dessous du niveau tolérable en installant un parafoudre soumis à un essai de classe I et de NPF IV pour les lignes de puissance et les lignes téléphoniques.

F.3 Bâtiment de bureaux

F.3.1 Données et caractéristiques pertinentes

La deuxième étude de cas concerne un immeuble de bureaux qui comporte des archives, des bureaux et un centre informatique.

Le bâtiment de bureaux est situé dans une région plate sans structures environnantes. La densité de points d'impact au sol de la foudre est N_{SG} = 4 (nombre d'impacts par km^2 et par an).

Le bâtiment de bureaux est alimenté par une ligne de puissance et une ligne de communication. En outre, une partie conductrice externe est reliée à la structure (canalisation d'eau). La ligne de communication externe est constituée d'un câble fibronique non métallique, tandis que la ligne de communication interne est une ligne non blindée en cuivre.

Les données relatives au bâtiment et à son environnement sont indiquées dans le Tableau F.10. Les données relatives aux lignes entrantes et aux réseaux internes connectés à ces lignes sont données dans le Tableau F.11 pour la ligne de puissance et dans le Tableau F.12 pour la ligne de communication.

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Tableau F.10 – Bâtiment de bureaux: caractéristiques de l'environnement et de la structure

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Densité de points d'impact au sol de la foudre (nombre de points d'impact par km^2 et par an)		N_{SG}	4,0	
Facteur qui lie N_G à N_{SG}		k	2	Article A.1
Dimensions de la structure (m)		L, W, H	20, 40, 25	
Facteur d'emplacement de la structure	Structure isolée	C_D	1	Tableau A.1
Matériau de construction	Béton armé	P_S	0,5	Tableau B.4
Blindage de la structure	Aucun	K_{S1}	1	Équation (B.8)
Facteur d'environnement	Suburbain	C_E	0,5	Tableau A.4
SPF	Aucun	P_{LPS}	1	Tableau B.3
TWS	Aucun	P_{TWS}	1	Article B.1

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Tableau F.11 – Bâtiment de bureaux: ligne de puissance

Paramètre d'entrée		Commentaire	Symbole	Valeur	Référence
Section HT	Longueur (m)		L_L	1 000	Article A.4
	Facteur d'installation	Enterrée	C_I	0,3	Tableau A.2
	Facteur de type de ligne	Ligne HT	C_T	0,2	Tableau A.3
	Facteur d'environnement	Suburbain	C_E	0,5	Tableau A.4
	Blindage de ligne (Ω/km)	Non blindée	R_S	–	
Section BT	Longueur (m)		L_L	100	
	Facteur d'installation	Enterrée	C_I	0,3	Tableau A.2
	Facteur de type de ligne	Ligne BT	C_T	1	Tableau A.3
	Facteur d'environnement	Suburbain	C_E	0,5	Tableau A.4
	Blindage de ligne (Ω/km)	Non blindée	R_S	–	
Blindage, mise à la terre, isolation		Aucun	C_{LD}	1	Tableau B.9
			C_{LI}	1	
Liaison équipotentielle		Aucun	P_{EB}	1	Tableau B.13
Structure adjacente		Aucun	L_J, W_J, H_J	–	La longueur de la ligne HT est de 1 km
Facteur d'emplacement de la structure adjacente		Aucun	C_{DJ}	–	Tableau A.1
Tension de tenue du réseau interne (kV)			U_{WP}	2,5	
Nombre de conducteurs		Conducteurs 3 phases + neutre	n_P	4	Tableau B.7
		Paramètre résultant	P_{LD}	1	Tableau B.11 et Tableau B.12
Distance latérale pour S2 (m)		U_{WP} est supérieur à U_{WT}	r_{MP}	-	Non utilisée, voir l'Équation (A.8) et le Tableau F.12
Distance latérale pour S4 (m)			r_{IP}	384	$2\,000/U_{WP}^{1,8}$, voir l'Équation (A.12)

Tableau F.12 – Bâtiment de bureaux: ligne de communication

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Longueur (m)	Câble fibronique	L_L	0	Article A.4
Tension de tenue du réseau interne (kV) relié à la ligne de communication interne non blindée en cuivre.		U_{WT}	1,5	
Distance latérale pour S2 (m)	U_{WT} est inférieur à U_{WP}	r_{MT}	233	$350/U_{WT}$, voir l'Équation (A.8)

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F.3.2 Calcul du nombre annuel prévisible d'événements dangereux

Les résultats des calculs sont donnés dans le Tableau F.13 pour les surfaces d'exposition et dans le Tableau F.14 pour le nombre prévisible d'événements dangereux.

Tableau F.13 – Bâtiment de bureaux: surfaces d'exposition de la structure et des lignes

	Symbole	Résultat m^2	Équation de référence
Structure	A_D	$2{,}75 \times 10^4$	Équation (A.3)
	A_M	$1{,}99 \times 10^5$	Équation (A.8)
Ligne de puissance	A_{LP1}	4×10^4	Équation (A.10)
	A_{IP1}	$7{,}69 \times 10^5$	Équation (A.12)
	A_{LP2}	4×10^3	Équation (A.10)
	A_{IP2}	$7{,}69 \times 10^4$	Équation (A.12)
Ligne de communication	A_{LT}	0	Équation (A.10)
	A_{IT}	0	Équation (A.12)

Tableau F.14 – Bâtiment de bureaux: nombre annuel prévisible d'événements dangereux

	Symbole	Résultat 1/an	Équation de référence
Structure	N_D	$1{,}1 \times 10^{-1}$	Équation (A.5)
	N_M	$3{,}98 \times 10^{-1}$	Équation (A.7)
Ligne de puissance	N_{LP1}	$4{,}8 \times 10^{-3}$	Équation (A.9)
	N_{IP1}	$4{,}61 \times 10^{-2}$	Équation (A.11)
	N_{LP2}	$2{,}4 \times 10^{-3}$	Équation (A.9)
	N_{IP2}	$2{,}31 \times 10^{-2}$	Équation (A.11)
Ligne de communication	N_{LT}	0	Équation (A.9)
	N_{IT}	0	Équation (A.11)

F.3.3 Évaluation des risques

Il convient, en premier lieu, d'identifier la façon dont la structure peut être découpée en zones. Pour chaque zone, le risque R de pertes d'importance publique et la fréquence F des dommages causés aux réseaux internes doivent être évalués.

Ceci entraîne:

a) la nécessité de déterminer le risque R et de le comparer au risque tolérable $R_T = 10^{-5}$ (7.3). Si nécessaire, des mesures de protection adaptées pour atténuer ce risque sont choisies. Les composantes de risque sont évaluées conformément au Tableau 3;

b) la nécessité de déterminer la fréquence de dommages F et de la comparer au risque tolérable exigé F_T (9.3). Dans ce cas, d'après les évaluations technico-économiques qui s'appliquent au service exploité dans le bâtiment, la fréquence de dommages tolérable a été fixée par le Directeur technique de la société à la valeur $F_T = 5 \times 10^{-2}$. Par conséquent, il convient de choisir des mesures de protection adaptées pour réduire cette fréquence des dommages, si nécessaire. Les composantes de la fréquence de dommages sont évaluées

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F.3.4 Définition des zones dans le bâtiment de bureaux

Les zones suivantes sont définies:

Z_1 (zone d'entrée à l'extérieur);

Z_2 (toiture);

Z_3 (archives);

Z_4 (bureaux);

Z_5 (centre informatique);

en tenant compte des éléments suivants:

- des personnes peuvent avoir accès à la toiture;
- la structure est divisée en deux compartiments isolés à l'épreuve du feu: l'un pour les archives (Z_3) et l'autre pour les bureaux et le centre informatique (Z_4 et Z_5);
- toutes les zones intérieures Z_3, Z_4 et Z_5 comportent des réseaux internes connectés à des lignes de puissance et de communication;
- il n'y a pas de blindages spatiaux;
- les personnes qui se trouvent dans les zones extérieures Z_1 et Z_2 sont protégées contre un impact direct par la structure ou son SPF extérieur et il n'est donc pas nécessaire de calculer R_B pour ces zones dans cet exemple;
- les personnes qui se trouvent dans les zones extérieures Z_1 et Z_2 ne sont pas protégées contre des tensions de contact dues à un impact direct sur la structure et il est donc nécessaire de calculer R_{AT} pour ces zones.

L'utilisation de valeurs inférieures à 1 pour r_p a été choisie en accord avec le propriétaire du bâtiment (voir l'Article B.4).

Les valeurs de durée de présence annuelle des personnes dans chacune des zones et les composantes de risque à prendre en compte sont indiquées dans le Tableau F.15.

Tableau F.15 – Bâtiment de bureaux: durée de présence des personnes et composantes de risque dans les zones

Zone	Durée de présence heures/année	Composantes de risque								
		R_{AT}	R_{AD}	R_B	R_C	R_M	R_U	R_V	R_W	R_Z
Z_1 (entrée à l'extérieur)	175	X								
Z_2 (toiture)	18	X	X							
Z_3 (archive)	440	X		X			X	X		
Z_4 (bureaux)	2 630	X		X			X	X		
Z_5 (centre informatique)	2 200	X		X			X	X		

Les paramètres pertinents pour les zones Z_1 à Z_5 sont donnés dans les Tableaux F.16 à F.20.

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Tableau F.16 – Bâtiment de bureaux: facteurs valables pour la zone Z_1 (zone d'entrée à l'extérieur)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Surface de sol	Marbre	r_t	10^{-3}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Aucun	r_f	0	Tableau B.6
Protection contre l'incendie	Aucun	r_p	1	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 175/8 760	P_P	0,02	Équation (B.14)
Facteur relatif aux matériels dans la zone	Non applicable	P_e	-	Équation (B.15)
Système de parafoudres (ligne de puissance)	Pas de réseaux internes	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Pas de réseaux internes	P_{SPD}	1	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Pas de réseaux internes	K_{S3}	0	Tableau B.10
Câblage interne (ligne de communication)	Pas de réseaux internes		0	
Type de zone en fonction des pertes	Zone à faibles pertes	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	
	Personnes blessées par incendie	L_{F1}	-	
	Dommages physiques causés par un incendie	L_{F2}	-	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	-	

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Tableau F.17 – Bâtiment de bureaux: facteurs valables pour la zone Z_2 (toiture)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Surface de sol	Asphalte	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Équipe de maintenance présente dans la zone exposée	P_o	1	Article B.3
Risque d'incendie	Aucun	r_f	0	Tableau B.6
Protection contre l'incendie	Aucun	r_p	1	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 18/8 760	P_P	0,002	Équation (B.14)
Facteur relatif aux matériels dans la zone	Non applicable	P_e	-	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	-	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	-	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Pas de réseaux internes	K_{S3}	-	Tableau B.10
Câblage interne (ligne de communication)				
Type de zone en fonction des pertes	Zone à faibles pertes	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	10^{-1}	
	Personnes blessées par incendie	L_{F1}	-	
	Dommages physiques causés par un incendie	L_{F2}	-	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	-	

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Tableau F.18 – Bâtiment de bureaux: facteurs valables pour la zone Z_3 (archives)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Type de plancher	Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Élevé	r_f	10^{-1}	Tableau B.6
Protection contre l'incendie	Alarme automatique	r_p	0,2	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 440/8 760	P_P	0,05	Équation (B.14)
Facteur relatif aux matériels dans la zone	t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	1	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Non blindé (conducteurs de boucle dans le même conduit)	K_{S3}	0,2	Tableau B.10
Câblage interne (ligne de communication)	Non blindé (conducteurs de boucle avec différents acheminements)		1	
Facteur de tension de tenue (réseau interne de puissance)	U_W = 2,5 kV			
Facteur de tension de tenue (réseau interne de communication)	U_W = 1,5 kV			
Type de zone en fonction des pertes	Zone à perte normale	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	
	Personnes blessées par incendie	L_{F1}	5×10^{-2}	
	Dommages physiques causés par un incendie	L_{F2}	5×10^{-2}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	5×10^{-2}	

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Tableau F.19 – Bâtiment de bureaux: facteurs valables pour la zone Z_4 (bureaux)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Type de plancher	Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Faible	r_f	10^{-3}	Tableau B.6
Protection contre l'incendie	Extincteurs	r_p	0,5	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 2 630/8 760	P_P	0,3	Équation (B.14)
Facteur relatif aux matériels dans la zone	t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	1	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Non blindé (conducteurs de boucle dans le même conduit)	K_{S3}	0,2	Tableau B.10
Câblage interne (ligne de communication)	Non blindé (conducteurs de boucle avec différents acheminements)		1	
Facteur de tension de tenue (réseau interne de puissance)	U_W = 2,5 kV			
Facteur de tension de tenue (réseau interne de communication)	U_W = 1,5 kV			
Type de zone en fonction des pertes	Zone à perte normale	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	
	Personnes blessées par incendie	L_{F1}	5×10^{-2}	
	Dommages physiques causés par un incendie	L_{F2}	5×10^{-2}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	5×10^{-2}	

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Tableau F.20 – Bâtiment de bureaux: facteurs valables pour la zone Z_5 (centre informatique)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Type de plancher	Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Faible	r_f	10^{-3}	Tableau B.6
Protection contre l'incendie	Installation d'alarme automatique	r_p	0,2	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 2 200/8 760	P_P	0,25	Équation (B.14)
Facteur relatif aux matériels dans la zone	t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	1	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Non blindé (conducteurs de boucle dans le même conduit)	K_{S3}	0,2	Tableau B.10
Câblage interne (ligne de communication)	Non blindé (conducteurs de boucle avec différents acheminements)		1	
Facteur de tension de tenue (réseau interne de puissance)	U_W = 2,5 kV			
Facteur de tension de tenue (réseau interne de communication)	U_W = 1,5 kV			
Type de zone en fonction des pertes	Zone à pertes élevées	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	
	Personnes blessées par incendie	L_{F1}	10^{-1}	
	Dommages physiques causés par un incendie	L_{F2}	10^{-1}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	5×10^{-2}	

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F.3.5 Appréciation du risque

Le risque R peut être exprimé selon l'Équation (1). Les composantes impliquées sont indiquées dans le Tableau F.15 et les valeurs de risque dans le Tableau F.21.

Tableau F.21 – Bâtiment de bureaux: risque pour la structure non protégée (valeurs × 10^{-5})

Symbole	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	0,002	≈ 0	≈ 0	≈ 0	≈ 0
R_{AD}	-	2,259	-	-	-
R_B	-	-	5,770	0,179	0,137
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,756	0,023	0,018
R	0,002	2,259	6,526	0,202	0,156
R_T	1				

Comme, dans les zones Z_2 et Z_3, le risque est supérieur à la valeur tolérable $R_T = 10^{-5}$, une protection contre la foudre de la structure est exigée pour atténuer le risque dans ces zones.

F.3.6 Évaluation de la fréquence des dommages

La fréquence des dommages F peut être exprimée selon l'Équation (12). Les composantes de fréquence doivent être évaluées conformément au 9.2. Les composantes impliquées et l'évaluation de la fréquence des dommages sont données dans le Tableau F.22.

Tableau F.22 – Bâtiment de bureaux: fréquence des dommages pour la structure non protégée

Symbole	Z_1	Z_2	Z_3	Z_4	Z_5
F_C	-	-	0,11	0,11	0,11
F_M	-	-	0,398	0,398	0,398
F_{WP}	-	-	0,007	0,007	0,007
F_{WT}	-	-	-	-	-
F_{ZP}	-	-	0,0692	0,0692	0,0692
F_{ZT}	-	-	-	-	-
F	-	-	0,584	0,584	0,584
F_T	-	-	0,05	0,05	0,05

Comme la fréquence des dommages F est supérieure à la valeur tolérable $F_T = 5 \times 10^{-2}$, une protection contre la foudre est exigée pour la structure afin de réduire la fréquence des dommages.

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F.3.7 Risque – Choix de mesures de protection

D'après le Tableau F.21, la zone exposée au risque le plus élevé est la zone Z_3 (archives) en raison de la valeur élevée du risque d'incendie (composantes de risque R_B et R_V).

Des mesures de protection appropriées pour réduire le risque R dans la zone Z_3 consistent à installer un SPF de NPF II afin de protéger le bâtiment, ce qui réduit la composante de risque R_B dans les zones Z_2, Z_3, Z_4 et Z_5. D'après le Tableau B.3, cela permet de réduire la valeur de P_{LPS} de 1 à 0,05, la valeur de P_{EB} de 1 à 0,02 (en raison des parafoudres sur les lignes connectées) et, enfin, les valeurs de P_U et de P_V par le même facteur.

Pour la liaison équipotentielle, le SPF est équipé de parafoudres installés sur la ligne de puissance, à l'entrée de la ligne dans la structure.

L'application de ces mesures de protection permet d'obtenir de nouvelles valeurs de composantes de risque, comme cela est indiqué dans le Tableau F.23.

Tableau F.23 – Composantes de risque pour la structure protégée (valeurs × 10^{-5})

Symbole	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0
R_{AD}	-	0,113	-	-	-
R_B	-	-	0,577	0,018	0,014
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,015	≈ 0	≈ 0
R	≈ 0	0,113	0,592	0,018	0,014
R_T	1				

F.3.8 Fréquence des dommages – Choix de mesures de protection

Pour réduire la fréquence des dommages F à la valeur exigée ($F_T = 5 \times 10^{-2}$), la mesure appropriée consiste à installer un système de protection par parafoudres coordonnés afin de protéger les réseaux internes connectés à la ligne de puissance.

La ligne de communication à l'intérieur du bâtiment est une ligne non blindée en cuivre et la protection du matériel de communication est donc également nécessaire, puisque cela a une incidence sur les composantes F_C et F_M.

D'après le Tableau F.22, un NPF II destiné à protéger les réseaux internes connectés à la ligne de puissance est approprié pour les systèmes de protection par parafoudres coordonnés. Le même NPF II est utilisé pour le parafoudre qui protège le matériel de communication interne.

Ce parafoudre réduit la valeur de P_{SPD} qui s'applique à la fréquence des dommages F_1 dans les zones Z_3, Z_4 et Z_5 de 1 à 0,02 et réduit également la valeur de P_{SPD} qui s'applique aux fréquences des dommages F_2, F_3 et F_4. Les nouvelles valeurs des composantes de la fréquence des dommages sont indiquées dans le Tableau F.24.

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Tableau F.24 – Bâtiment de bureaux: fréquence des dommages pour la structure protégée

Symbole	Z_3	Z_4	Z_5
F_C	0,004	0,004	0,004
F_M	0,008	0,008	0,008
F_{WP}	≈ 0	≈ 0	≈ 0
F_{WT}	-	-	-
F_{ZP}	0,001	0,001	0,001
F_{ZT}	-	-	-
F	0,014	0,014	0,014
F_T	0,05	0,05	0,05

F.3.9 Conclusions

Le risque R et la fréquence des dommages F peuvent être réduits tous les deux au-dessous du niveau tolérable en installant:

– un SPF de NPF II pour protéger le bâtiment;

– un système de protection par parafoudres coordonnés de NPF II pour les réseaux de puissance et un parafoudre de NPF II pour le matériel de communication.

NOTE L'alarme incendie a été prise en compte dans le calcul des risques, car elle était protégée contre les surtensions et d'autres dommages et que les pompiers peuvent intervenir en moins de 10 min, comme cela est indiqué à l'Article B.4.

F.4 Hôpital

F.4.1 Données et caractéristiques pertinentes

Une étude de cas plus complexe concerne un établissement hospitalier classique qui comprend un bloc chambres, un bloc opératoire et une unité de soins intensifs.

L'hôpital est situé dans une région plate sans structures environnantes. La densité de points d'impact au sol de la foudre est N_{SG} = 8 (nombre d'impacts par km^2 et par an).

L'hôpital est desservi par une ligne de puissance et une ligne de communication. Deux parties conductrices externes sont reliées à la structure (canalisation d'eau et canalisation de gaz).

La ligne de communication est constituée de fibronique sans métal, à l'instar des réseaux internes auxquels elle est raccordée. Comme il est impossible de transmettre ou d'induire des chocs sur des lignes ou des circuits fibroniques, ces lignes et réseaux internes peuvent être négligés dans l'appréciation du risque et dans l'évaluation de la fréquence des dommages.

Les données relatives au bâtiment et à son environnement sont indiquées dans le Tableau F.25.

Les données relatives à la ligne de puissance entrante et aux réseaux internes connectés à cette ligne sont indiquées dans le Tableau F.26.

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Tableau F.25 – Hôpital: caractéristiques de l'environnement et de la structure

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Densité de points d'impact au sol de la foudre (nombre de points d'impact par km^2 et par an)		N_{SG}	8,0	
Facteur qui lie N_G à N_{SG}		k	2	Article A.1
Dimensions de la structure (m)		L, W, H	50, 150, 10	
Facteur d'emplacement de la structure	Structure isolée	C_D	1	A.2.3, Tableau A.1
Matériau de construction	Béton armé	P_S	0,5	Article B.4, Tableau B.4
Blindage de la structure	Aucun	K_{S1}	1	Article B.6, Équation (B.8)
Facteur d'environnement	Suburbain	C_E	0,5	Article A.4, Tableau A.4
SPF	Aucun	P_{LPS}	1	Article B.3, Tableau B.3
TWS	Aucun	P_{TWS}	1	Article B.1

Tableau F.26 – Hôpital: ligne de puissance

Paramètre d'entrée		Commentaire	Symbole	Valeur	Référence
Section HT	Longueur (m)		L_L	1 000	Article A.4
	Facteur d'installation	Enterrée	C_I	0,3	Tableau A.2
	Facteur de type de ligne	Ligne HT	C_T	0,2	Tableau A.3
	Facteur d'environnement	Suburbain	C_E	0,5	Tableau A.4
	Blindage de ligne (Ω/km)	Non blindée	R_S	–	
Section BT	Longueur (m)		L_L	50	
	Facteur d'installation	Enterrée	C_I	0,3	Tableau A.2
	Facteur de type de ligne	Ligne BT	C_T	1	Tableau A.3
	Facteur d'environnement	Suburbain	C_E	0,5	Tableau A.4
	Blindage de ligne (Ω/km)	Non blindée	R_S	–	
Blindage, mise à la terre, isolation		Aucun	C_{LD}	1	Tableau B.9
			C_{LI}	1	
Liaison équipotentielle		Aucun	P_{EB}	1	Tableau B.13
Structure adjacente		Aucun	L_J, W_J, H_J	–	La longueur de la ligne HT est de 1 km
Facteur d'emplacement de la structure adjacente		Aucun	C_{DJ}	–	Tableau A.1
Tension de tenue du réseau interne (kV)			U_W	2,5	
Nombre de conducteurs		Conducteurs 3 phases + neutre	n_P	4	Tableau B.7
		Paramètre			

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Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Distance latérale pour S2 (m)		r_{MP}	140	$350/U_{WP}$, voir l'Équation (A.8)
Distance latérale pour S4 (m)		r_{IP}	384	$2\,000/U_{WP}^{1,8}$, voir l'Équation (A.12)

F.4.2 Calcul du nombre annuel prévisible d'événements dangereux

Les résultats des calculs sont donnés dans le Tableau F.27 pour les surfaces d'exposition et dans le Tableau F.28 pour le nombre prévisible d'événements dangereux.

Tableau F.27 – Hôpital: surfaces d'exposition de la structure et de la ligne de puissance

	Symbole	Résultat m^2	Équation de référence
Structure	A_D	$2{,}23 \times 10^4$	Équation (A.3)
	A_M	$1{,}18 \times 10^5$	Équation (A.8)
Ligne de puissance	A_{LP1}	$4{,}00 \times 10^4$	Équation (A.10)
	A_{IP1}	$7{,}69 \times 10^5$	Équation (A.12)
	A_{LP2}	$2{,}00 \times 10^3$	Équation (A.10)
	A_{IP2}	$3{,}84 \times 10^4$	Équation (A.12)

Tableau F.28 – Hôpital: nombre annuel prévisible d'événements dangereux

	Symbole	Résultat 1/an	Équation de référence
Structure	N_D	$1{,}79 \times 10^{-1}$	Équation (A.5)
	N_M	$4{,}70 \times 10^{-1}$	Équation (A.7)
Ligne de puissance	N_{LP1}	$9{,}6 \times 10^{-3}$	Équation (A.9)
	N_{IP1}	$9{,}23 \times 10^{-2}$	Équation (A.11)
	N_{LP2}	$2{,}4 \times 10^{-3}$	Équation (A.9)
	N_{IP2}	$2{,}31 \times 10^{-2}$	Équation (A.11)
	N_{LP}	$1{,}2 \times 10^{-2}$	
	N_{IP}	$1{,}15 \times 10^{-1}$	

F.4.3 Évaluation des risques

Il convient, en premier lieu, d'identifier la façon dont la structure peut être découpée en zones. Pour chaque zone, le risque R et la fréquence des dommages F causés aux réseaux internes sont évalués.

Ceci entraîne:

a) la nécessité de déterminer le risque R et de le comparer au risque tolérable $R_T = 10^{-5}$ (7.3). Si nécessaire, des mesures de protection adaptées pour atténuer ce risque sont choisies. Les composantes de risque sont évaluées conformément au Tableau 3;

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b) la nécessité de déterminer la fréquence de dommages F et de la comparer au risque tolérable exigé F_T (9.3). Dans ce cas, d'après les évaluations relatives à la qualité du service fourni par l'hôpital, la fréquence tolérable des dommages a été fixée par le Directeur général de l'hôpital à la valeur $F_T = 10^{-2}$ pour le bloc opératoire et l'unité de soins intensifs, et à la valeur $F_T = 5 \times 10^{-2}$ pour le bloc chambres. Si nécessaire, des mesures de protection adaptées sont choisies pour réduire cette fréquence des dommages. Les composantes de la fréquence de dommages sont évaluées conformément au 9.2.

F.4.4 Définition des zones de l'hôpital

Les zones suivantes sont définies comme suit:

Z_1 (zone d'entrée à l'extérieur);

Z_2 (toiture);

Z_3 (bloc chambres);

Z_4 (bloc opératoire);

Z_5 (unité de soins intensifs);

en tenant compte des éléments suivants:

– le type de surface est différent à l'intérieur et à l'extérieur;
– deux compartiments isolés à l'épreuve du feu existent: un pour le bloc chambres (Z_3) et l'autre pour le bloc opératoire et l'unité de soins intensifs (Z_4 et Z_5);
– dans toutes les zones intérieures Z_3, Z_4 et Z_5, des réseaux internes sont connectés à la ligne de puissance;
– il n'y a pas de blindages spatiaux;
– l'unité de soins intensifs contient de nombreux réseaux de communication sensibles et un blindage spatial peut être adopté comme mesure de protection;
– les personnes qui se trouvent dans les zones extérieures Z_1 et Z_2 sont protégées contre un impact direct par la structure ou son SPF extérieur et il n'est donc pas nécessaire de calculer R_B pour ces zones dans cet exemple;
– les personnes qui se trouvent dans les zones extérieures Z_1 et Z_2 ne sont pas protégées contre des tensions de contact dues à un impact direct sur la structure et il est donc nécessaire de calculer R_{AT} pour ces zones.

L'utilisation de valeurs inférieures à 1 pour r_p a été choisie en accord avec le propriétaire du bâtiment (voir l'Article B.4).

Les valeurs de durée de présence annuelle des personnes dans chacune des zones et les composantes de risque à prendre en compte sont indiquées dans le Tableau F.29.

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Tableau F.29 – Hôpital: durée de présence des personnes et composantes de risque dans les zones

Zone	Durée de présence heures/année	Composantes de risque								
		R_{AT}	R_{AD}	R_B	R_C	R_M	R_U	R_V	R_W	R_Z
Z_1 (entrée à l'extérieur)	175	X								
Z_2 (toiture)	90	X	X				X			
Z_3 (bloc chambres)	8 760	X		X	X	X	X	X	X	X
Z_4 (bloc opératoire)	3 100	X		X	X	X	X	X	X	X
Z_5 (unité de soins intensifs)	8 760	X		X	X	X	X	X	X	X

Les paramètres définis pour les zones Z_1 à Z_5 sont donnés dans les Tableaux F.30 à F.34.

Tableau F.30 – Hôpital: facteurs valables pour la zone Z_1 (à l'extérieur du bâtiment)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Surface de sol	Béton	r_t	10^{-2}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Aucun	r_f	-	Tableau B.6
Protection contre l'incendie	Aucun	r_p	-	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 175/8 760	P_P	0,02	Équation (B.14)
Facteur relatif aux matériels dans la zone	Non applicable	P_e	-	Équation (B.15)
Blindage de la zone	Aucun	K_{S2}	-	Équation (B.9)
Câblage interne (ligne de puissance)	Pas de réseaux internes	K_{S3P}	-	Tableau B.10
Câblage interne (ligne de communication)	Pas de réseaux internes	K_{S3T}	-	
Type de zone en fonction des pertes	Zone à faibles pertes	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	Tableau C.2
	Personnes blessées par incendie	L_{F1}	-	
	Dommages physiques causés par un incendie	L_{F2}	-	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	-	

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Tableau F.31 – Hôpital: facteurs valables pour la zone Z_2 (toiture)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Surface de sol	Asphalte	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Équipe de maintenance présente dans la zone exposée	P_o	1	Article B.3
Risque d'incendie	Aucun	r_f	0	Tableau B.6
Protection contre l'incendie	Aucun	r_p	-	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 90/8 760	P_P	0,01	Équation (B.14)
Facteur relatif aux matériels dans la zone	Non applicable	P_e	-	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	-	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	-	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	-	Équation (B.9)
Câblage interne (ligne de puissance)	Non applicable	K_{S3P}	-	Tableau B.10
Câblage interne (ligne de communication)	Pas de réseaux internes	K_{S3T}	-	
Type de zone en fonction des pertes	Zone à faibles pertes	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	10^{-1}	Tableau C.2
	Personnes blessées par incendie	L_{F1}	-	
	Dommages physiques causés par un incendie	L_{F2}	-	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	-	
Valeur tolérable	Risque	R_T	10^{-5}	Tableau B.2
	Fréquence des dommages	F_T	-	Tableau B.1

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Tableau F.32 – Hôpital: facteurs valables pour la zone Z_3 (chambres)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Type de plancher	Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Ordinaire	r_f	10^{-2}	Tableau B.6
Protection contre l'incendie	Alarme automatique	r_p	0,2	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 8 760/8 760	P_P	1	Équation (B.14)
Facteur relatif aux matériels dans la zone	t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	1	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Non blindé (conducteurs de boucle dans le même conduit)	K_{S3P}	0,2	Tableau B.10
Câblage interne (ligne de communication)	Câbles fibroniques non métalliques	K_{S3T}	-	
Facteur de tension de tenue (réseau interne de puissance)	U_W = 2,5 kV			
Facteur de tension de tenue (réseau interne de communication)	Non applicable			
Type de zone en fonction des pertes	Zone à pertes élevées	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	Tableau C.2
	Personnes blessées par incendie	L_{F1}	10^{-1}	
	Dommages physiques causés par un incendie	L_{F2}	10^{-1}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	10^{-3}	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	5×10^{-2}	

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Tableau F.33 – Hôpital: facteurs valables pour la zone Z_4 (bloc opératoire)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Type de plancher	Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Faible	r_f	10^{-3}	Tableau B.6
Protection contre l'incendie	Installations d'alarmes automatiques	r_p	0,2	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 3 100/8 760	P_P	0,35	Équation (B.14)
Facteur relatif aux matériels dans la zone	t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	-	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Non blindé (conducteurs de boucle dans le même câble)	K_{S3P}	0,01	Tableau B.10
Câblage interne (ligne de communication)	Câbles fibroniques non métalliques	K_{S3T}	-	
Facteur de tension de tenue (réseau interne de puissance)	U_W = 2,5 kV			
Facteur de tension de tenue (réseau interne de communication)	Non applicable			
Type de zone en fonction des pertes	Zone à pertes très élevées	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	Tableau C.2
	Personnes blessées par incendie	L_{F1}	2×10^{-1}	
	Dommages physiques causés par un incendie	L_{F2}	2×10^{-1}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	10^{-2}	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	10^{-2}	

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Tableau F.34 – Hôpital: facteurs valables pour la zone Z_5 (unité de soins intensifs)

Paramètre d'entrée	Commentaire	Symbole	Valeur	Référence
Type de plancher	Linoléum	r_t	10^{-5}	Tableau B.2
Protection contre les chocs (impact sur la structure)	Aucun	P_{am}	1	Tableau B.1
Position des personnes dans la zone exposée	Non applicable	P_o	-	Article B.3
Risque d'incendie	Faible	r_f	10^{-3}	Tableau B.6
Protection contre l'incendie	Installations d'alarmes automatiques	r_p	0,2	Tableau B.5
Facteur relatif aux personnes dans la zone	t_z/8 760 = 8 760/8 760	P_P	1	Équation (B.14)
Facteur relatif aux matériels dans la zone	t_e/8 760 = 8 760/8 760	P_e	1	Équation (B.15)
Système de parafoudres (ligne de puissance)	Aucun	P_{SPD}	1	Tableau B.7
Système de parafoudres (ligne de communication)	Aucun	P_{SPD}	1	Tableau B.8
Blindage de la zone	Aucun	K_{S2}	1	Équation (B.9)
Câblage interne (ligne de puissance)	Non blindé (conducteurs de boucle dans le même câble)	K_{S3P}	0,01	Tableau B.10
Câblage interne (ligne de communication)	Câbles fibroniques non métalliques	K_{S3T}	-	
Facteur de tension de tenue (réseau interne de puissance)	U_W = 2,5 kV			
Facteur de tension de tenue (réseau interne de communication)	Non applicable			
Type de zone en fonction des pertes	Zone à pertes très élevées	-	-	Tableau C.2
L: pertes	Personnes blessées par des tensions de contact et de pas	L_T	10^{-2}	Tableau C.2
	Personnes blessées par impact direct	L_D	-	Tableau C.2
	Personnes blessées par incendie	L_{F1}	2×10^{-1}	
	Dommages physiques causés par un incendie	L_{F2}	2×10^{-1}	
	Personnes blessées en raison de défaillances des réseaux internes	L_O	10^{-2}	
Valeur tolérable	Risque	R_T	10^{-5}	
	Fréquence des dommages	F_T	10^{-2}	

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S12298Text Modification

F.4.5 Appréciation du risque

Le risque R peut être exprimé selon l'Équation (1). Les composantes impliquées sont indiquées dans le Tableau F.29 et les valeurs de risque dans le Tableau F.35.

Tableau F.35 – Hôpital: risque pour la structure non protégée (valeurs × 10^{-5})

Symbole	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	0,036	≈ 0	0,002	0,001	0,002
R_{AD}	-	18 357	-	-	-
R_B	-	-	3,572	0,484	0,714
R_C	-	-	17,862	63,213	178,619
R_M	-	-	1,881	0,017	0,047
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,480	0,065	0,096
R_W	-	-	1,200	4,247	12,000
R_Z	-	-	11,531	40,807	115,308
R	0,036	18 357	36,528	108,834	306,787
R_T	1				

Comme, dans les zones Z_2, Z_3, Z_4 et Z_5, le risque R est supérieur à la valeur tolérable $R_T = 10^{-5}$, une protection contre la foudre de la structure est exigée pour atténuer le risque dans ces zones.

F.4.6 Évaluation de la fréquence des dommages

La fréquence des dommages F peut être exprimée selon l'Équation (12). Les composantes de fréquence doivent être évaluées conformément au 9.2. Les composantes impliquées et l'évaluation de la fréquence totale sont données dans le Tableau F.36.

Tableau F.36 – Hôpital: fréquence des dommages pour la structure non protégée

Symbole	Z_3	Z_4	Z_5
F_C	0,179	0,179	0,179
F_M	0,019	≈ 0	≈ 0
F_W	0,012	0,012	0,012
F_Z	0,115	0,115	0,115
F	0,325	0,306	0,306
F_T	0,05	0,01	0,01

NOTE Aucune valeur n'est spécifiée pour la zone Z_2, puisque le Tableau F.31 indique que la zone Z_2 ne contient aucun matériel.

La considération suivante peut être faite en s'appuyant sur le Tableau F.36: comme la fréquence des dommages F est supérieure aux valeurs tolérables F_T dans toutes les zones où des réseaux internes sont installés, une protection du matériel contre les chocs est exigée dans la structure afin de réduire la fréquence des dommages

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S12298Text Modification

F.4.7 Risque – Choix de mesures de protection

D'après le Tableau F.35, les zones exposées au risque le plus élevé sont en général les suivantes:

– Z_5 (unité de soins intensifs);

– Z_4 (bloc opératoire); en raison de la valeur élevée des défaillances des réseaux internes R_C (composante de risque R_C ≈ 70 % du risque total dans la zone correspondante), il est nécessaire de réduire P_C.

Des valeurs de risque élevées sont également constatées dans les zones suivantes:

– Z_3 (bloc chambres), en raison de la valeur élevée de présence de personnes dans la zone (composantes de risque R_B, R_C et R_Z);

– Z_2 (toiture), en raison de la forte probabilité d'un impact de foudre direct sur des personnes qui se tiennent debout dans la zone exposée (composante de risque R_{AD}).

Ces composantes de risque prédominantes peuvent être réduites par les mesures suivantes:

a) placer dans le bâtiment un panneau d'avertissement qui interdit au personnel de maintenance d'aller sur la toiture pendant un orage, ce qui réduit la composante de risque R_{AD} (P_{am} = 0,1 pour la zone Z_2);

b) équiper l'ensemble du bâtiment (y compris les zones exposées sur la toiture) d'un SPF de classe II conforme à l'IEC 62305-3, ce qui réduit les composantes R_{AD} et R_B par la probabilité P_{LPS} = 0,05. Pour la liaison équipotentielle, le SPF est équipé de parafoudres installés sur la ligne de puissance, à l'entrée de la ligne dans la structure (NPF II). L'établissement obligatoire de la liaison équipotentielle de foudre réduit également les composantes R_U et R_V par l'intermédiaire de la probabilité P_{EB} = 0,02;

c) équiper les zones Z_3, Z_4 et Z_5 d'un système de protection par parafoudres coordonnés conforme à l'IEC 62305-4 pour les réseaux internes de puissance. Ceci permet de réduire les composantes R_C, R_M et R_W et R_Z par l'intermédiaire de la probabilité P_{SPD}.

- Zone Z_3: NPF I, P_{SPD} = 0,01;
- Zone Z_4: meilleur que le NPF I, P_{SPD} = 0,002;
- Zone Z_5: meilleur que le NPF I, P_{SPD} = 0,002.

Avec cette solution, les valeurs de risque du Tableau F.35 varient pour conduire aux valeurs réduites indiquées dans le Tableau F.37.

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S12298Text Modification

Tableau F.37 – Hôpital: risque pour la structure protégée (valeurs × 10^{-5})

Symbole	Z_1	Z_2	Z_3	Z_4	Z_5
R_{AT}	0,002	≈ 0	≈ 0	≈ 0	≈ 0
R_{AD}	-	0,092	-	-	-
R_B	-	-	0,357	0,048	0,071
R_C	-	-	0,179	0,126	0,357
R_M	-	-	0,019	≈ 0	≈ 0
R_U	-	-	≈ 0	≈ 0	≈ 0
R_V	-	-	0,010	0,001	0,002
R_W	-	-	0,012	0,008	0,024
R_Z	-	-	0,115	0,082	0,231
R	0,002	0,092	0,692	0,266	0,685
R_T	1				

F.4.8 Fréquence des dommages – Choix de mesures de protection

Pour réduire la fréquence des dommages F à la valeur exigée F_T, la mesure appropriée consiste à installer un système de protection par parafoudres coordonnés afin de protéger les réseaux internes connectés à une ligne de puissance.

D'après le Tableau F.38, la solution à utiliser pour réduire le risque R s'applique également pour réduire la fréquence des dommages. Un système de protection par parafoudres coordonnés convient pour protéger les réseaux internes connectés à une ligne de puissance.

Un tel système SPD réduit la valeur de P_{SPD} dans la zone Z_3 de 1 à 0,01, et dans les zones Z_4 et Z_5 de 1 à 0,002. Les nouvelles valeurs des composantes de la fréquence des dommages sont indiquées dans le Tableau F.38.

Tableau F.38 – Hôpital: fréquence des dommages pour la structure protégée

Symbole	Z_3	Z_4	Z_5
F_C	0,001 8	0,000 4	0,000 4
F_M	0,000 2	≈ 0	≈ 0
F_W	0,000 1	≈ 0	≈ 0
F_Z	0,001 1	0,000 2	0,000 2
F	0,003 2	0,000 6	0,000 6
F_T	0,05	0,01	0,01
NOTE Dans ce tableau, des nombres à 4 décimales sont utilisés en raison des valeurs très faibles.			

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S12298Text Modification

F.4.9 Conclusions

Le risque R et la fréquence des dommages F peuvent être réduits tous les deux au-dessous du niveau tolérable en installant:

– un panneau d'avertissement qui interdit au personnel de maintenance d'aller sur la toiture lors d'orages;

– un SPF de classe II pour protéger le bâtiment et les zones exposées sur la toiture, ce qui comprend l'établissement d'une liaison équipotentielle pour la ligne de puissance entrante pour un NPF II;

– un système de protection par parafoudres coordonnés pour les réseaux de puissance dans toutes les zones.

NOTE L'alarme incendie a été prise en compte dans le calcul des risques, car elle était protégée contre les surtensions et d'autres dommages et que les pompiers ont pu intervenir en moins de 10 min, comme cela est indiqué à l'Article B.4.

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S12298-G5General Comment

I am George Portfleet a member of the United Lightning Protection Association. I am writing to voice my support for S12298, a proposal that promotes safer, more resilient Risk Category IV buildings, facilities critical to public safety during emergencies. Requiring a lightning risk assessment based on recognized national and international standards, this proposal will provide informed, objective decisions without mandating unnecessary systems. It enhances life safety, supports business continuity, and strengthens community resilience during Florida's frequent storm events.

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Mod_12298_G5_General_IBC 12298.pdf

S12298-G4General Comment

I am George Portfleet a member of the United Lightning Protection Association. I am writing to voice my support for S12298, a proposal that promotes safer, more resilient Risk Category IV buildings, facilities critical to public safety during emergencies. Requiring a lightning risk assessment based on recognized national and international standards, this proposal will provide informed, objective decisions without mandating unnecessary systems. It enhances life safety, supports business continuity, and strengthens community resilience during Florida's frequent storm events.

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S12298Rationale

The problem:

There is a lack of a standardized, detailed methodology within the IBC to assess and mitigate lightning risks specifically for Risk Category IV buildings and other structures. These buildings contain essential facilities (e.g., hospitals, emergency shelters) and also those buildings where the loss of function is a real hazard to the occupants/users. The assignment in Risk Category IV is to help ensure these buildings maintain functionality and safety during natural hazards; in this case severe weather events. This specialized code language will provide a systematic, accurate, and consistent approach to evaluating lightning risk for these essential uses and recommend protective measures.

Specific examples:

Lightning strikes can significantly disrupt hospital operations, affecting both infrastructure and patient care. Key impacts include:

Electrical and Electronic System Failures:

a. Power Supply Disruptions: Lightning can cause power outages, compromising critical systems. For instance, a 2017 lightning strike at a Florida hospital led to a fire and subsequent failure of backup power systems, necessitating the evacuation of 225 patients.
b. Equipment Damage: Sensitive medical devices are vulnerable to voltage spikes from lightning, potentially leading to malfunctions or complete failure. This can impede patient monitoring and treatment.

Communication System Interruptions:

a. Lightning-induced surges can disrupt hospital communication networks, including telephones, intercoms, and internet services, hindering coordination among medical staff and with external emergency services.

Structural Damage:

a. Direct lightning strikes can cause fires or physical damage to hospital buildings, posing safety risks to patients and staff and potentially leading to evacuations.

To safeguard against these risks, hospitals can implement comprehensive lightning protection systems. These mitigation measures include:

- External Protection: Installation of lightning rods and other systems to intercept strikes.
- Surge Protection Devices (SPDs): To shield electrical and electronic equipment from voltage spikes.
- Equipotential Bonding: Ensuring all conductive parts within the hospital are at the same electrical potential to prevent dangerous voltage differences during a lightning event.
- Regular Maintenance and Compliance: Adhering to standards such as NFPA 70, NFPA 780, and UL 96A to ensure the effectiveness of lightning protection systems.

Implementing these measures can enhance hospital resilience against lightning-related incidents, ensuring continuity of critical healthcare services.

S12298Rationale

Historical Losses:

Documented instances of lightning strikes have shown that they can cause fires in critical infrastructure, power outages disrupting emergency operations, and structural damage leading to costly repairs and operational downtime.

The quantification of Impact: The new language can incorporate data from past incidents to model the economic, structural, and human costs of lightning-related failures. This data-driven foundation helps stakeholders understand the necessity of robust lightning protection.

Over the past five years, lightning strikes have significantly impacted commercial properties in the United States, leading to substantial insurance claims and financial losses. Key statistics include:

- Percentage of Claims: Lightning-induced fires account for approximately 3% to 5% of all U.S. commercial property insurance claims annually. (Institute for Intergovernmental Research) https://www.iii.org/press-release/struck-by-lightning-how-businesses-canbecome-more-resilient-triple-i-and-lpi
- Annual Financial Impact: These incidents result in over $2 billion in insured losses each year for small and medium-sized businesses. (Institute for Intergovernmental Research) https://www.iii.org/press-release/when-lightning-strikes-how-business-canprotect-its-bottom-line
- Types of Damage: Lightning can cause fires, structural damage, and electrical system failures, leading to significant financial burdens for businesses. (Voss Law Firm) https://www.vosslawfirm.com/blog/a-guide-to-commercial-insurance-claims-for-lightningstrikes.
- While specific annual data for each of the past five years is limited, these figures highlight the consistent and substantial impact of lightning on commercial properties.

Implementing the analysis of the benefits of certified lightning protection systems and then securing appropriate insurance coverage are essential steps for businesses to mitigate these risks.

Lightning strikes have been responsible for several significant power outages. Notable instances include:

1. New York City Blackout (1977)

   Date: July 13–14, 1977

   Cause: A severe lightning storm led to a series of electrical failures, beginning with a lightning strike on a substation on the Hudson River. This initiated a cascading failure throughout the city's power grid.

   Impact: Approximately 9 million people were affected by the power outage, which lasted around 25 hours. The blackout resulted in widespread looting, arson, and significant property damage.

2. Southern Brazil Blackout (1999)

   Date: March 11, 1999

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Mod_12298_Rationale_Reason Statement.pdf

S12298Rationale

Cause: A lightning strike at an electricity substation in Bauru, São Paulo State, caused most of the 440kV circuits at the substation to trip. This led to a chain reaction resulting in a widespread power outage.

Impact: The blackout affected an estimated 75 to 97 million people across multiple states, including São Paulo, Rio de Janeiro, and Minas Gerais.

3. United Kingdom Power Outage (2019):

Date: August 9, 2019

Cause: A lightning strike on a transmission line led to the loss of 500 MW of embedded generation. Subsequently, two large generators, Little Barford Power Station and Hornsea Wind Farm, tripped, causing a significant drop in frequency.

Impact: Experienced power cuts for 15 to 20 minutes. The outage also caused substantial travel disruption, particularly on the railway network, and affected infrastructure such as Newcastle Airport and Ipswich Hospital.

These events highlight the vulnerability of power grids to lightning strikes and underscore the importance of robust infrastructure and responsive measures to mitigate such risks.

How does this increase protection?

This code change will provide the following safety enhancements:

- Reduce risk of structural fires and electrical surges caused by lightning.
- Protect occupants and critical assets within the buildings.
- Ensure that the functionality of the essential facilities continue.
- Failures in electrical systems can affect life-sustaining equipment, such as ventilators and infusion pumps, endangering patient health, especially in intensive care units.

This code change will also provide improvements to functionality that ensures continuity of operations for essential services during severe weather, such as healthcare and emergency response. It will also minimize downtime by integrating resilient design features and protective measures while also facilitating adherence to higher safety standards for critical infrastructure, ensuring alignment with federal or state mandates.

Other Thoughts:

The proposed language can also accommodate different geographic and environmental factors by including variables like regional lightning density, soil conductivity, and building materials to tailor recommendations.

The proposed language could include cost-benefit analyses of different protection systems, enabling informed decisions about resource allocation. The Cost per Square Foot for Low-Rise Buildings is approximately $2.10 to $2.70 per square foot of roof area and Five-Story Buildings is approximately $1.50 to $1.90 per square foot of roof area.

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Mod_12298_Rationale_Reason Statement.pdf

S12298Rationale

The new language should help streamline assessments to integrate seamlessly into design and approval phases, avoiding delays in the construction timeline.

Cost Impact: Increase

Estimated Immediate Cost Impact: The proposed language could include cost-benefit analyses of different protection systems, enabling informed decisions about resource allocation. The Cost per Square Foot of such systems for Low-Rise Buildings is approximately $2.10 to $2.70 per square foot of roof area and Five-Story Buildings is approximately $1.50 to $1.90 per square foot of roof area for the installation of such protective systems based on industry studies. It should be noted however that the code change only requires the hazard assessment for Risk Category IV buildings or structures and that is considerably less in cost. The decision to install such a protective system would be a factor in whether or not it was needed for the use.

Estimated Immediate Cost Impact Justification (methodology and variables): The cost impacts are based on industry studies. It is a simple cost of system over roof area provided. The new language should help streamline assessments to integrate seamlessly into design and approval phases, avoiding delays in the construction timeline.

Estimated Life Cycle Cost Impact: This proposal only requires an analysis of whether the use needs protection from lightning storms. Therefore it is only a slight increase.

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TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

21

S12167

Date Submitted	02/16/2025	**Section**	1709.5.1	**Proponent**	Milad Shabanian
Chapter	17	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language Yes**

Related Modifications

Summary of Modification

Revise exterior windows and doors provision with focus on water intrusion.

Rationale

See attached document.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
No impact to local entity relative to enforcement of code
Impact to building and property owners relative to cost of compliance with code
No impact to building and property owners relative to cost of compliance with code.
Impact to industry relative to the cost of compliance with code
No impact to building and property owners relative to cost of compliance with code
Impact to small business relative to the cost of compliance with code
No impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This change provides a reasonable solution improving public safety by providing requirements focusing on water intrusion.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Improves building construction and resistance against water intrusion during wind driven rain condition.
Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
No it does not.

Does not degrade the effectiveness of the code
No it does not.

Alternate Language

2nd Comment Period

S12167-A2

Proponent T Stafford **Submitted** 8/24/2025 12:44:58 PM **Attachments** No

Rationale:

This comment is one of two that are being submitted for consideration by the Structural TAC as alternatives to the original proposal. This comment maintains the deletion of the overhang exception to water intrusion testing for doors but would permit doors with a limited water rating (LW) as specified in AAMA/WDMA/CSA 101/I.S.2/A440. Products with an LW rating are characterized by a water intrusion test that is less than the minimum test pressure required for the indicated Performance Grade (typically at 0 psf). However, LW products are intended to be used in locations where adequate protection from water exposure is provided. The overhang exception in the current FBC will provide some protection of the door from wind driven rain. However, it clearly cannot protect doors from horizontal wind driven rain that occurs during hurricanes. Therefore, this comment deletes the overhang exception and specifically requires doors with an LW rating to be protected from water exposure as specified by the manufacturer or a registered design professional. This comment reflects a compromise from the original proposal. It requires some level of water intrusion testing but at much lower levels than required for doors installed in areas that are not adequately protected from water exposure.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Local entities will be required to ensure that doors with an LW rating are protected from water exposure as required by the manufacturer or a registered design professional.

Impact to building and property owners relative to cost of compliance with code

No impact to building and property owners relative to cost of compliance with code.

Impact to industry relative to the cost of compliance with code

No impact to industry relative to cost of compliance with code.

Impact to small business relative to the cost of compliance with code

No impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposed modification will provide improved water intrusion protection for doors.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification strengthens the code by providing improved water intrusion protection for doors.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

This proposed modification does not degrade the effectiveness of the code.

2nd Comment Period

S12167-A1

Proponent Jennifer Hatfield **Submitted** 8/23/2025 3:02:35 PM **Attachments** No

Rationale:

As discussed at the June TAC meeting, the proponent and industry asked for initial disapproval so we could work together to provide alternatives to deleting the existing language. This comment provides one option of how to address concerns but without removing a critical component of the code that is necessary in some instances when an owner needs to also consider accessibility and safety concerns that would result from a higher threshold. This alternative language will make it clear that door assemblies must have a limited water rating per the standard and must have an overhang installed. It also increases the overhang requirements for better protection from water intrusion.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Impact to small business relative to the cost of compliance with code

No impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This alternate language provides a reasonable solution to both better protect the public from water intrusion at the same time taking into account accessibility and safety requirements associated with a higher threshold.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Yes, it strengthens the code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not.

Does not degrade the effectiveness of the code

It does not.

1st Comment Period History

S12167-G1

Proponent Jennifer Hatfield Submitted 4/16/2025 4:00:26 PM Attachments No

Comment:

On behalf of the Fenestration & Glazing Industry Alliance (FGIA) we must oppose this proposal as it currently stands, along with its corresponding FBC, Residential proposal that would delete the exception to water intrusion testing for exterior doors that have an overhang spanning outward over the door of a specified length. At a minimum, some type of exception provision must be provided in the cases where accessibility requirements must be met. A ½ inch door threshold height required for accessibility has a high risk of water intrusion unless an overhang or other provisions are provided that reduce the water exposure to the door. Further, there are cases where a higher threshold becomes a safety concern due to the trip hazard that comes with it. Many older homeowners may prefer eliminating a trip hazard that could otherwise become a significant risk of falling with the possibility of serious medical conditions resulting from such an incident. In cases where a lower threshold is either required or preferred, requiring an overhang provides some level of protection rather than no protection at all. It is a balance between important water intrusion considerations and safety/accessibility considerations. As noted in the proponents rationale, FGIA looks forward to collaborating with IBHS, the Commission, and other interested parties to determine a solution that may modify the existing language rather than a complete deletion.

S12167-A2Text Modification

Further modify the proposal as follows:

1709.5.1 Exterior windows and doors. Exterior windows and sliding doors shall be tested and labeled as conforming to AAMA/WDMA/CSA101/I.S.2/A440 or TAS 202 (HVHZ shall comply with TAS 202 and ASTM E1300 or Section 2404). Exterior side-hinged doors shall be tested and labeled as conforming to AAMA/WDMA/CSA101/ I.S.2/A440 or comply with Section 1709.5.2. Products tested and labeled as conforming to AAMA/WDMA/CSA 101/I.S.2/A440 or TAS 202 shall not be subject to the requirements of Sections 2403.2 and 2403.3. Exterior windows and doors shall be labeled with a permanent label, marking, or etching providing traceability to the manufacturer and product. The following shall also be required either on a permanent label or on a temporary supplemental label applied by the manufacturer: information identifying the manufacturer, the product model/series number, positive and negative design pressure rating, product maximum size tested, impact-resistant rating if applicable, Florida product approval number or Miami-Dade product approval number, applicable test standard(s), and approved product certification agency, testing laboratory, evaluation entity or Miami-Dade product approval.

The labels are limited to one design pressure rating per referenced standard. The temporary supplemental label shall remain on the window or door until final approval by the building official.

Exceptions:

1. (*n*o change*)*

2. Door assemblies labeled with a limited water (LW) rating as specified in AAMA/WDMA/CSA 101/I.S.2/A440 shall be protected from water exposure in accordance with the door system manufacturer's applicable instructions or as determined by a *registered design professional*.

3 ~~2~~. (*no change*)

4 ~~3~~. (*no change*)

Page: 1

Mod12167_A2_TextOfModification.pdf

S12167-A1Text Modification

1709.5.1 Exterior windows and doors. Exterior windows and sliding doors shall be tested and labeled as conforming to AAMA/WDMA/CSA101/I.S.2/A440 or TAS 202 (HVHZ shall comply with TAS 202 and ASTM E1300 or Section 2404). Exterior side-hinged doors shall be tested and labeled as conforming to AAMA/WDMA/CSA101/ I.S.2/A440 or comply with Section 1709.5.2. Products tested and labeled as conforming to AAMA/WDMA/CSA 101/I.S.2/A440 or TAS 202 shall not be subject to the requirements of Sections 2403.2 and 2403.3. Exterior windows and doors shall be labeled with a permanent label, marking, or etching providing traceability to the manufacturer and product. The following shall also be required either on a permanent label or on a temporary supplemental label applied by the manufacturer: information identifying the manufacturer, the product model/series number, positive and negative design pressure rating, product maximum size tested, impact-resistant rating if applicable, Florida product approval number or Miami-Dade product approval number, applicable test standard(s), and approved product certification agency, testing laboratory, evaluation entity or Miami-Dade product approval.

The labels are limited to one design pressure rating per referenced standard. The temporary supplemental label shall remain on the window or door until final approval by the building official.

Exceptions:

1. (*no change*)

2. Door assemblies labeled with a Limited Water (LW) rating as specified in AAMA/WDMA/CSA 101/I.S.2/A440 shall be permitted to be installed where the overhang (OH) ratio is equal to or more than 1 ~~need not be tested for water infiltration~~. The overhang ratio shall be calculated by the following equation:

OH ratio = OH Length/OH Height

Where:

OH length = The minimum horizontal measure of how far a permanent overhang over a door projects outward in each direction of the exterior surface of the ~~from~~ door frame ~~surface~~ (refer to Figure A). For installations with side walls that have height equal to the overhang height on each side of the door and that extend the full length of the overhang that is perpendicular to the door, the overhang length that is parallel to the door need not be considered (refer to Figure B).

OH height = The maximum vertical measure of the distance from the bottom of the door frame ~~sill~~ to the bottom surface of the permanent overhang over the ~~a~~ door (refer to Figures A and B).

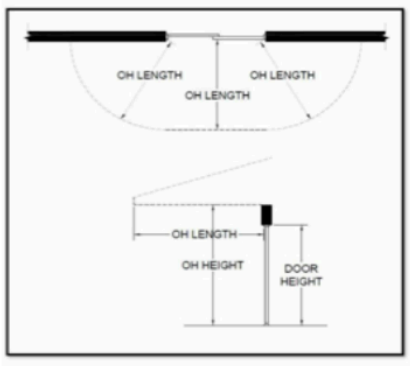


Figure A

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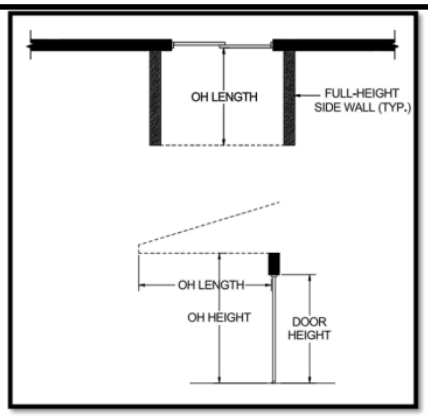


Figure B

3. (*no change*)

4. (*no change*)

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S12167Text Modification

1709.5.1 Exterior windows and doors. Exterior windows and sliding doors shall be tested and labeled as conforming to AAMA/WDMA/CSA101/I.S.2/A440 or TAS 202 (HVHZ shall comply with TAS 202 and ASTM E1300 or Section 2404). Exterior side-hinged doors shall be tested and labeled as conforming to AAMA/WDMA/CSA101/ I.S.2/A440 or comply with Section 1709.5.2. Products tested and labeled as conforming to AAMA/WDMA/CSA 101/I.S.2/A440 or TAS 202 shall not be subject to the requirements of Sections 2403.2 and 2403.3. Exterior windows and doors shall be labeled with a permanent label, marking, or etching providing traceability to the manufacturer and product. The following shall also be required either on a permanent label or on a temporary supplemental label applied by the manufacturer: information identifying the manufacturer, the product model/series number, positive and negative design pressure rating, product maximum size tested, impact-resistant rating if applicable, Florida product approval number or Miami-Dade product approval number, applicable test standard(s), and approved product certification agency, testing laboratory, evaluation entity or Miami-Dade product approval.

The labels are limited to one design pressure rating per referenced standard. The temporary supplemental label shall remain on the window or door until final approval by the building official.

Exceptions:

1. (*n*o change*)*

~~2. Door assemblies installed where the overhang (OH) ratio is equal to or more than 1 need not be tested for water infiltration. The overhang ratio shall be calculated by the following equation:~~

~~OH ratio = OH Length/OH Height where:~~

~~OH length = The horizontal measure of how far an overhang over a door projects out from door surface.~~

~~OH height = The vertical measure of the distance from the door sill to the bottom of the overhang over a door.~~

2 ~~3~~. (*no change*)

3 ~~4~~. (*no change*)

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Rationale:

This proposal is submitted on behalf of the Insurance Institute for Business and Home Safety (IBHS), based on observations from post-event investigations and experiments that highlight the need for this change.

This proposal deletes the exception to water intrusion testing for exterior doors that have an overhang spanning outward over the door of a specified length. AAMA/WDMA/CSA 101/I.S.2/A440 and TAS 202 require windows and doors to be tested for water intrusion. This exception to water intrusion testing in AAMA/WDMA/CSA 101/I.S.2/A440 and TAS 202 is unique to the Florida Building Code. It is not contained in either of the referenced standards nor the *International Codes*. An example of the application of the overhang exception is shown in the following illustration which is taken from Figure 3 of the FEMA *Hurricane Ian in Florida Recovery Advisory 3, Reducing Water Intrusion Through Windows and Doors (2023d)*:

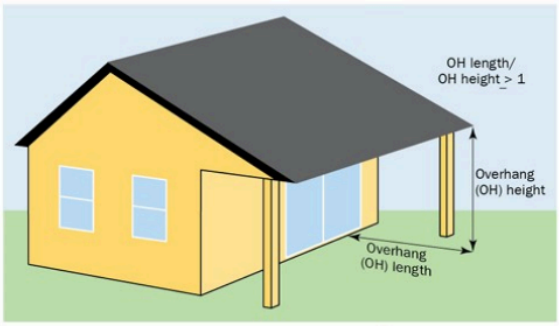


Figure 3: Overhang exception to water penetration testing for doors in the FBCB and FBCR.

This exception originated as a way to comply with the accessibility requirements but still provide some protection from water intrusion due to wind driven rain. A higher threshold or sill riser is often needed to provide the required resistance to water intrusion. However, a higher threshold or sill can in some instances be in conflict with the accessibility requirements for accessible routes. As currently written, this exception provides a blanket exemption to water intrusion testing regardless of whether the door is part of an accessible route or not.

This protection configuration will provide some protection of the door from wind driven rain. However, it clearly cannot protect doors from horizontal wind driven rain that occurs during hurricanes. Interior finishes and contents can be severely damaged by water intrusion through doors.

The FEMA Hurricane Ian in Florida Mitigation Assessment Team (MAT) report documented numerous homeowner reports of water intrusion through doors, particularly sliding glass doors, at nearly all sites visited. (See Section 4.2.3 and Figures 4-9 and 4-10 for examples provided in the FEMA Hurricane Ian in Florida Mitigation Team Assessment Report, FEMA P-2342 (https://www.fema.gov/sites/default/files/documents/fema_rm-hurriance-ian-mat-report-12-2023.pdf). The report notes that at this site, the exterior sliding doors had an overhang length the

S12167Rationale

exceeded the minimum length required to comply with the exception in the FBC. However, the homeowner reported significant water intrusion due to wind-driven rain through the sliding door.

This water intrusion can result in costly damage to interior contents and furnishings. The observations from the FEMA Hurricane Ian in Florida MAT led to the report recommending the following in Recommendation FL-12a:

The Florida Building Commission should collaborate with the window industry (Window and Door Manufacturers Association [WDMA], Fenestration and Glazing Industry Alliance, and key manufacturers) and other stakeholders to modify or delete the exceptions to water intrusion testing in the FBC. The FBC exempts doors from water intrusion testing required by American Architectural Manufacturers Association (AAMA)/WDMA/Canadian Standards Association (CSA) 101/I.S.2/A440, and TAS 202 for doors installed in certain conditions. While these installations may provide sufficient protection in areas outside hurricane-prone regions, it will not protect doors from the wind driven horizontal rain that commonly occurs during hurricanes. The entire State of Florida is within a hurricane-prone region.

This proposal, if approved, would implement this recommendation by deleting this exception to the required water intrusion testing in the specified referenced standards.

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Mod_12167_Rationale_FBCB-Overhang Exception_Rationale.pdf

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

22

S12274

Date Submitted	02/18/2025	**Section**	2304.10.8	**Proponent**	Cade Booth
Chapter	23	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

t601, 602.4, 703.8, 703.9, t705.5, 718.2.1, 722.7, 403.3.2, [F]3314.1, 2301.3, 2304.10.8, 2304.11.1.1, 2304.11.3, 2304.11.4, 1711.1, t1711.1, 1711.2, 110.3.14, 202, t504.3, t504.4, t506.2, 508.4.4.1, 509.4.1.1, 1405.5, 1406.2.1, 1406.3, 3102.3, 3102.6.1.1, D102.2.5, and refs ch 35.

Summary of Modification

The proposed updates the FBC to include mass timber, aligning it with national standards and advancements in building science, fire safety, and structural integrity. Backed by extensive research and testing, this ensures clear enforcement, cost-effective compliance, and statewide consistency.

Rationale

***PLEASE NOTE: Individual sections have been submitted in addition to and alongside the full chapter portions to allow for focused discussion or otherwise if needed. This proposed modification serves as a placeholder. *** For a comprehensive understanding of the proposed mass timber code modifications, be sure to review the full rationale statement PDF. It includes a summary of mass timber's history, the benefits of adoption for Florida, the need for action, and key supporting information. You'll also find links to technical resources and documents that provide further validation. Don't miss this essential guide to why mass timber belongs in the Florida Building Code! In summary, as mass timber construction continues to gain traction across the U.S., including within Florida, it is crucial for the Florida Building Code (FBC) to be updated to incorporate provisions for this proven and innovative construction method. With 40 states already adopting mass timber regulations based on the International Building Code (IBC), these proposed modifications align Florida with nationally recognized consensus codes. The changes will provide a clear, standardized framework for enforcement, streamline compliance for building owners and developers, and support greater design flexibility, all while maintaining rigorous fire safety and structural integrity standards. Adopting mass timber into the FBC will also help Florida keep pace with emerging construction technologies, ensuring the state can effectively regulate these advancements without compromising safety or performance.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Positive; lowers impact. Including mass timber in the FBC provides a consistent regulatory framework for building and fire code officials. It streamlines enforcement, reduces uncertainty, and improves efficiency in plan reviews and inspections by ensuring uniform standards across jurisdictions.

Impact to building and property owners relative to cost of compliance with code

Positive; lowers impact. The inclusion of mass timber offers a new construction method that can lower costs for building owners. A consistent regulatory approach statewide simplifies approvals, reduces delays, and allows owners to choose cost-effective materials without uncertainty.

Impact to industry relative to the cost of compliance with code

Positive; neutral or lowers impact. Including mass timber in the FBC gives builders and developers more construction options, increasing competition and potentially lowering costs. Consistent enforcement across the state reduces regulatory uncertainty and streamlines the approval process.

Impact to small business relative to the cost of compliance with code

Positive; lowers impact. Small businesses benefit from a uniform regulatory framework, reducing compliance costs. With mass timber, smaller firms can leverage prefabrication, shorter timelines, and cost savings, leading to more cost-effective projects and new business opportunities.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Yes. Mass timber has been thoroughly tested for structural integrity and fire performance, proving its safety and durability. Its inclusion in the Florida Building Code ensures consistent regulation statewide, reducing uncertainty for officials and enhancing safety through uniform enforcement.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Yes, strengthens and improves FBC. Mass timber, included in national codes since 2021, is supported by comprehensive research and testing. It offers a durable, fire-safe alternative that expands construction options without compromising safety, strengthening the code with new, tested materials.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No discrimination and aligns with national standards since its 2021 IBC inclusion. Adopted in 40 states, with 6 more in process, mass timber is not replacing existing methods but adds a tested, proven option, ensuring fairness in material selection without preference or restriction.

Does not degrade the effectiveness of the code

Adopting mass timber strengthens the FBC by adding structural and fire safety criteria validated by testing and research from the ICC TWB. It doesn't alter or weaken requirements for other construction types but ensures consistent enforcement of tested, nationally accepted standards.

2nd Comment Period

S12274-G1

Proponent Cade Booth Submitted 8/22/2025 3:20:26 PM Attachments No

Comment:

As promised, the AWC has offered and provided direct training to TAC members and engaged in multiple discussions to help resolve outstanding concerns. We look forward to continuing the conversation on the mass timber provisions at the second TAC meetings. This proposed change provides two options to demonstrate fire protection for connections in Types IV-A, IV-B, and IV-C construction: testing or engineering analysis. Connections that are part of a successful ASTM E119 fire resistance test are considered acceptable. For connections not included in such tests, an engineering analysis is required to show that the protection will limit temperature rise in all critical components. These provisions ensure that connections meet the same fire-resistance expectations as the mass timber elements themselves. More detailed information can be found under ICC code change record No S170-19.

S12274Text Modification

CHAPTER 23

WOOD

SECTION 2304
GENERAL CONSTRUCTION REQUIREMENTS

Add new section as follows:

2304.10.8 Fire protection of connections. Connections used with fire-resistance-rated members and in fire-resistance-rated assemblies of Type IV-A, IV-B or IV-C construction shall be protected for the time associated with the fire-resistance rating. Protection time shall be determined by one of the following:

1.Testing in accordance with Section 703.2 where the connection is part of the fire resistance test.

2.Engineering analysis that demonstrates that the temperature rise at any portion of the connection is limited to an average temperature rise of 250°F (139°C), and a maximum temperature rise of 325°F (181°C), for a time corresponding to the required fire-resistance rating of the structural element being connected. For the purposes of this analysis, the connection includes connectors, fasteners, and portions of wood members included in the structural design of the connection.

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FBC 9th edition – Mass Timber Package

Th following document is a comprehensive package of all code modifications related to mass timber proposals. It is provided for your reference as it is essential these proposals be able to be reviewed in context rather than in isolation, as the adoption of new construction types – Type IV-A, IV-B, and IV-C – has broad implications throughout the Florida Building Code. Having context of these provisions together ensures a clear understanding of their interconnections, facilitating informed decision-making regarding the integration of mass timber construction into the code.

The proposed modifications to the Florida Building Code have been organized in a presentation sequence for logic rather than strictly following the order of the code. This approach ensures that the rationale for mass timber construction is presented clearly, allowing stakeholders to understand the technical justification before diving into specific code provisions. This proposal package first establishes the construction types themselves – Types IV-A, IV-B, IV-C – to provide a foundational understanding. It then transitions into details of fire protection, followed by specific provisions necessary to integrate mass timber into the code. Finally, it addresses additional supporting provisions, including inspections, allowable heights and areas, and distinctions where existing code is applicable to the existing Type IV-HT only. The sequence is intended to provide a comprehensive package for consideration and refence for the inclusion of mass timber in the Florida Building Code, 9th edition.

A Table of Contents (in order of appearance in the package) and Index (in order of section reference) have been provided for reference.

Thank you.

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FBC 9th edition – Mass Timber Package

CHAPTER 6
TYPES OF CONSTRUCTION

SECTION 601
GENERAL

Revise table as follows:

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a,b,c]	1[b, c]	0[c]	1[b, c]	0	3[a]	2[a]	2[a]	HT	1	0
Bearing walls												
Exterior[e, f]	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	3	2	2	1/HT[g]	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	$1^1/_2$	1	1	HT	1	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

b. Where every part of the roof construction is 20 feet or more above the floor or mezzanine immediately below, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking, except where any of the following conditions apply.

1. In Group F-1, H, M, and S-1 occupancies.
2. Where the roof is an occupiable space.

Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

c. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members, where a 1-hour or less fire-resistance rating is required.

d. Not less than the fire-resistance rating required by other sections of this code.

e. Not less than the fire-resistance rating based on fire separation distance (see Table 705.5).

f. Not less than the fire-resistance rating as referenced in Section 704.10.

g. Heavy timber bearing walls supporting more than two floors or more than a floor and a roof shall have a *fire-resistance rating* of not less than 1 hour.

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SECTION 602
CONSTRUCTION CLASSIFICATION

Revise and add new sections as follows:

602.4 Type IV. ~~Type IV construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated wood, heavy timber (HT) or structural composite lumber (SCL) without concealed spaces. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, structural composite lumber (SCL), and cross-laminated timber and details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rating or heavy timber complying with Section 2304.11.2.2 shall be permitted.~~ Type IV construction is that type of construction in which the *building elements* are *mass timber* or noncombustible materials and have *fire-resistance ratings* in accordance with Table 601. *Mass timber* elements shall meet the *fire-resistance-rating* requirements of this section based on either the *fire-resistance rating* of the *noncombustible protection*, the *mass timber*, or a combination of both and shall be determined in accordance with Section 703.2. The minimum dimensions and permitted materials for *building elements* shall comply with the provisions of this section and Section 2304.11. *Mass timber* elements of Types IV-A, IV-B and IV-C construction shall be protected with *noncombustible protection* applied directly to the *mass timber* in accordance with Sections 602.4.1 through 602.4.3. The time assigned to the *noncombustible protection* shall be determined in accordance with Section 703.6 and comply with Section 722.7.

Cross-laminated timber shall be labeled as conforming to ANSI/APA PRG 320 as referenced in Section 2303.1.4.

Exterior *load-bearing walls* and *nonload-bearing walls* shall be *mass timber* construction, or shall be of noncombustible construction.

> **Exception:** Exterior *load-bearing walls* and *nonload-bearing walls* of Type IV-HT construction in accordance with Section 602.4.4.

The interior *building elements*, including *nonload-bearing walls* and partitions, shall be of *mass timber* construction or of noncombustible construction.

> **Exception:** Interior *building elements* and nonload-bearing walls and partitions of Type IV-HT construction in accordance with Section 602.4.4.

Combustible concealed spaces are not permitted except as otherwise indicated in Sections 602.4.1 through 602.4.4. Combustible stud spaces within light frame walls of Type IV-HT construction shall not be considered concealed spaces, but shall comply with Section 718.

In *buildings* of Type IV-A, IV-B, and IV-C construction with an occupied floor located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access, up to and including 12 *stories* or 180 feet (54 864 mm) above *grade plane*, *mass timber* interior exit and elevator hoistway enclosures shall be protected in accordance with Section 602.4.1.2. In *buildings* greater than 12 *stories* or 180 feet (54 864 mm) above *grade plane*, interior exit and elevator hoistway enclosures shall be constructed of noncombustible materials.

> **602.4.1 Type IV-A.** *Building elements* in Type IV-A construction shall be protected in accordance with Sections 602.4.1.1 through 602.4.1.6. The required *fire-resistance rating* of noncombustible elements and protected *mass timber* elements shall be determined in accordance with Section 703.2.
>
> > **602.4.1.1 Exterior protection.** The outside face of *exterior walls* of *mass timber* construction shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1). Components of the *exterior wall covering* shall be of noncombustible material except *water-resistive barriers* having a peak heat release rate of less than 150kW/m^2, a total heat release of

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less than 20 MJ/m^2 and an effective heat of combustion of less than 18MJ/kg as determined in accordance with ASTM E1354 and having a *flame spread index* of 25 or less and a *smoke-developed index* of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2.

602.4.1.2 Interior protection. Interior faces of all *mass timber* elements, including the inside faces of exterior *mass timber* walls and *mass timber* roofs, shall be protected with materials complying with Section 703.3.

602.4.1.2.1 Protection time. *Noncombustible protection* shall contribute a time equal to or greater than times assigned in Table 722.7.1(1), but not less than 80 minutes. The use of materials and their respective protection contributions specified in Table 722.7.1(2) shall be permitted to be used for compliance with Section 722.7.1.

602.4.1.3 Floors. The floor assembly shall contain a noncombustible material not less than 1 inch (25 mm) in thickness above the *mass timber*. Floor finishes in accordance with Section 804 shall be permitted on top of the noncombustible material. The underside of floor assemblies shall be protected in accordance with Section 602.4.1.2.

602.4.1.4 Roofs. The *interior surfaces* of *roof assemblies* shall be protected in accordance with Section 602.4.1.2. *Roof coverings* in accordance with Chapter 15 shall be permitted on the outside surface of the *roof assembly*.

602.4.1.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *Florida Building Code, Mechanical*, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected in accordance with Section 602.4.1.2.

602.4.1.6 Shafts. *Shafts* shall be permitted in accordance with Sections 713 and 718. Both the *shaft* side and room side of *mass timber* elements shall be protected in accordance with Section 602.4.1.2.

602.4.2 Type IV-B. *Building elements* in Type IV-B construction shall be protected in accordance with Sections through 602.4.2.6. The required *fire-resistance rating* of noncombustible elements or *mass timber* elements shall be determined in accordance with Section 703.2.

602.4.2.1 Exterior protection. The outside face of *exterior walls* of *mass timber* construction shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1). Components of the *exterior wall covering* shall be of noncombustible material except *water-resistive barriers* having a peak heat release rate of less than 150kW/m^2, a total heat release of less than 20 MJ/m^2 and an effective heat of combustion of less than 18MJ/kg as determined in accordance with ASTM E1354, and having a *flame spread index* of 25 or less and a *smoke-developed index* of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2.

602.4.2.2 Interior protection. Interior faces of all *mass timber* elements, including the inside face of exterior *mass timber* walls and *mass timber* roofs, shall be protected, as required by this section, with materials complying with Section 703.3.

602.4.2.2.1 Protection time. *Noncombustible protection* shall contribute a time equal to or greater than times assigned in Table 722.7.1(1), but not less than 80 minutes. The use of materials and their respective protection contributions specified in Table 722.7.1(2) shall be

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permitted to be used for compliance with Section 722.7.1.

602.4.2.2.2 Protected area. Interior faces of *mass timber* elements, including the inside face of exterior *mass timber* walls and *mass timber* roofs, shall be protected in accordance with Section 602.4.2.2.1.

Exceptions: Unprotected portions of *mass timber* ceilings and walls complying with Section 602.4.2.2.4 and the following:

1. Unprotected portions of *mass timber* ceilings and walls complying with one of the following:

1.1 Unprotected portions of *mass timber* ceilings, including attached beams, shall be permitted and shall be limited to an area less than or equal to 100 percent of the floor area in any *dwelling unit* within a story or *fire area* within a story.

1.2 Unprotected portions of *mass timber* walls, including attached columns, shall be permitted and shall be limited to an area less than or equal to 40 percent of the floor area in any *dwelling unit* within a story or *fire area* within a story.

1.3 Unprotected portions of both walls and ceilings of *mass timber*, including attached columns and beams, in any *dwelling unit* or *fire area* shall be permitted in accordance with Section 602.4.2.2.3.

2. *Mass timber* columns and beams that are not an integral portion of walls or ceilings, respectively, shall be permitted to be unprotected without restriction of either aggregate area or separation from one another.

602.4.2.2.3 Mixed unprotected areas. In each *dwelling unit* or *fire area*, where both portions of ceilings and portions of walls are unprotected, the total allowable unprotected area shall be determined in accordance with Equation 6-1.

$$(U_{tc}/\ U_{ac})+(U_{tw}/U_{aw}) \leq 1 \quad \textbf{(Equation 6-1)}$$

where:

U_{tc} = Total unprotected *mass timber* ceiling areas.

U_{ac} = Allowable unprotected *mass timber* ceiling area conforming to Exception 1.1 of Section 602.4.2.2.2.

U_{tw} = Total unprotected *mass timber* wall areas.

U_{aw} = Allowable unprotected *mass timber* wall area conforming to Exception 1.2 of Section 602.4.2.2.2.

602.4.2.2.4 Separation distance between unprotected mass timber elements. In each *dwelling unit* or *fire area*, unprotected portions of *mass timber* walls shall be not less than 15 feet (4572 mm) from unprotected portions of other walls measured horizontally along the floor.

602.4.2.3 Floors. The floor assembly shall contain a noncombustible material not less than 1 inch (25 mm) in thickness above the *mass timber*. Floor finishes in accordance with Section 804 shall be permitted on top of the noncombustible material. Except where unprotected *mass timber* ceilings are permitted in Section 602.4.2.2.2, the underside of floor assemblies shall be protected in accordance with

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Section 602.4.1.2.

602.4.2.4 Roofs. The *interior surfaces* of roof assemblies shall be protected in accordance with Section 602.4.2.2 except, in nonoccupiable spaces, they shall be treated as a concealed space with no portion left unprotected. *Roof coverings* in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.2.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *Florida Building Code, Mechanical*, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected in accordance with Section 602.4.1.2.

602.4.2.6 Shafts. *Shafts* shall be permitted in accordance with Sections 713 and 718. Both the *shaft* side and room side of *mass timber* elements shall be protected in accordance with Section 602.4.1.2.

602.4.3 Type IV-C. *Building elements* in Type IV-C construction shall be protected in accordance with Sections 602.4.3.1 through 602.4.3.6. The required *fire-resistance rating* of *building elements* shall be determined in accordance with Section 703.2.

602.4.3.1 Exterior protection. The exterior side of walls of combustible construction shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as determined in Table 722.7.1(1). Components of the *exterior wall covering* shall be of noncombustible material except *water-resistive barriers* having a peak heat release rate of less than 150 kW/m^2, a total heat release of less than 20 MJ/m^2 and an effective heat of combustion of less than 18 MJ/kg as determined in accordance with ASTM E1354 and having a *flame spread index* of 25 or less and a *smoke-developed index* of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2.

602.4.3.2 Interior protection. *Mass timber* elements are permitted to be unprotected.

602.4.3.3 Floors. Floor finishes in accordance with Section 804 shall be permitted on top of the floor construction.

602.4.3.4 Roof coverings. *Roof coverings* in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.3.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *Florida Building Code, Mechanical*, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1).

602.4.3.6 Shafts. *Shafts* shall be permitted in accordance with Sections 713 and 718. *Shafts* and elevator hoistway and *interior exit stairway enclosures* shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1), on both the inside of the *shaft* and the outside of the *shaft*.

602.4.4 Type IV-HT. Type IV-HT (Heavy Timber) construction is that type of construction in which the *exterior walls* are of noncombustible materials and the interior *building elements* are of solid wood, laminated heavy timber or *structural composite lumber* (SCL), without concealed spaces or with concealed spaces complying with Section 602.4.4.3. The minimum dimensions for permitted materials including solid timber,

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glued-laminated timber, SCL and *cross-laminated timber* (CLT) and the details of Type IV construction shall comply with the provisions of this section and Section 2304.11. *Exterior walls* complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rated or heavy timber conforming with Section 2304.11.2.2 shall be permitted.

~~602.4.1~~ **602.4.4.1. Fire-retardant-treated wood in *exterior walls*.** *Fire-retardant-treated wood* framing and sheathing complying with Section 2303.2 shall be permitted within *exterior wall* assemblies with a 2-hour rating or less.

~~602.4.2~~ **602.4.4.2 Cross-laminated timber in *exterior walls*.** *Cross-laminated timber* not less than 4 inches (102 mm) in thickness complying with Section 2303.1.4 shall be permitted within *exterior wall* assemblies with a 2-hour rating or less. Heavy timber structural members appurtenant to the *CLT exterior wall* shall meet the requirements of Table 2304.11 and be fire-resistance rated as required for the *exterior wall*. The exterior surface of the *cross-laminated timber* and heavy timber elements shall be ~~is~~ protected by one the following:

1. *Fire-retardant-treated wood* sheathing complying with Section 2303.2 and not less than 15/32 inch (12 mm) thick.
2. *Gypsum board* not less than 1/2 inch (12.7 mm) thick; or
3. A noncombustible material.

602.4.4.3 Concealed spaces. Concealed spaces shall not contain combustible materials other than *building elements* and electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *Florida Building Code, Mechanical*. Concealed spaces shall comply with applicable provisions of Section 718. Concealed spaces shall be protected in accordance with one or more of the following:

1. The building shall be sprinklered throughout in accordance with Section 903.3.1.1 and automatic sprinklers shall also be provided in the concealed space.
2. The concealed space shall be completely filled with noncombustible insulation.
3. Combustible surfaces within the concealed space shall be fully sheathed with not less than 5/8 -inch *Type X gypsum board*.

Exception: Concealed spaces within interior walls and partitions with a 1-hour or greater *fire-resistance rating* complying with Section 2304.11.2.2 shall not require additional protection.

~~602.4.3~~ **602.4.4.4 Exterior structural members.** Where a horizontal separation of 20 feet (6096 mm) or more is provided, wood columns and arches conforming to heavy timber sizes complying with Section 2304.11 shall be permitted to be used externally.

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CHAPTER 7
FIRE AND SMOKE PROTECTION FEATURES

SECTION 703
FIRE-RESISTANCE RATINGS AND FIRE TESTS

Add new sections as follows:

703.8 Determination of noncombustible protection time contribution. The time, in minutes, contributed to the *fire-resistance rating* by the *noncombustible protection* of *mass timber building elements*, components, or assemblies, shall be established through a comparison of assemblies tested using procedures set forth in ASTM E119 or UL 263. The test assemblies shall be identical in construction, loading and materials, other than the *noncombustible protection*. The two test assemblies shall be tested to the same criteria of structural failure with the following conditions:

1. Test Assembly 1 shall be without protection.
2. Test Assembly 2 shall include the representative *noncombustible protection*. The protection shall be fully defined in terms of configuration details, attachment details, *joint* sealing details, accessories and all other relevant details.

The *noncombustible protection* time contribution shall be determined by subtracting the *fire-resistance* time, in minutes, of Test Assembly 1 from the *fire-resistance* time, in minutes, of Test Assembly 2.

703.9 Sealing of adjacent mass timber elements. In *buildings* of Types IV-A, IV-B and IV-C construction, sealant or adhesive shall be provided to resist the passage of air in the following locations:

1. At abutting edges and intersections of *mass timber building elements* required to be fire-resistance rated.
2. At abutting intersections of *mass timber building elements* and *building elements* of other materials where both are required to be fire-resistance rated.

Sealants shall meet the requirements of ASTM C920. Adhesives shall meet the requirements of ASTM D3498.

Exception: Sealants or adhesives need not be provided where they are not a required component of a tested fire-resistance-rated assembly.

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SECTION 705
PROJECTIONS

Revise table as follows:

TABLE 705.5
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U[h]
X < 5[b]	All	3	2	1
5 ≤ X < 10	IA, IVA	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB, IVA, IVB	2	1	1[c]
	IIB, VB	1	0	0
	Others	1	1	1[c]
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
b. See Section 706.1.1 for party walls.
c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
e. For special requirements for Group H occupancies, see Section 415.6.
f. For special requirements for Group S aircraft hangars, see Section 412.4.1.
g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

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SECTION 718
CONCEALED SPACES

Revise section as follows:

718.2.1 Fireblocking materials. *Fireblocking* shall consist of the following materials:

1. Two-inch (51 mm) nominal lumber.
2. Two thicknesses of 1-inch (25 mm) nominal lumber with broken lap joints.
3. One thickness of 0.719-inch (18.3 mm) *wood structural panels* with joints backed by 0.719-inch (18.3 mm) *wood structural panels.*
4. One thickness of 0.75-inch (19.1 mm) *particleboard* with joints backed by 0.75-inch (19 mm) *particleboard.*
5. One-half-inch (12.7 mm) *gypsum board.*
6. One-fourth-inch (6.4 mm) cement-based millboard.
7. Batts or blankets of *mineral wool*, *mineral fiber* or other *approved* materials installed in such a manner as to be securely retained in place.
8. Cellulose insulation installed as tested for the specific application.
9. *Mass timber* complying with Section 2304.11.
10. One thickness of $^{19}/_{32}$-inch (15.1 mm) *fire-retardant-treated wood* structural panel complying with Section 2303.2.

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SECTION 722
CALCULATED FIRE-RESISTANCE

Add new sections as follows:

722.7 Fire-resistance rating for mass timber. The required *fire resistance* of *mass timber* elements in Section 602.4 shall be determined in accordance with Section 703.2. The *fire-resistance rating* of *building elements* shall be as required in Tables 601 and 705.5 and as specified elsewhere in this code. The *fire-resistance rating* of the *mass timber* elements shall consist of the *fire resistance* of the unprotected element added to the protection time of the *noncombustible protection*.

722.7.1 Minimum required protection. Where required by Sections 602.4.1 through 602.4.3, *noncombustible protection* shall be provided for *mass timber building elements* in accordance with Table 722.7.1(1). The rating, in minutes, contributed by the *noncombustible protection* of *mass timber building elements*, components or assemblies, shall be established in accordance with Section 703.6. The protection contributions indicated in Table 722.7.1(2) shall be deemed to comply with this requirement where installed and fastened in accordance with Section 722.7.2.

TABLE 722.7.1(1)
PROTECTION REQUIRED FROM NONCOMBUSTIBLE COVERING MATERIAL

REQUIRED FIRE-RESISTANCE RATING OF BUILDING ELEMENT PER Table 601 AND Table 602 (hours)	MINIMUM PROTECTION REQUIRED FROM NONCOMBUSTIBLE PROTECTION (minutes)
1	40
2	80
3 or more	120

TABLE 722.7.1(2)
PROTECTION PROVIDED BY NONCOMBUSTIBLE COVERING MATERIAL

NONCOMBUSTIBLE PROTECTION	PROTECTION CONTRIBUTION (minutes)
1/2-inch Type X gypsum board	25
5/8-inch Type X gypsum board	40

722.7.2 Installation of gypsum board noncombustible protection. *Gypsum board* complying with Table 722.7.1(2) shall be installed in accordance with this section.

722.7.2.1 Interior surfaces. Layers of *Type X gypsum board* serving as *noncombustible protection* for *interior surfaces* of wall and ceiling assemblies determined in accordance with Table 722.7.1(1) shall be installed in accordance with the following:

1. Each layer shall be attached with Type S drywall screws of sufficient length to penetrate the *mass timber* at least 1 inch (25 mm) when driven flush with the paper surface of the *gypsum board*.

   Exception: The third layer, where determined necessary by Section 722.7, shall be permitted to be attached with 1-inch (25 mm) No. 6 Type S drywall screws to furring channels in accordance with AISI S220.

2. Screws for attaching the base layer shall be 12 inches (305 mm) on center in both directions.

3. Screws for each layer after the base layer shall be 12 inches (305 mm) on center in both directions and offset from the screws of the previous layers by 4 inches (102 mm) in both directions.

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4. All panel edges of any layer shall be offset 18 inches (457 mm) from those of the previous layer.

5. All panel edges shall be attached with screws sized and offset as in Items 1 through 4 and placed at least 1 inch (25 mm) but not more than 2 inches (51 mm) from the panel edge.

6. All panels installed at wall-to-ceiling intersections shall be installed such that ceiling panels are installed first and the wall panels are installed after the ceiling panel has been installed and is fitted tight to the ceiling panel. Where multiple layers are required, each layer shall repeat this process.

7. All panels installed at a wall-to-wall intersection shall be installed such that the panels covering an *exterior wall* or a wall with a greater *fire-resistance rating* shall be installed first and the panels covering the other wall shall be fitted tight to the panel covering the first wall. Where multiple layers are required, each layer shall repeat this process.

8. Panel edges of the face layer shall be taped and finished with joint compound. Fastener heads shall be covered with joint compound.

9. Panel edges protecting *mass timber* elements adjacent to unprotected *mass timber* elements in accordance with Section 602.4.2.2 shall be covered with 11/4-inch (32 mm) metal corner bead and finished with joint compound.

722.7.2.2 Exterior surfaces. Layers of *Type X gypsum board* serving as *noncombustible protection* for the outside of the exterior *mass timber* walls determined in accordance with Table 722.7.1(1) shall be fastened 12 inches (305 mm) on center each way and 6 inches (152 mm) on center at all joints or ends. All panel edges shall be attached with fasteners located at least 1 inch (25 mm) but not more than 2 inches (51 mm) from the panel edge. Fasteners shall comply with one of the following:

1. Galvanized nails of minimum 12 gage with a 7/16-inch (11 mm) head of sufficient length to penetrate the *mass timber* a minimum of 1 inch (25 mm).

2. Screws that comply with ASTM C1002 (Type S, W or G) of sufficient length to penetrate the *mass timber* a minimum of 1 inch (25 mm).

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CHAPTER 4
SPECIAL DETAILED REQUIREMENTS BASED ON OCCUPANCY AND USE

SECTION 403
HIGH-RISE BUILDINGS

Revise section as follows:

403.3.2 Water supply to required fire pumps. In all *buildings* that are more than 420 feet (128 000 mm) in *building height* and *buildings* of Type IV-A and IV-B construction that are more than 120 feet (36 576 mm) in *building height*, required fire pumps shall be supplied by connections to no fewer than two water mains located in different streets. Separate supply piping shall be provided between each connection to the water main and the pumps. Each connection and the supply piping between the connection and the pumps shall be sized to supply the flow and pressure required for the pumps to operate.

Exception: Two connections to the same main shall be permitted provided the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through no fewer than one of the connections.

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CHAPTER 33
SAFEGUARDS DURING CONSTRUCTION

Add new section as follows:

SECTION 3314
FIRE SAFETY REQUIREMENTS FOR BUILDINGS OF TYPES IV-A, IV-B, AND IV-C CONSTRUCTION

[F] 3314.1 Fire safety requirements for buildings of Types IV-A, IV-B, and IV-C construction. Buildings of Types IV-A, IV-B, and IV-C construction designed to be greater than six stories above grade plane shall comply with the following requirements during construction unless otherwise approved by the fire code official.

1. Standpipes shall be provided in accordance with Section 3313.

2. A water supply for fire department operations, as approved by the fire code official and the fire chief.

3. Where building construction exceeds six stories above grade plane, at least one layer of noncombustible protection where required by Section 602.4 shall be installed on all building elements more than 4 floor levels, including mezzanines, below active *mass timber* construction before erecting additional floor levels.

   Exceptions:
   1. *Shafts* and vertical exit enclosures shall not be considered a part of the active mass timber construction.
   2. Noncombustible material on the top of mass timber floor assemblies shall not be required before erecting additional floor levels.

4. Where building construction exceeds six stories above grade plane required exterior wall coverings shall be installed on all floor levels more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor level.

   Exception: *Shafts* and vertical exit enclosures shall not be considered a part of the active mass timber construction.

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CHAPTER 23
WOOD

SECTION 2301
GENERAL

Revise section as follows:

2301.3 ~~Nominal sizes~~ Dimensions. For the purposes of this chapter, where dimensions of lumber are specified, they shall be deemed to be nominal dimensions unless specifically designated as actual dimensions (see Section 2304.2). Where dimensions of *cross-laminated timber* thickness are specified, they shall be deemed to be actual dimensions.

SECTION 2304
GENERAL CONSTRUCTION REQUIREMENTS

Add new section and revise sections as follows:

2304.10.8 Fire protection of connections. Connections used with *fire-resistance*-rated members and in fire-resistance-rated assemblies of Type IV-A, IV-B or IV-C construction shall be protected for the time associated with the fire-resistance rating. Protection time shall be determined by one of the following:

1. Testing in accordance with Section 703.2 where the connection is part of the *fire resistance* test.

2. Engineering analysis that demonstrates that the temperature rise at any portion of the connection is limited to an average temperature rise of 250°F (139°C), and a maximum temperature rise of 325°F (181°C), for a time corresponding to the required *fire-resistance* rating of the structural element being connected. For the purposes of this analysis, the connection includes connectors, fasteners, and portions of wood members included in the structural design of the connection.

2304.11.1.1 Columns. Minimum dimensions of columns shall be in accordance with Table 2304.11. Columns shall be connected in an *approved* manner. Columns shall be continuous or aligned vertically from floor to floor in ~~superimposed throughout~~ all stories of Type IV-HT construction ~~and connected in an approved manner~~. Girders and beams at column connections shall be closely fitted around columns and adjoining ends shall be cross tied to each other, or intertied by caps or ties, to transfer horizontal *loads* across joints. Wood bolsters shall not be placed on tops of columns unless the columns support roof *loads* only. Where traditional heavy timber detailing is used, connections shall be permitted to be by means of reinforced concrete or metal caps with brackets, by properly designed steel or iron caps, with pintles and base plates, by timber splice plates affixed to the columns by metal connectors housed within the contact faces, or by other *approved* methods.

2304.11.3 Floors. Floors shall be without concealed spaces or with concealed spaces complying with Section 602.4.4. Wood floors shall be constructed in accordance with Section 2304.11.3.1 or 2304.11.3.2.

2304.11.4 Roof decks. Roofs shall be without concealed spaces ~~and roof~~ or with concealed spaces complying with Section 602.4.3. Roof decks shall be constructed in accordance with Section 2304.11.4.1 or 2304.11.4.2. Other types of decking shall be an alternative that provides equivalent *fire resistance* and structural properties are being provided. Where supported by a wall, *roof decks* shall be anchored to walls to resist forces determined in accordance with Chapter 16. Such anchors shall consist of steel bolts, lags, screws or *approved* hardware of sufficient strength to resist prescribed forces.

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CHAPTER 17
SPECIAL INSPECTION AND TESTS

SECTION 1711
MASS TIMBER CONSTRUCTION

Add new sections and table as follows:

1711.1 Mass timber construction. Inspections of mass timber elements in Types IV-A, IV-B and IV-C construction shall be in accordance with Table 1711.1.

TABLE 1711.1
REQUIRED INSPECTIONS OF MASS TIMBER CONSTRUCTION

TYPE			CONTINUOUS SPECIAL INSPECTION	PERIODIC INSPECTION
1.	Inspection of anchorage and connections of mass timber construction to timber deep foundation systems.		—	X
2.	Inspect erection of mass timber construction.		—	X
3.	Inspection of connections where installation methods are required to meet design loads.			
	Threaded fasteners	Verify use of proper installation equipment.	—	X
		Verify use of pre-drilled holes where required.	—	X
		Inspect screws, including diameter, length, head type, spacing, installation angle and depth.	—	X
	Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads.		X	—
	Adhesive anchors not defined in preceding cell.		—	X
	Bolted connections.		—	X
	Concealed connections.		—	X

1711.2 Sealing of mass timber. Periodic *special inspections* of sealants or adhesives shall be conducted where sealant or adhesive required by Section 703.7 is applied to *mass timber building elements* as designated in the *approved construction documents*.

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CHAPTER 1
SCOPE AND ADMINISTRATION

SECTION 110
INSPECTIONS

Add new section as follows:

110.3.14 Types IV-A, IV-B, and IV-C connection protection inspection. In buildings of Types IV-A, IV-B, and IV-C construction, where connection fire-resistance ratings are provided by wood cover calculated to meet the requirements of Section 2304.10.8, inspection of the wood cover shall be made after the cover is installed, but before any other coverings or finishes are installed.

CHAPTER 2
DEFINITIONS

SECTION 202
DEFINITIONS

Revise and add new definitions as follows:

[BS] WALL, LOAD-BEARING. Any wall meeting either of the following classifications:

1. Any metal or wood stud wall that supports more than 100 pounds per linear foot (1459 N/m) of vertical load in addition to its own weight.
2. Any *masonry*, ~~or~~ concrete, or *mass timber* wall that supports more than 200 pounds per linear foot (2919 N/m) of vertical load in addition to its own weight.

MASS TIMBER. Structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross section dimensions of Type IV construction.

NONCOMBUSTIBLE PROTECTION (FOR MASS TIMBER). Noncombustible material, in accordance with Section 703.5, designed to increase the *fire-resistance rating* and delay the combustion of *mass timber*.

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CHAPTER 5
GENERAL BUILDING HEIGHTS AND AREAS

SECTION 504
BUILDING HEIGHT AND NUMBER OF STORIES

Revise tables as follows:

TABLE 504.3[a]
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A, B, E, F, M, S, U	NS[b]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
H-1, H-2, H-3, H-5	NS[c,d] / S	UL	160	65	55	65	55	120	90	65	65	50	40
H-4	NS[c,d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1Condition 1, I-3	NS[d,e]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1Condition 2, I-2	NS[d,e,f]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									
I-4	NS[d,g]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
Rh	NS[d,h]	UL	160	65	55	65	55	65	65	65	65	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60

For SI: 1 foot = 304.8 mm.

Note: UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2;

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.
b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
d. The NS value is only for use in evaluation of existing building height in accordance with the *Florida Building Code, Existing Building*.
e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies Condition 1, see Exception 1 of Section 903.2.6.
f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and the *Florida Fire Prevention Code*.
g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.
h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

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TABLE 504.4[a, b]
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
F-1	NS	UL	11	4	2	3	2	3	3	3	4	2	1
	S	UL	12	5	3	4	3	10	7	5	5	3	2
F-2	NS	UL	11	5	3	4	3	5	5	5	5	3	2
	S	UL	12	6	4	5	4	12	8	6	6	4	3
H-1	NS[c, d]	1	1	1	1	1	1	NP	NP	NP	1	1	NP
	S							1	1	1			
H-2	NS[c, d]	UL	3	2	1	2	1	1	1	1	2	1	1
	S							2	2	2			
H-3	NS[c, d]	UL	6	4	2	4	2	3	3	3	4	2	1
	S							4	4	4			
H-4	NS[c, d]	UL	7	5	3	5	3	5	5	5	5	3	2
	S	UL	8	6	4	6	4	8	7	6	6	4	3
H-5	NS[c, d]	4	4	3	3	3	3	2	2	2	3	3	2
	S							3	3	3			
I-1 Condition 1	NS[d, e]	UL	9	4	3	4	3	4	4	4	4	3	2
	S	UL	10	5	4	5	4	10	7	5	5	4	3
I-1 Condition 2	NS[d, e]	UL	9	4	3	4	3	3	3	3	4	3	2
	S	UL	10	5				10	6	4			
I-2	NS[d, f]	UL	4	2	1	1	NP	NP	NP	NP	1	1	NP
	S	UL	5	3				7	5	1			
I-3	NS[d, e]	UL	4	2	1	2	1	2	2	2	2	2	1
	S	UL	5	3	2	3	2	7	5	3	3	3	2
I-4	NS[d, g]	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
M	NS	UL	11	4	2	4	2	4	4	4	4	3	1
	S	UL	12	5	3	5	3	12	8	6	5	4	2

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TABLE 504.4[a, b]—continued
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
R-1	NS[d, h]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-2	NS[d, h]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4	4								4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-3	NS[d, h]	UL	11	4	4	4	4	4	4	4	4	3	3
	S13R	4	4									4	4
	S	UL	12	5	5	5	5	18	12	5	5	4	4
R-4	NS[d, h]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	5	5	4	3
S-1	NS	UL	11	4	2	3	2	4	4	4	4	3	1
	S	UL	12	5	4	4	4	10	7	5	5	4	2
S-2	NS	UL	11	5	3	4	3	4	4	4	5	4	2
	S	UL	12	6	4	5	4	12	8	5	6	5	3
U	NS	UL	5	4	2	3	2	4	4	4	4	2	1
	S	UL	6	5	3	4	3	9	6	5	5	3	2

Note: UL = Unlimited; NP = Not Permitted; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.
b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
d. The NS value is only for use in evaluation of existing *building height* in accordance with the *Florida Building Code, Existing Building*.
e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.
f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and the *Florida Fire Prevention Code*.
g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.
h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8

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SECTION 506
BUILDING AREA

Revise table as follows:

TABLE 506.2[a, b]
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, or SM, as applicable)
IN SQUARE FEET

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1												
	SM												
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
E	NS	UL	UL	26,500	14,500	23,500	14,500	76,500	51,000	31,875	25,500	18,500	9,500
	S1	UL	UL	106,000	58,000	94,000	58,000	306,000	204,000	127,500	102,000	74,000	38,000
	SM	UL	UL	79,500	43,500	70,500	43,500	229,500	153,000	95,625	76,500	55,500	28,500
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	100,500	67,000	41,875	33,500	14,000	8,500
	S1	UL	UL	100,000	62,000	76,000	48,000	402,000	268,000	167,500	134,000	56,000	34,000
	SM	UL	UL	75,000	46,500	57,000	36,000	301,500	201,000	125,625	100,500	42,000	25,500
F-2	NS	UL	UL	37,500	23,000	28,500	18,000	151,500	101,000	63,125	50,500	21,000	13,000
	S1	UL	UL	150,000	92,000	114,000	72,000	606,000	404,000	252,500	202,000	84,000	52,000
	SM	UL	UL	112,500	69,000	85,500	54,000	454,500	303,000	189,375	151,500	63,000	39,000
H-1	NS[c]	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	NP
	S1												
H-2	NS[c]	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	3,000
	S1												
	SM												
H-3	NS[c]	UL	60,000	26,500	14,000	17,500	13,000	25,500	25,500	25,500	25,500	10,000	5,000
	S1												
	SM												
H-4	NS[c, d]	UL	UL	37,500	17,500	28,500	17,500	72,000	54,000	40,500	36,000	18,000	6,500
	S1	UL	UL	150,000	70,000	114,000	70,000	288,000	216,000	162,000	144,000	72,000	26,000
	SM	UL	UL	112,500	52,500	85,500	52,500	216,000	162,000	121,500	108,000	54,000	19,500
H-5	NS[c, d]	UL	UL	37,500	23,000	28,500	19,000	72,000	54,000	40,500	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	288,000	216,000	162,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	216,000	162,000	121,500	108000	54,000	27,000

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TABLE 506.2[a, b]—continued
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, or SM, as applicable)
IN SQUARE FEET

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
I-1	NS[d, e]	UL	55,000	19,000	10,000	16,500	10,000	54,000	36,000	18,000	18,000	10,500	4,500
	S1	UL	220,000	76,000	40,000	66,000	40,000	216,000	144,000	72,000	72,000	42,000	18,000
	SM	UL	165,000	57,000	30,000	49,500	30,000	162,000	108,000	54,000	54,000	31,500	13,500
I-2	NS[d, f]	UL	UL	15,000	11,000	12,000	NP	36,000	24,000	12,000	12,000	9,500	NP
	S1	UL	UL	60,000	44,000	48,000	NP	144,000	96,000	48,000	48,000	38,000	NP
	SM	UL	UL	45,000	33,000	36,000	NP	108,000	72,000	36,000	36,000	28,500	NP
I-3	NS[d, e]	UL	UL	15,000	10,000	10,500	7,500	36,000	24,000	12,000	12,000	7,500	5,000
	S1	UL	UL	60,000	40,000	42,000	30,000	144,000	96,000	48,000	48,000	30,000	20,000
	SM	UL	UL	45,000	30,000	31,500	22,500	108,000	72,000	36,000	36,000	22,500	15,000
I-4	NS[d, g]	UL	60,500	26,500	13,000	23,500	13,000	76,500	51,000	25,500	25,500	18,500	9,000
	S1	UL	121,000	106,000	52,000	94,000	52,000	306,000	204,000	102,000	102,000	74,000	36,000
	SM	UL	181,500	79,500	39,000	70,500	39,000	229,500	153,000	76,500	76,500	55,500	27,000
M	NS	UL	UL	21,500	12,500	18,500	12,500	61,500	41,000	26,625	20,500	14,000	9,000
	S1	UL	UL	86,000	50,000	74,000	50,000	246,000	164,000	102,500	82,000	56,000	36,000
	SM	UL	UL	64,500	37,500	55,500	37,500	184,500	123,000	76,875	61,500	42,000	27,000
R-1	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-2	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-3	NS[d, h]	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S13R												
	S1												
	SM												
R-4	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
S-1	NS	UL	48,000	26,000	17,500	26,000	17,500	76,500	51,000	31,875	25,500	14,000	9,000
	S1	UL	192,000	104,000	70,000	104,000	70,000	306,000	204,000	127,500	102,000	56,000	36,000
	SM	UL	144,000	78,000	52,500	78,000	52,500	229,500	153,000	95,625	76,500	42,000	27,000
S-2	NS	UL	79,000	39,000	26,000	39,000	26,000	115,500	77,000	48,125	38,500	21,000	13,500
	S1	UL	316,000	156,000	104,000	156,000	104,000	462,000	308,000	192,500	154,000	84,000	54,000
	SM	UL	237,000	117,000	78,000	117,000	78,000	346,500	231,000	144,375	115,500	63,000	40,500
U	NS[i]	UL	35,500	19,000	8,500	14,000	8,500	54,000	36,000	22,500	18,000	9,000	5,500
	S1	UL	142,000	76,000	34,000	56,000	34,000	216,000	144,000	90,000	72,000	36,000	22,000
	SM	UL	106,500	57,000	25,500	42,000	25,500	162,000	108,000	67,500	54,000	27,000	16,500

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TABLE 506.2[a, b]—continued
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D or SM, as applicable)
IN SQUARE FEET

Note: UL = Unlimited; NP = Not Permitted
For SI: 1 square foot = 0.0929 m^2.

NS = Buildings not equipped throughout with an automatic sprinkler system; S1 = Buildings a maximum of one story above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; SM = Buildings two or more stories above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2.

a. See Chapters 4 and 5 for specific exceptions to the allowable area in this chapter.
b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
d. The NS value is only for use in evaluation of existing building area in accordance with the *Florida Building Code, Existing Building*.
e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.
f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and the *Florida Fire Prevention Code*.
g. New Group I-4 occupancies see Exceptions 2 and 3 of Section 903.2.6.
h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

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SECTION 508
MIXED USE AND OCCUPANCY

Revise section as follows:

508.4.4.1 Construction. Required separations shall be *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both, so as to completely separate adjacent occupancies. *Mass timber* elements serving as *fire barriers* or *horizontal assemblies* to separate occupancies in Type IV-B or IV-C construction shall be separated from the interior of the *building* with an *approved* thermal barrier consisting of *gypsum board* that is not less than 1/2 inch (12.7 mm) in thickness or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.

Exception: The thermal barrier shall not be required on the top of horizontal assemblies serving as occupancy separations.

SECTION 509
INCIDENTAL USES

Add new section as follows:

509.4.1.1 Type IV-B and IV-C construction. Where Table 509 specifies a fire-resistance-rated separation, *mass timber* elements serving as *fire barriers* or *horizontal assemblies* in Type IV-B or IV-C construction shall be separated from the interior of the incidental use with an *approved* thermal barrier consisting of *gypsum board* that is not less than 1/2 inch (12.7mm) in thickness or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.

Exception: The thermal barrier shall not be required on the top of horizontal assemblies serving as incidental use separations.

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CHAPTER 14
EXTERIOR WALLS

SECTION 1405
INSTALLATION OF WALL COVERINGS

Revise section as follows:

1405.5 Wood Veneers. Wood veneers on exterior walls of buildings of Type I, II, III and IV-HT construction shall be not less than 1 inch (25mm) nominal thickness, 0.438-inch (11.1 mm) exterior *hardboard* siding or 0.375-inch (9.5 mm) exterior-type *wood structural panels* or *particleboard* and shall conform to the following:

1. The *veneer* shall not exceed 40 feet (12 190 mm) in height above grade. Where *fire-retardant-treated wood* is used, the height shall not exceed 60 feet (18 290 mm) in height above grade.

2. The *veneer* is attached to or furred from a noncombustible *backing* that is fire-resistance rated as required by other provisions of this code.

3. Where open or spaced wood *veneers* (without concealed spaces) are used, they shall not project more than 24 inches (610 mm) from the *building* wall.

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SECTION 1406
COMBUSTIBLE MATERIALS ON THE EXTERIOR SIDE OF EXTERIOR WALLS

Revise sections as follows:

1406.2.1 Type I, II, III and IV-HT construction. On buildings of Type I, II, III and IV-HT construction, exterior wall coverings shall be permitted to be constructed of combustible materials, complying with the following limitations:

1. Combustible exterior wall coverings shall not exceed 10 percent of an exterior wall surface area where the fire separation distance is 5 feet (1524 mm) or less.
2. Combustible exterior wall coverings shall be limited to 40 feet (12 192 mm) in height above grade plane.
3. Combustible exterior wall coverings constructed of fire-retardant-treated wood complying with Section 2303.2 for exterior installation shall not be limited in wall surface area where the fire separation distance is 5 feet (1524 mm) or less and shall be permitted up to 60 feet (18 288 mm) in height above grade plane regardless of the fire separation distance.
4. Wood veneers shall comply with Section 1405.5.

1406.3 Balconies and similar projections. Balconies and similar projections of combustible construction other than *fire-retardant-treated wood* shall be *fire-resistance* rated where required by Table 601 for floor construction or shall be of heavy timber construction in accordance with Section 2304.11. The aggregate length of the projections shall not exceed 50 percent of the *building*'s perimeter on each floor.

Exceptions:

1. On *buildings* of Type I and II construction, three *stories* or less above *grade plane*, *fire-retardant-treated wood* shall be permitted for balconies, porches, decks and exterior *stairways* not used as required *exits*.
2. Untreated *wood, and plastic composites* that comply with ASTM D7032 and Section 2612, are permitted for pickets and rails or similar guard devices that are limited to 42 inches (1067 mm) in height.
3. Balconies and similar projections on *buildings* of Type III, IV-HT and V construction shall be permitted to be of Type V construction, and shall not be required to have a *fire-resistance rating* where sprinkler protection is extended to these areas.
4. Where sprinkler protection is extended to the balcony areas, the aggregate length of the balcony on each floor shall not be limited.

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CHAPTER 31
SPECIAL CONSTRUCTION

SECTION 3102
MEMBRANE STRUCTURES

Revise sections as follows:

3102.3 Type of construction. *Noncombustible membrane structures* shall be classified as Type IIB construction. Noncombustible frame or cable-supported *structures* covered by an *approved membrane* in accordance with Section 3102.3.1 shall be classified as Type IIB construction. Heavy timber frame-supported *structures* covered by an *approved membrane* in accordance with Section 3102.3.1 shall be classified as Type IV-HT construction. Other *membrane structures* shall be classified as Type V construction.

> **Exception**: Plastic less than 30 feet (9144 mm) above any floor used in *greenhouses*, where *occupancy* by the general public is not authorized, and for aquaculture pond covers is not required to meet the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701.

3102.6.1.1 Membrane. A *membrane* meeting the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701 shall be permitted to be used as the roof or as a *skylight* on buildings of Type IIB, III, IV-HT and V construction, provided the *membrane* is not less than 20 feet (6096 mm) above any floor, balcony or gallery.

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CHAPTER 35
REFERENCED STANDARDS

Revise or add references as follows:

AISI S220—20	**North American Standard for Cold-formed Steel Framing-Nonstructural Members**, 2020 Edition 722.7.2.1
ANSI/APA PRG 320-2019	**Standard for Performance-Rated Cross-Laminated Timber** 602.4
ASTM C920—18	**Standard for Specification for Elastomeric Joint Sealants** 703.9
ASTM C1002—20	**Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs** 722.7.2.2
ASTM D3498—19a	**Standard Specifications for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor Systems** 703.9
ASTM D7032—21	**Standard Specification for Establishing Performance Ratings for Wood-Plastic Composite and Plastic Lumber Deck Boards, Stair Treads, Guards and Handrails** 703.9, 705.2.3.1
ASTM E84—21a	**Standard Test Methods for Surface Burning Characteristics of Building Materials** 202, 602.4.1.1, 602.4.2.1, 602.4.3.1,
ASTM E119—20	**Standard Test Methods for Fire Tests of Building Construction and Materials** 703.8
ASTM E1354—17	**Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products using an Oxygen Consumption Calorimeter** 602.4.1.1, 602.4.2.1, 602.4.3.1
NFPA 241—22	**Standard for Safeguarding Construction, Alteration and Demolition Operations** 3301.1, 3303.2
NFPA 275—22	**Standard Method of Fire Tests for the Evaluation of Thermal Barriers** 508.4.4.1, 509.4.1
NFPA 701—23	**Standard Methods of Fire Tests for Flame Propagation of Textiles and Films** 3102.3, 3102.6.1.1
UL 263—11	**Fire Tests of Building Construction and Materials – with Revisions through August 2021** 703.8
UL 723—18	**Standard for Test for Surface Burning Characteristics of Building Materials** 602.4.1.1, 602.4.2.1, 602.4.3.1

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APPENDIX D
FIRE DISTRICTS

SECTION D102
BUILDING RESTRICTIONS

Revise section as follows:

D102.2.5 Structural fire rating. Walls, floors, roofs and their supporting structural members shall be a minimum of 1-hour fire-resistance-rated construction.

Exceptions:

1. Buildings of Type IV-HT construction.
2. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
3. Automobile parking structures.
4. Buildings surrounded on all sides by a permanently open space of not less than 30 feet (9144 mm).
5. Partitions complying with Section 603.1, Item 11.

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FBC – Mass Timber Summary

BACKGROUND

The **Ad Hoc Committee on Tall Wood Buildings (TWB)** was created by the ICC Board in 2015 to explore the science of tall wood buildings and develop code changes for such structures.

The TWB and its various working groups (WGs) held meetings, studied issues, and sought input from expert sources worldwide. The TWB posted these documents and input on its website for interested parties to follow its progress and allow public input throughout.

At its first meeting, the TWB discussed **several performance objectives** to be met with the proposed criteria for tall wood buildings:

- **No collapse** under reasonable scenarios of complete burnout of fuel without considering automatic sprinkler protection.
- **No unusually high radiation exposure** from the subject building to adjoining properties that could present a risk of ignition under reasonably severe fire scenarios.
- **No unusual response to typical radiation exposure** from adjacent properties that could present a risk of ignition of the subject building under reasonably severe fire scenarios.
- **No unusual fire department access issues.**
- **Egress systems** designed to protect building occupants during the design escape time, plus a factor of safety.
- **Highly reliable fire suppression systems** to reduce the risk of failure during reasonably expected fire scenarios. The degree of reliability should be proportional to evacuation time (height) and the risk of collapse.

The comprehensive package of proposals from the **TWB meets these performance objectives.**

DEFINITIONS

Included in the proposal are three new or revised definitions: **Wall, Load-Bearing; Mass Timber;** and **Noncombustible Protection (for Mass Timber).** These definitions are important for understanding the proposed changes to Type IV Construction.

Load-Bearing Wall

The modification to the term **"load-bearing wall"** has been updated to include **"mass timber"** as a category equivalent to other materials. Based on research conducted by wood trade associations, **mass timber walls** (e.g., sawn, glued-laminated, cross-laminated timbers) have the ability to support the minimum 200 pounds per linear foot vertical load requirement required of "load bearing".

Mass Timber

The term **"mass timber"** already exists undefined in previous editions of the Florida Building Code (FBC). The definition proposed represents both legacy heavy timber (a.k.a. Type IV construction) and the three new construction types proposed for **FBC Chapter 6**. The purpose of defining this term is to establish that the term represents various sawn and engineered timber products referenced in **FBC Chapter 23 (Wood)** and PRG-320 "Standard for Performance-Rated Cross-Laminated Timber."

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Noncombustible Protection (For Mass Timber)

The definition of **"Noncombustible Protection (For Mass Timber)"** was created to address the **passive fire protection** requirement of mass timber.

- Mass timber is permitted to have its **own fire-resistance rating** (e.g., Mass Timber only) and/or have a fire-resistance rating based on **a combination of mass timber fire resistance plus protection by noncombustible materials**, as defined in **Section 703.5** (e.g., additional materials that delay combustion, such as gypsum board).
- While it is uncommon to list a code section number within a definition, it was necessary in this case to ensure that the user understands the intent.
- Protection by a **noncombustible material** will act to **delay the combustion** of mass timber.

TYPES OF CONSTRUCTION

The committee recognized tall mass timber buildings worldwide generally fall into three categories:

1. **Fully Protected Mass Timber** – The mass timber is fully protected by noncombustible materials.
2. **Partially Exposed Mass Timber** – Some portions of mass timber may be exposed in limited amounts on walls and/or ceilings.
3. **Unprotected Mass Timber** – The mass timber structure may be fully exposed.

The **TWB** determined that fire testing was necessary to validate these concepts. During its first meeting, members discussed the nature and intent of fire testing to ensure meaningful results for the TWB and, more specifically, for the fire service. A test plan was subsequently developed, consisting of one-bedroom apartments on two levels, each with a corridor leading to a stairway. The purpose of the tests was to evaluate the contribution of mass timber to a fire, the performance of connections and joints, and conditions for responding fire personnel.

The **Fire WG** refined the test plan, which was implemented in a series of five full-scale, multi-story building tests at the **ATF laboratories** in Beltsville, MD. The results, along with testing conducted by others, helped form the basis for the **Codes WG** to develop its code change proposals, including this one, which was approved by the TWB.

MASS TIMBER CONSTRUCTION CLASSIFICATIONS

Type IV-A: Fully Protected Mass Timber

Type IV-A is completely protected with noncombustible materials, primarily layers of **5/8-inch Type X gypsum board**. Fire tests have shown that mass timber construction protected in this way can survive a complete burnout of a residential fuel load **without engaging the mass timber in the fire**.

To ensure uniform protection, the text clearly requires **all** building elements to be protected, including floor surfaces, walls and ceiling surfaces, interior roof surfaces, underside of floor surfaces, and shafts.

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Type IV-A is designed to have **the same fire resistance rating as Type I-A construction**, requiring **2-hour and 3-hour structural elements**. The fire resistance rating of structural elements was set conservatively to **sustain fuel loads without sprinkler protection** and **without contributing structural members to the fire**, similar to the IBC strategy for Type I construction.

Type IV-B: Partially Exposed Mass Timber

Type IV-B allows for some exposed **wood surfaces** on ceilings, walls, columns, and beams. However, the amount of exposed wood is **limited** to restrict potential contribution to an interior fire.

Type IV-B has undergone the same fire tests as Type IV-A. Results show a predictable char layer develops on mass timber, similar to traditional sawn lumber, provided **substantial delamination is avoided**. While portions of mass timber may be unprotected, concealed spaces, shafts, and other specified areas must **be fully protected** with noncombustible materials.

Type IV-B is designed to have **the same base fire resistance requirements as Type I-B construction**, and therefore requires **2-hour structural elements**. Unlike Type I-B, the IBC allowance to reduce structural elements to 1-hour protection **is not proposed for Type IV-B**.

Type IV-C: Fully Exposed Mass Timber

Type IV-C construction allows **fully exposed mass timber**, with the key restrictions that concealed spaces, shafts, elevator hoistways, and interior exit stairway enclosures must be protected with noncombustible materials.

This construction type is different from traditional **Heavy Timber (Type IV-HT)** because **Type IV-C requires a 2-hour fire rating**. However, despite this added fire rating, the **height in feet for Type IV-C remains the same as Type IV-HT**. The committee proposed **additional floors** for some occupancy groups in Type IV-C construction.

Modifications to Tables 601 and 602

This proposal includes **modifications to Tables 601 and 602** to set performance requirements for mass timber construction, aligning them with **Type I construction standards**:

- **Type IV-A → Same fire resistance ratings as Type I-A**
- **Type IV-B → Same fire resistance ratings as Type I-B**
- **Type IV-C → Fire resistance is achieved solely through mass timber**

Because **Type IV-C lacks a direct counterpart in Type I construction**, its fire resistance ratings were set to **match those of Type IV-B**. As a result, permitted building heights for Type IV-C are **significantly reduced** in both feet and stories, as reflected in proposed changes to Tables 504.3, 504.4, and 506.2.

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Rationale Statement for Proposed Modification to the Florida Building Code, 9th edition (2026)

The proposed modification seeks to incorporate provisions for the use of mass timber in the 9th edition of the Florida Building Code (FBC), aligning it with advancements in building science, fire safety, and structural integrity. This proposal is supported by thousands of hours of research, rigorous fire and structural testing, and extensive modeling by national and international experts and researchers, including the ICC Ad Hoc Committee on Tall Wood Buildings (TWB).

The TWB was established in 2015 in response to concerns from code officials regarding mass timber buildings being constructed without the benefit of codified regulations – precisely the situation in Florida today. To ensure the appropriate degree of rigor, the TWB was composed of a balanced group of stakeholders and subject matter experts to investigate and evaluate the feasibility of tall wood construction and develop comprehensive code provisions addressing fire and life safety concerns. The result was a package of code changes that were successfully integrated into the 2021 International Building Code (IBC), followed by refinements in the 2024 IBC. These provisions now form the foundation for the safe and consistent use of mass timber in 40 states and counting.

Recognizing the critical importance of consistent regulatory frameworks, national consensus codes – including the IBC and NFPA standards – have incorporated mass timber as a safe and viable construction method. The National Association of State Fire Marshals (NASFM) reaffirmed this in a November 2022 position statement, emphasizing:

> "The use of approved mass timber in tall-wood building construction is of the highest concern to NASFM as we stand for the safety of citizens and firefighters. This identified material and construction type has most recently been evaluated in the model code community. **Many facts have been discovered through independent research and testing that have validated this method as meeting the technical requirements of the codes.**" [Emphasis added]

Similarly, the International Association of Fire Chiefs (IAFC) urged jurisdictions to adopt the mass timber provisions of the IBC, stating in January 2020:

> [The IAFC] "Urge communities who are considering new mass-timber buildings to utilize the code provisions found in the 2021 ICC Code documents. There are many opportunities for consideration of buildings that may be taller, larger, or without the protection that was studied. **Communities should continue to use the codes and standards that were established through the model code development process.**" [emphasis added]

Mass timber construction is expanding rapidly across the United States, including in Florida, as developers and architects seek sustainable, efficient, and cost-effective building solutions. However, Florida currently lacks codified mass timber provisions, creating regulatory uncertainty and enforcement challenges for building and fire code officials.

To address this gap, the American Wood Council (AWC) developed the Mass Timber AMM Guide to assist with the 8th edition of the Florida Building Code. This guide, based on the 2024 IBC, provided

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for membership by the Building Officials Association of Florida (BOAF) and additionally available from the AWC, provides essential guidance on mass timber construction. However, because the guide does not carry the force of law, formal adoption of mass timber provisions in the Florida Building Code remains necessary to ensure consistent regulation and enforcement across jurisdictions, provide clarity and uniformity for building and fire code officials, streamline the permitting and inspection processes, and maintain the highest standards of fire and life safety.

By adopting these provisions into the Florida Building Code, Florida will:

1. **Ensure Regulatory Alignment** – Maintain consistency with the latest national model codes and standards, facilitating uniformity and a predictable regulatory environment for developers, architects, engineers, and code officials across jurisdictions.
2. **Enhance Sustainability** – Include an additional construction option utilizing renewable materials, contributing to lower embodied carbon for a more sustainable built environment.
3. **Promote Economic Growth** – Enable innovative construction methods that reduce costs and reduce construction timelines, benefiting both the public and private sectors with projected stimulation of Florida's forestry and manufacturing industries.
4. **Strengthen Regulatory Consistency** – Provide clear and uniform guidelines for building and fire code officials, ensuring efficient enforcement of mass timber provisions across the state.
5. **Maintain Fire and Life Safety** – Ensure the adoption of mass timber includes the rigorous safety measures developed through extensive research and code development, in alignment with the positions of NASFM and the IAFC.

The Need for Action:

Mass Timber buildings are currently being constructed in Florida without the benefit of codified requirements, leaving building and fire code officials without the necessary framework to regulate these structures consistently and safely. Failing to adopt these provisions risks creating a patchwork of enforcement and inconsistent safety standards.

It is critical that Florida act now to provide a building code that will ensure that all mass timber buildings meet the highest standards of fire and life safety by adopting the proposed modifications.

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For more information:

For more information, the following resources provide technical, regulatory, and real-world evidence demonstrating the safety, reliability, and benefits of tall mass timber construction:

- **ICC Ad Hoc Committee on Tall Wood Buildings**: This committee was established to explore the building science of tall wood buildings and develop related code changes. iccsafe.org
    - https://www.iccsafe.org/products-and-services/i-codes/code-development/cs/icc-ad-hoc-committee-on-tall-wood-buildings/
        - Note: The "Meeting Minutes and Documents" and "Resource Documents" sections of the committee webpage above contain the extensive research and technical information reviewed by the ad hoc committee, including original rationale statements for each proposed section.
        - Based on comprehensive analysis of this information, the committee developed a set of proposals that were adopted to establish regulations that were determined to effectively address fire and life safety considerations for tall mass timber buildings.
- **Understanding the Tall Mass Timber Code Changes**: A guide detailing the code changes approved by the ICC Ad Hoc Committee on Tall Wood Buildings, offering insights into the technical requirements and safety considerations for mass timber construction.
    - For Building Code Officials: https://awc.org/wp-content/uploads/2023/11/MTCC-Guide-Print-20180919.pdf
    - For Fire Code Officials: https://awc.org/wp-content/uploads/2022/01/tmt_toolkit.pdf
- **TMT Fire Testing:** A catalog of research and testing on the fire resistance and safety of mass timber components and structures, including related literature and fire test videos. awc.org
    - https://awc.org/woodaware/tmt-fire-testing/
- **Position Statements:**
    - International Association of Fire Chiefs (IAFC): www.iafc.org/about-iafc/positions/position/tall-wood-mass-timber-buildings
    - National Association of State Fire Marshals (NASFM): www.firemarshals.org/NASFM-Documents (on list at bottom of page)

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TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

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S12276

Date Submitted	02/18/2025	**Section**	2304.11.3	**Proponent**	Cade Booth
Chapter	23	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

t601, 602.4, 703.8, 703.9, t705.5, 718.2.1, 722.7, 403.3.2, [F]3314.1, 2301.3, 2304.10.8, 2304.11.1.1, 2304.11.3, 2304.11.4, 1711.1, t1711.1, 1711.2, 110.3.14, 202, t504.3, t504.4, t506.2, 508.4.4.1, 509.4.1.1, 1405.5, 1406.2.1, 1406.3, 3102.3, 3102.6.1.1, D102.2.5, and refs ch 35.

Summary of Modification

The proposed updates the FBC to include mass timber, aligning it with national standards and advancements in building science, fire safety, and structural integrity. Backed by extensive research and testing, this ensures clear enforcement, cost-effective compliance, and statewide consistency.

Rationale

***PLEASE NOTE: Individual sections have been submitted in addition to and alongside the full chapter portions to allow for focused discussion or otherwise if needed. This proposed modification serves as a placeholder. *** For a comprehensive understanding of the proposed mass timber code modifications, be sure to review the full rationale statement PDF. It includes a summary of mass timber's history, the benefits of adoption for Florida, the need for action, and key supporting information. You'll also find links to technical resources and documents that provide further validation. Don't miss this essential guide to why mass timber belongs in the Florida Building Code! In summary, as mass timber construction continues to gain traction across the U.S., including within Florida, it is crucial for the Florida Building Code (FBC) to be updated to incorporate provisions for this proven and innovative construction method. With 40 states already adopting mass timber regulations based on the International Building Code (IBC), these proposed modifications align Florida with nationally recognized consensus codes. The changes will provide a clear, standardized framework for enforcement, streamline compliance for building owners and developers, and support greater design flexibility, all while maintaining rigorous fire safety and structural integrity standards. Adopting mass timber into the FBC will also help Florida keep pace with emerging construction technologies, ensuring the state can effectively regulate these advancements without compromising safety or performance.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Positive; lowers impact. Including mass timber in the FBC provides a consistent regulatory framework for building and fire code officials. It streamlines enforcement, reduces uncertainty, and improves efficiency in plan reviews and inspections by ensuring uniform standards across jurisdictions.

Impact to building and property owners relative to cost of compliance with code

Positive; lowers impact. The inclusion of mass timber offers a new construction method that can lower costs for building owners. A consistent regulatory approach statewide simplifies approvals, reduces delays, and allows owners to choose cost-effective materials without uncertainty.

Impact to industry relative to the cost of compliance with code

Positive; neutral or lowers impact. Including mass timber in the FBC gives builders and developers more construction options, increasing competition and potentially lowering costs. Consistent enforcement across the state reduces regulatory uncertainty and streamlines the approval process.

Impact to small business relative to the cost of compliance with code

Positive; lowers impact. Small businesses benefit from a uniform regulatory framework, reducing compliance costs. With mass timber, smaller firms can leverage prefabrication, shorter timelines, and cost savings, leading to more cost-effective projects and new business opportunities.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Yes. Mass timber has been thoroughly tested for structural integrity and fire performance, proving its safety and durability. Its inclusion in the Florida Building Code ensures consistent regulation statewide, reducing uncertainty for officials and enhancing safety through uniform enforcement.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Yes, strengthens and improves FBC. Mass timber, included in national codes since 2021, is supported by comprehensive research and testing. It offers a durable, fire-safe alternative that expands construction options without compromising safety, strengthening the code with new, tested materials.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No discrimination and aligns with national standards since its 2021 IBC inclusion. Adopted in 40 states, with 6 more in process, mass timber is not replacing existing methods but adds a tested, proven option, ensuring fairness in material selection without preference or restriction.

Does not degrade the effectiveness of the code

Adopting mass timber strengthens the FBC by adding structural and fire safety criteria validated by testing and research from the ICC TWB. It doesn't alter or weaken requirements for other construction types but ensures consistent enforcement of tested, nationally accepted standards.

2nd Comment Period

S12276-G1

Proponent Cade Booth Submitted 8/22/2025 3:25:10 PM Attachments No

Comment:

As promised, the AWC has offered and provided direct training to TAC members and engaged in multiple discussions to help resolve outstanding concerns. We look forward to continuing the conversation on the mass timber provisions at the second TAC meetings. Allowing protected concealed spaces outlined in 602.4 in Type IV buildings supports adaptive reuse of heavy timber structures and the installation of mechanicals in CLT construction. In addition to standard concealed space requirements, this change requires either sprinkler coverage, elimination of air space with noncombustible insulation, or covering combustible surfaces with 5/8-inch Type X gypsum. These provisions are based on NFPA 13, so in order to use these provisions the building must be fully protected by a compliant sprinkler system. These concealed space requirements are not unique or new to the code and no discussion was noted on them during the first TAC.

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CHAPTER 23

WOOD

SECTION 2304
GENERAL CONSTRUCTION REQUIREMENTS

Revise section as follows:

2304.11.3 Floors. Floors shall be without concealed spaces or with concealed spaces complying with Section 602.4.4. Wood floors shall be constructed in accordance with Section 2304.11.3.1 or 2304.11.3.2.

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FBC 9th edition – Mass Timber Package

Th following document is a comprehensive package of all code modifications related to mass timber proposals. It is provided for your reference as it is essential these proposals be able to be reviewed in context rather than in isolation, as the adoption of new construction types – Type IV-A, IV-B, and IV-C – has broad implications throughout the Florida Building Code. Having context of these provisions together ensures a clear understanding of their interconnections, facilitating informed decision-making regarding the integration of mass timber construction into the code.

The proposed modifications to the Florida Building Code have been organized in a presentation sequence for logic rather than strictly following the order of the code. This approach ensures that the rationale for mass timber construction is presented clearly, allowing stakeholders to understand the technical justification before diving into specific code provisions. This proposal package first establishes the construction types themselves – Types IV-A, IV-B, IV-C – to provide a foundational understanding. It then transitions into details of fire protection, followed by specific provisions necessary to integrate mass timber into the code. Finally, it addresses additional supporting provisions, including inspections, allowable heights and areas, and distinctions where existing code is applicable to the existing Type IV-HT only. The sequence is intended to provide a comprehensive package for consideration and refence for the inclusion of mass timber in the Florida Building Code, 9th edition.

A Table of Contents (in order of appearance in the package) and Index (in order of section reference) have been provided for reference.

Thank you.

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CHAPTER 6
TYPES OF CONSTRUCTION

SECTION 601
GENERAL

Revise table as follows:

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a,b,c]	1[b, c]	0[c]	1[b, c]	0	3[a]	2[a]	2[a]	HT	1	0
Bearing walls												
Exterior[e, f]	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	3	2	2	1/HT[g]	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	$1^1/_2$	1	1	HT	1	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

b. Where every part of the roof construction is 20 feet or more above the floor or mezzanine immediately below, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking, except where any of the following conditions apply.

1. In Group F-1, H, M, and S-1 occupancies.
2. Where the roof is an occupiable space.

Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

c. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members, where a 1-hour or less fire-resistance rating is required.

d. Not less than the fire-resistance rating required by other sections of this code.

e. Not less than the fire-resistance rating based on fire separation distance (see Table 705.5).

f. Not less than the fire-resistance rating as referenced in Section 704.10.

g. Heavy timber bearing walls supporting more than two floors or more than a floor and a roof shall have a *fire-resistance rating* of not less than 1 hour.

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SECTION 602
CONSTRUCTION CLASSIFICATION

Revise and add new sections as follows:

602.4 Type IV. ~~Type IV construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated wood, heavy timber (HT) or structural composite lumber (SCL) without concealed spaces. The minimum dimensions for permitted materials including solid timber, glued laminated timber, structural composite lumber (SCL), and cross-laminated timber and details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1 hour fire resistance rating or heavy timber complying with Section 2304.11.2.2 shall be permitted.~~ Type IV construction is that type of construction in which the *building elements* are *mass timber* or noncombustible materials and have *fire-resistance ratings* in accordance with Table 601. *Mass timber* elements shall meet the *fire-resistance-rating* requirements of this section based on either the *fire-resistance rating* of the n*oncombustible protection*, the *mass timber*, or a combination of both and shall be determined in accordance with Section 703.2. The minimum dimensions and permitted materials for *building elements* shall comply with the provisions of this section and Section 2304.11. *Mass timber* elements of Types IV-A, IV-B and IV-C construction shall be protected with *noncombustible protection* applied directly to the *mass timber* in accordance with Sections 602.4.1 through 602.4.3. The time assigned to the *noncombustible protection* shall be determined in accordance with Section 703.6 and comply with Section 722.7.

Cross-laminated timber shall be labeled as conforming to ANSI/APA PRG 320 as referenced in Section 2303.1.4.

Exterior *load-bearing walls* and *nonload-bearing walls* shall be *mass timber* construction, or shall be of noncombustible construction.

> **Exception:** Exterior *load-bearing walls* and *nonload-bearing walls* of Type IV-HT construction in accordance with Section 602.4.4.

The interior *building elements*, including *nonload-bearing walls* and partitions, shall be of *mass timber* construction or of noncombustible construction.

> **Exception:** Interior *building elements* and nonload-bearing walls and partitions of Type IV-HT construction in accordance with Section 602.4.4.

Combustible concealed spaces are not permitted except as otherwise indicated in Sections 602.4.1 through 602.4.4. Combustible stud spaces within light frame walls of Type IV-HT construction shall not be considered concealed spaces, but shall comply with Section 718.

In *buildings* of Type IV-A, IV-B, and IV-C construction with an occupied floor located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access, up to and including 12 *stories* or 180 feet (54 864 mm) above *grade plane*, *mass timber* interior exit and elevator hoistway enclosures shall be protected in accordance with Section 602.4.1.2. In *buildings* greater than 12 *stories* or 180 feet (54 864 mm) above *grade plane*, interior exit and elevator hoistway enclosures shall be constructed of noncombustible materials.

> **602.4.1 Type IV-A.** *Building elements* in Type IV-A construction shall be protected in accordance with Sections 602.4.1.1 through 602.4.1.6. The required *fire-resistance rating* of noncombustible elements and protected *mass timber* elements shall be determined in accordance with Section 703.2.
>
> > **602.4.1.1 Exterior protection.** The outside face of *exterior walls* of *mass timber* construction shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1). Components of the *exterior wall covering* shall be of noncombustible material except *water-resistive barriers* having a peak heat release rate of less than 150kW/m^2, a total heat release of

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less than 20 MJ/m^2 and an effective heat of combustion of less than 18MJ/kg as determined in accordance with ASTM E1354 and having a *flame spread index* of 25 or less and a *smoke-developed index* of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2.

602.4.1.2 Interior protection. Interior faces of all *mass timber* elements, including the inside faces of exterior *mass timber* walls and *mass timber* roofs, shall be protected with materials complying with Section 703.3.

602.4.1.2.1 Protection time. *Noncombustible protection* shall contribute a time equal to or greater than times assigned in Table 722.7.1(1), but not less than 80 minutes. The use of materials and their respective protection contributions specified in Table 722.7.1(2) shall be permitted to be used for compliance with Section 722.7.1.

602.4.1.3 Floors. The floor assembly shall contain a noncombustible material not less than 1 inch (25 mm) in thickness above the *mass timber*. Floor finishes in accordance with Section 804 shall be permitted on top of the noncombustible material. The underside of floor assemblies shall be protected in accordance with Section 602.4.1.2.

602.4.1.4 Roofs. The *interior surfaces* of *roof assemblies* shall be protected in accordance with Section 602.4.1.2. *Roof coverings* in accordance with Chapter 15 shall be permitted on the outside surface of the *roof assembly*.

602.4.1.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *Florida Building Code, Mechanical*, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected in accordance with Section 602.4.1.2.

602.4.1.6 Shafts. *Shafts* shall be permitted in accordance with Sections 713 and 718. Both the *shaft* side and room side of *mass timber* elements shall be protected in accordance with Section 602.4.1.2.

602.4.2 Type IV-B. *Building elements* in Type IV-B construction shall be protected in accordance with Sections through 602.4.2.6. The required *fire-resistance rating* of noncombustible elements or *mass timber* elements shall be determined in accordance with Section 703.2.

602.4.2.1 Exterior protection. The outside face of *exterior walls* of *mass timber* construction shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1). Components of the *exterior wall covering* shall be of noncombustible material except *water-resistive barriers* having a peak heat release rate of less than 150kW/m^2, a total heat release of less than 20 MJ/m^2 and an effective heat of combustion of less than 18MJ/kg as determined in accordance with ASTM E1354, and having a *flame spread index* of 25 or less and a *smoke-developed index* of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2.

602.4.2.2 Interior protection. Interior faces of all *mass timber* elements, including the inside face of exterior *mass timber* walls and *mass timber* roofs, shall be protected, as required by this section, with materials complying with Section 703.3.

602.4.2.2.1 Protection time. *Noncombustible protection* shall contribute a time equal to or greater than times assigned in Table 722.7.1(1), but not less than 80 minutes. The use of materials and their respective protection contributions specified in Table 722.7.1(2) shall be

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permitted to be used for compliance with Section 722.7.1.

602.4.2.2.2 Protected area. Interior faces of *mass timber* elements, including the inside face of exterior *mass timber* walls and *mass timber* roofs, shall be protected in accordance with Section 602.4.2.2.1.

Exceptions: Unprotected portions of *mass timber* ceilings and walls complying with Section 602.4.2.2.4 and the following:

1. Unprotected portions of *mass timber* ceilings and walls complying with one of the following:

1.1 Unprotected portions of *mass timber* ceilings, including attached beams, shall be permitted and shall be limited to an area less than or equal to 100 percent of the floor area in any *dwelling unit* within a story or *fire area* within a story.

1.2 Unprotected portions of *mass timber* walls, including attached columns, shall be permitted and shall be limited to an area less than or equal to 40 percent of the floor area in any *dwelling unit* within a story or *fire area* within a story.

1.3 Unprotected portions of both walls and ceilings of *mass timber*, including attached columns and beams, in any *dwelling unit* or *fire area* shall be permitted in accordance with Section 602.4.2.2.3.

2. *Mass timber* columns and beams that are not an integral portion of walls or ceilings, respectively, shall be permitted to be unprotected without restriction of either aggregate area or separation from one another.

602.4.2.2.3 Mixed unprotected areas. In each *dwelling unit* or *fire area*, where both portions of ceilings and portions of walls are unprotected, the total allowable unprotected area shall be determined in accordance with Equation 6-1.

$(U_{tc}/\ U_{ac})+(U_{tw}/U_{aw}) \leq 1$ **(Equation 6-1)**

where:

U_{tc} = Total unprotected *mass timber* ceiling areas.

U_{ac} = Allowable unprotected *mass timber* ceiling area conforming to Exception 1.1 of Section 602.4.2.2.2.

U_{tw} = Total unprotected *mass timber* wall areas.

U_{aw} = Allowable unprotected *mass timber* wall area conforming to Exception 1.2 of Section 602.4.2.2.2.

602.4.2.2.4 Separation distance between unprotected mass timber elements. In each *dwelling unit* or *fire area*, unprotected portions of *mass timber* walls shall be not less than 15 feet (4572 mm) from unprotected portions of other walls measured horizontally along the floor.

602.4.2.3 Floors. The floor assembly shall contain a noncombustible material not less than 1 inch (25 mm) in thickness above the *mass timber*. Floor finishes in accordance with Section 804 shall be permitted on top of the noncombustible material. Except where unprotected *mass timber* ceilings are permitted in Section 602.4.2.2.2, the underside of floor assemblies shall be protected in accordance with

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Section 602.4.1.2.

602.4.2.4 Roofs. The *interior surfaces* of roof assemblies shall be protected in accordance with Section 602.4.2.2 except, in nonoccupiable spaces, they shall be treated as a concealed space with no portion left unprotected. *Roof coverings* in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.2.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *Florida Building Code, Mechanical*, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected in accordance with Section 602.4.1.2.

602.4.2.6 Shafts. *Shafts* shall be permitted in accordance with Sections 713 and 718. Both the *shaft* side and room side of *mass timber* elements shall be protected in accordance with Section 602.4.1.2.

602.4.3 Type IV-C. *Building elements* in Type IV-C construction shall be protected in accordance with Sections 602.4.3.1 through 602.4.3.6. The required *fire-resistance rating* of *building elements* shall be determined in accordance with Section 703.2.

602.4.3.1 Exterior protection. The exterior side of walls of combustible construction shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as determined in Table 722.7.1(1). Components of the *exterior wall covering* shall be of noncombustible material except *water-resistive barriers* having a peak heat release rate of less than 150 kW/m^2, a total heat release of less than 20 MJ/m^2 and an effective heat of combustion of less than 18 MJ/kg as determined in accordance with ASTM E1354 and having a *flame spread index* of 25 or less and a *smoke-developed index* of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2.

602.4.3.2 Interior protection. *Mass timber* elements are permitted to be unprotected.

602.4.3.3 Floors. Floor finishes in accordance with Section 804 shall be permitted on top of the floor construction.

602.4.3.4 Roof coverings. *Roof coverings* in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.3.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *Florida Building Code, Mechanical*, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1).

602.4.3.6 Shafts. *Shafts* shall be permitted in accordance with Sections 713 and 718. *Shafts* and elevator hoistway and *interior exit stairway enclosures* shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1), on both the inside of the *shaft* and the outside of the *shaft*.

602.4.4 Type IV-HT. Type IV-HT (Heavy Timber) construction is that type of construction in which the *exterior walls* are of noncombustible materials and the interior *building elements* are of solid wood, laminated heavy timber or *structural composite lumber* (SCL), without concealed spaces or with concealed spaces complying with Section 602.4.4.3. The minimum dimensions for permitted materials including solid timber,

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glued-laminated timber, SCL and *cross-laminated timber* (CLT) and the details of Type IV construction shall comply with the provisions of this section and Section 2304.11. *Exterior walls* complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rated or heavy timber conforming with Section 2304.11.2.2 shall be permitted.

~~602.4.1~~ **602.4.4.1. Fire-retardant-treated wood in *exterior walls*.** *Fire-retardant-treated wood* framing and sheathing complying with Section 2303.2 shall be permitted within *exterior wall* assemblies with a 2-hour rating or less.

~~602.4.2~~ **602.4.4.2 Cross-laminated timber in *exterior walls*.** *Cross-laminated timber* not less than 4 inches (102 mm) in thickness complying with Section 2303.1.4 shall be permitted within *exterior wall* assemblies with a 2-hour rating or less. Heavy timber structural members appurtenant to the *CLT exterior wall* shall meet the requirements of Table 2304.11 and be fire-resistance rated as required for the *exterior wall*. The exterior surface of the *cross-laminated timber* and heavy timber elements shall be ~~is~~ protected by one the following:

1. *Fire-retardant-treated wood* sheathing complying with Section 2303.2 and not less than 15/32 inch (12 mm) thick.
2. *Gypsum board* not less than 1/2 inch (12.7 mm) thick; or
3. A noncombustible material.

602.4.4.3 Concealed spaces. Concealed spaces shall not contain combustible materials other than *building elements* and electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *Florida Building Code, Mechanical*. Concealed spaces shall comply with applicable provisions of Section 718. Concealed spaces shall be protected in accordance with one or more of the following:

1. The building shall be sprinklered throughout in accordance with Section 903.3.1.1 and automatic sprinklers shall also be provided in the concealed space.
2. The concealed space shall be completely filled with noncombustible insulation.
3. Combustible surfaces within the concealed space shall be fully sheathed with not less than 5/8 -inch *Type X gypsum board*.

Exception: Concealed spaces within interior walls and partitions with a 1-hour or greater *fire-resistance rating* complying with Section 2304.11.2.2 shall not require additional protection.

~~602.4.3~~ **602.4.4.4 Exterior structural members.** Where a horizontal separation of 20 feet (6096 mm) or more is provided, wood columns and arches conforming to heavy timber sizes complying with Section 2304.11 shall be permitted to be used externally.

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CHAPTER 7
FIRE AND SMOKE PROTECTION FEATURES

SECTION 703
FIRE-RESISTANCE RATINGS AND FIRE TESTS

Add new sections as follows:

703.8 Determination of noncombustible protection time contribution. The time, in minutes, contributed to the *fire-resistance rating* by the *noncombustible protection* of *mass timber building elements*, components, or assemblies, shall be established through a comparison of assemblies tested using procedures set forth in ASTM E119 or UL 263. The test assemblies shall be identical in construction, loading and materials, other than the *noncombustible protection*. The two test assemblies shall be tested to the same criteria of structural failure with the following conditions:

1. Test Assembly 1 shall be without protection.
2. Test Assembly 2 shall include the representative *noncombustible protection*. The protection shall be fully defined in terms of configuration details, attachment details, *joint* sealing details, accessories and all other relevant details.

The *noncombustible protection* time contribution shall be determined by subtracting the *fire-resistance* time, in minutes, of Test Assembly 1 from the *fire-resistance* time, in minutes, of Test Assembly 2.

703.9 Sealing of adjacent mass timber elements. In *buildings* of Types IV-A, IV-B and IV-C construction, sealant or adhesive shall be provided to resist the passage of air in the following locations:

1. At abutting edges and intersections of *mass timber building elements* required to be fire-resistance rated.
2. At abutting intersections of *mass timber building elements* and *building elements* of other materials where both are required to be fire-resistance rated.

Sealants shall meet the requirements of ASTM C920. Adhesives shall meet the requirements of ASTM D3498.

Exception: Sealants or adhesives need not be provided where they are not a required component of a tested fire-resistance-rated assembly.

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SECTION 705
PROJECTIONS

Revise table as follows:

TABLE 705.5
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U[h]
X < 5[b]	All	3	2	1
5 ≤ X < 10	IA, IVA	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB, IVA, IVB	2	1	1[c]
	IIB, VB	1	0	0
	Others	1	1	1[c]
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
b. See Section 706.1.1 for party walls.
c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
e. For special requirements for Group H occupancies, see Section 415.6.
f. For special requirements for Group S aircraft hangars, see Section 412.4.1.
g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

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SECTION 718
CONCEALED SPACES

Revise section as follows:

718.2.1 Fireblocking materials. *Fireblocking* shall consist of the following materials:

1. Two-inch (51 mm) nominal lumber.
2. Two thicknesses of 1-inch (25 mm) nominal lumber with broken lap joints.
3. One thickness of 0.719-inch (18.3 mm) *wood structural panels* with joints backed by 0.719-inch (18.3 mm) *wood structural panels.*
4. One thickness of 0.75-inch (19.1 mm) *particleboard* with joints backed by 0.75-inch (19 mm) *particleboard.*
5. One-half-inch (12.7 mm) *gypsum board.*
6. One-fourth-inch (6.4 mm) cement-based millboard.
7. Batts or blankets of *mineral wool*, *mineral fiber* or other *approved* materials installed in such a manner as to be securely retained in place.
8. Cellulose insulation-installed as tested for the specific application.
9. *Mass timber* complying with Section 2304.11.
10. One thickness of $^{19}/_{32}$-inch (15.1 mm) *fire-retardant-treated wood* structural panel complying with Section 2303.2.

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SECTION 722
CALCULATED FIRE-RESISTANCE

Add new sections as follows:

722.7 Fire-resistance rating for mass timber. The required *fire resistance* of *mass timber* elements in Section 602.4 shall be determined in accordance with Section 703.2. The *fire-resistance rating* of *building elements* shall be as required in Tables 601 and 705.5 and as specified elsewhere in this code. The *fire-resistance rating* of the *mass timber* elements shall consist of the *fire resistance* of the unprotected element added to the protection time of the *noncombustible protection*.

722.7.1 Minimum required protection. Where required by Sections 602.4.1 through 602.4.3, *noncombustible protection* shall be provided for *mass timber building elements* in accordance with Table 722.7.1(1). The rating, in minutes, contributed by the *noncombustible protection* of *mass timber building elements*, components or assemblies, shall be established in accordance with Section 703.6. The protection contributions indicated in Table 722.7.1(2) shall be deemed to comply with this requirement where installed and fastened in accordance with Section 722.7.2.

TABLE 722.7.1(1)
PROTECTION REQUIRED FROM NONCOMBUSTIBLE COVERING MATERIAL

REQUIRED FIRE-RESISTANCE RATING OF BUILDING ELEMENT PER Table 601 AND Table 602 (hours)	MINIMUM PROTECTION REQUIRED FROM NONCOMBUSTIBLE PROTECTION (minutes)
1	40
2	80
3 or more	120

TABLE 722.7.1(2)
PROTECTION PROVIDED BY NONCOMBUSTIBLE COVERING MATERIAL

NONCOMBUSTIBLE PROTECTION	PROTECTION CONTRIBUTION (minutes)
1/2-inch Type X gypsum board	25
5/8-inch Type X gypsum board	40

722.7.2 Installation of gypsum board noncombustible protection. *Gypsum board* complying with Table 722.7.1(2) shall be installed in accordance with this section.

722.7.2.1 Interior surfaces. Layers of *Type X gypsum board* serving as *noncombustible protection* for *interior surfaces* of wall and ceiling assemblies determined in accordance with Table 722.7.1(1) shall be installed in accordance with the following:

1. Each layer shall be attached with Type S drywall screws of sufficient length to penetrate the *mass timber* at least 1 inch (25 mm) when driven flush with the paper surface of the *gypsum board*.

   Exception: The third layer, where determined necessary by Section 722.7, shall be permitted to be attached with 1-inch (25 mm) No. 6 Type S drywall screws to furring channels in accordance with AISI S220.

2. Screws for attaching the base layer shall be 12 inches (305 mm) on center in both directions.

3. Screws for each layer after the base layer shall be 12 inches (305 mm) on center in both directions and offset from the screws of the previous layers by 4 inches (102 mm) in both directions.

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4. All panel edges of any layer shall be offset 18 inches (457 mm) from those of the previous layer.

5. All panel edges shall be attached with screws sized and offset as in Items 1 through 4 and placed at least 1 inch (25 mm) but not more than 2 inches (51 mm) from the panel edge.

6. All panels installed at wall-to-ceiling intersections shall be installed such that ceiling panels are installed first and the wall panels are installed after the ceiling panel has been installed and is fitted tight to the ceiling panel. Where multiple layers are required, each layer shall repeat this process.

7. All panels installed at a wall-to-wall intersection shall be installed such that the panels covering an *exterior wall* or a wall with a greater *fire-resistance rating* shall be installed first and the panels covering the other wall shall be fitted tight to the panel covering the first wall. Where multiple layers are required, each layer shall repeat this process.

8. Panel edges of the face layer shall be taped and finished with joint compound. Fastener heads shall be covered with joint compound.

9. Panel edges protecting *mass timber* elements adjacent to unprotected *mass timber* elements in accordance with Section 602.4.2.2 shall be covered with 11/4-inch (32 mm) metal corner bead and finished with joint compound.

722.7.2.2 Exterior surfaces. Layers of *Type X gypsum board* serving as *noncombustible protection* for the outside of the exterior *mass timber* walls determined in accordance with Table 722.7.1(1) shall be fastened 12 inches (305 mm) on center each way and 6 inches (152 mm) on center at all joints or ends. All panel edges shall be attached with fasteners located at least 1 inch (25 mm) but not more than 2 inches (51 mm) from the panel edge. Fasteners shall comply with one of the following:

1. Galvanized nails of minimum 12 gage with a 7/16-inch (11 mm) head of sufficient length to penetrate the *mass timber* a minimum of 1 inch (25 mm).

2. Screws that comply with ASTM C1002 (Type S, W or G) of sufficient length to penetrate the *mass timber* a minimum of 1 inch (25 mm).

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CHAPTER 4
SPECIAL DETAILED REQUIREMENTS BASED ON OCCUPANCY AND USE

SECTION 403
HIGH-RISE BUILDINGS

Revise section as follows:

403.3.2 Water supply to required fire pumps. In all *buildings* that are more than 420 feet (128 000 mm) in *building height* and *buildings* of Type IV-A and IV-B construction that are more than 120 feet (36 576 mm) in *building height*, required fire pumps shall be supplied by connections to no fewer than two water mains located in different streets. Separate supply piping shall be provided between each connection to the water main and the pumps. Each connection and the supply piping between the connection and the pumps shall be sized to supply the flow and pressure required for the pumps to operate.

Exception: Two connections to the same main shall be permitted provided the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through no fewer than one of the connections.

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CHAPTER 33
SAFEGUARDS DURING CONSTRUCTION

Add new section as follows:

SECTION 3314
FIRE SAFETY REQUIREMENTS FOR BUILDINGS OF TYPES IV-A, IV-B, AND IV-C CONSTRUCTION

[F] 3314.1 Fire safety requirements for buildings of Types IV-A, IV-B, and IV-C construction. Buildings of Types IV-A, IV-B, and IV-C construction designed to be greater than six stories above grade plane shall comply with the following requirements during construction unless otherwise approved by the fire code official.

1. Standpipes shall be provided in accordance with Section 3313.

2. A water supply for fire department operations, as approved by the fire code official and the fire chief.

3. Where building construction exceeds six stories above grade plane, at least one layer of noncombustible protection where required by Section 602.4 shall be installed on all building elements more than 4 floor levels, including mezzanines, below active *mass timber* construction before erecting additional floor levels.

   Exceptions:
   1. *Shafts* and vertical exit enclosures shall not be considered a part of the active mass timber construction.
   2. Noncombustible material on the top of mass timber floor assemblies shall not be required before erecting additional floor levels.

4. Where building construction exceeds six stories above grade plane required exterior wall coverings shall be installed on all floor levels more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor level.

   Exception: *Shafts* and vertical exit enclosures shall not be considered a part of the active mass timber construction.

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CHAPTER 23
WOOD

SECTION 2301
GENERAL

Revise section as follows:

2301.3 ~~Nominal sizes~~ Dimensions. For the purposes of this chapter, where dimensions of lumber are specified, they shall be deemed to be nominal dimensions unless specifically designated as actual dimensions (see Section 2304.2). Where dimensions of *cross-laminated timber* thickness are specified, they shall be deemed to be actual dimensions.

SECTION 2304
GENERAL CONSTRUCTION REQUIREMENTS

Add new section and revise sections as follows:

2304.10.8 Fire protection of connections. Connections used with *fire-resistance*-rated members and in fire-resistance-rated assemblies of Type IV-A, IV-B or IV-C construction shall be protected for the time associated with the fire-resistance rating. Protection time shall be determined by one of the following:

1. Testing in accordance with Section 703.2 where the connection is part of the *fire resistance* test.

2. Engineering analysis that demonstrates that the temperature rise at any portion of the connection is limited to an average temperature rise of 250°F (139°C), and a maximum temperature rise of 325°F (181°C), for a time corresponding to the required *fire-resistance* rating of the structural element being connected. For the purposes of this analysis, the connection includes connectors, fasteners, and portions of wood members included in the structural design of the connection.

2304.11.1.1 Columns. Minimum dimensions of columns shall be in accordance with Table 2304.11. Columns shall be connected in an *approved* manner. Columns shall be continuous or aligned vertically from floor to floor in ~~superimposed throughout~~ all stories of Type IV-HT construction ~~and connected in an approved manner~~. Girders and beams at column connections shall be closely fitted around columns and adjoining ends shall be cross tied to each other, or intertied by caps or ties, to transfer horizontal *loads* across joints. Wood bolsters shall not be placed on tops of columns unless the columns support roof *loads* only. Where traditional heavy timber detailing is used, connections shall be permitted to be by means of reinforced concrete or metal caps with brackets, by properly designed steel or iron caps, with pintles and base plates, by timber splice plates affixed to the columns by metal connectors housed within the contact faces, or by other *approved* methods.

2304.11.3 Floors. Floors shall be without concealed spaces or with concealed spaces complying with Section 602.4.4. Wood floors shall be constructed in accordance with Section 2304.11.3.1 or 2304.11.3.2.

2304.11.4 Roof decks. Roofs shall be without concealed spaces ~~and roof~~ or with concealed spaces complying with Section 602.4.3. Roof decks shall be constructed in accordance with Section 2304.11.4.1 or 2304.11.4.2. Other types of decking shall be an alternative that provides equivalent *fire resistance* and structural properties are being provided. Where supported by a wall, *roof decks* shall be anchored to walls to resist forces determined in accordance with Chapter 16. Such anchors shall consist of steel bolts, lags, screws or *approved* hardware of sufficient strength to resist prescribed forces.

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CHAPTER 17

SPECIAL INSPECTION AND TESTS

SECTION 1711
MASS TIMBER CONSTRUCTION

Add new sections and table as follows:

1711.1 Mass timber construction. Inspections of mass timber elements in Types IV-A, IV-B and IV-C construction shall be in accordance with Table 1711.1.

TABLE 1711.1
REQUIRED INSPECTIONS OF MASS TIMBER CONSTRUCTION

	TYPE		CONTINUOUS SPECIAL INSPECTION	PERIODIC INSPECTION
1.	Inspection of anchorage and connections of mass timber construction to timber deep foundation systems.		—	X
2.	Inspect erection of mass timber construction.		—	X
3.	Inspection of connections where installation methods are required to meet design loads.			
	Threaded fasteners	Verify use of proper installation equipment.	—	X
		Verify use of pre-drilled holes where required.	—	X
		Inspect screws, including diameter, length, head type, spacing, installation angle and depth.	—	X
	Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads.		X	—
	Adhesive anchors not defined in preceding cell.		—	X
	Bolted connections.		—	X
	Concealed connections.		—	X

1711.2 Sealing of mass timber. Periodic *special inspections* of sealants or adhesives shall be conducted where sealant or adhesive required by Section 703.7 is applied to *mass timber building elements* as designated in the *approved construction documents*.

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CHAPTER 1
SCOPE AND ADMINISTRATION

SECTION 110
INSPECTIONS

Add new section as follows:

110.3.14 Types IV-A, IV-B, and IV-C connection protection inspection. In buildings of Types IV-A, IV-B, and IV-C construction, where connection fire-resistance ratings are provided by wood cover calculated to meet the requirements of Section 2304.10.8, inspection of the wood cover shall be made after the cover is installed, but before any other coverings or finishes are installed.

CHAPTER 2
DEFINITIONS

SECTION 202
DEFINITIONS

Revise and add new definitions as follows:

[BS] WALL, LOAD-BEARING. Any wall meeting either of the following classifications:

1. Any metal or wood stud wall that supports more than 100 pounds per linear foot (1459 N/m) of vertical load in addition to its own weight.
2. Any *masonry*, ~~or~~ concrete, or *mass timber* wall that supports more than 200 pounds per linear foot (2919 N/m) of vertical load in addition to its own weight.

MASS TIMBER. Structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross section dimensions of Type IV construction.

NONCOMBUSTIBLE PROTECTION (FOR MASS TIMBER). Noncombustible material, in accordance with Section 703.5, designed to increase the *fire-resistance rating* and delay the combustion of *mass timber*.

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CHAPTER 5
GENERAL BUILDING HEIGHTS AND AREAS

SECTION 504
BUILDING HEIGHT AND NUMBER OF STORIES

Revise tables as follows:

TABLE 504.3[a]
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A, B, E, F, M, S, U	NS[b]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
H-1, H-2, H-3, H-5	NS[c,d]	UL	160	65	55	65	55	120	90	65	65	50	40
	S												
H-4	NS[c,d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1Condition 1, I-3	NS[d,e]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1Condition 2, I-2	NS[d,e,f]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									
I-4	NS[d,g]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
Rh	NS[d,h]	UL	160	65	55	65	55	65	65	65	65	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60

For SI: 1 foot = 304.8 mm.

Note: UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2;

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.
b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
d. The NS value is only for use in evaluation of existing building height in accordance with the *Florida Building Code, Existing Building*.
e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies Condition 1, see Exception 1 of Section 903.2.6.
f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and the *Florida Fire Prevention Code*.
g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.
h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

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TABLE 504.4[a, b]
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
F-1	NS	UL	11	4	2	3	2	3	3	3	4	2	1
	S	UL	12	5	3	4	3	10	7	5	5	3	2
F-2	NS	UL	11	5	3	4	3	5	5	5	5	3	2
	S	UL	12	6	4	5	4	12	8	6	6	4	3
H-1	NS[c, d]	1	1	1	1	1	1	NP	NP	NP	1	1	NP
	S							1	1	1			
H-2	NS[c, d]	UL	3	2	1	2	1	1	1	1	2	1	1
	S							2	2	2			
H-3	NS[c, d]	UL	6	4	2	4	2	3	3	3	4	2	1
	S							4	4	4			
H-4	NS[c, d]	UL	7	5	3	5	3	5	5	5	5	3	2
	S	UL	8	6	4	6	4	8	7	6	6	4	3
H-5	NS[c, d]	4	4	3	3	3	3	2	2	2	3	3	2
	S							3	3	3			
I-1 Condition 1	NS[d, e]	UL	9	4	3	4	3	4	4	4	4	3	2
	S	UL	10	5	4	5	4	10	7	5	5	4	3
I-1 Condition 2	NS[d, e]	UL	9	4	3	4	3	3	3	3	4	3	2
	S	UL	10	5				10	6	4			
I-2	NS[d, f]	UL	4	2	1	1	NP	NP	NP	NP	1	1	NP
	S	UL	5	3				7	5	1			
I-3	NS[d, e]	UL	4	2	1	2	1	2	2	2	2	2	1
	S	UL	5	3	2	3	2	7	5	3	3	3	2
I-4	NS[d, g]	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
M	NS	UL	11	4	2	4	2	4	4	4	4	3	1
	S	UL	12	5	3	5	3	12	8	6	5	4	2

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TABLE 504.4[a, b]—continued
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
R-1	NS[d, h]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-2	NS[d, h]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4	4								4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-3	NS[d, h]	UL	11	4	4	4	4	4	4	4	4	3	3
	S13R	4	4									4	4
	S	UL	12	5	5	5	5	18	12	5	5	4	4
R-4	NS[d, h]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	5	5	4	3
S-1	NS	UL	11	4	2	3	2	4	4	4	4	3	1
	S	UL	12	5	4	4	4	10	7	5	5	4	2
S-2	NS	UL	11	5	3	4	3	4	4	4	5	4	2
	S	UL	12	6	4	5	4	12	8	5	6	5	3
U	NS	UL	5	4	2	3	2	4	4	4	4	2	1
	S	UL	6	5	3	4	3	9	6	5	5	3	2

Note: UL = Unlimited; NP = Not Permitted; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.
b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
d. The NS value is only for use in evaluation of existing *building height* in accordance with the *Florida Building Code, Existing Building*.
e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.
f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and the *Florida Fire Prevention Code*.
g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.
h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8

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SECTION 506
BUILDING AREA

Revise table as follows:

TABLE 506.2[a, b]
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, or SM, as applicable)
IN SQUARE FEET

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1												
	SM												
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
E	NS	UL	UL	26,500	14,500	23,500	14,500	76,500	51,000	31,875	25,500	18,500	9,500
	S1	UL	UL	106,000	58,000	94,000	58,000	306,000	204,000	127,500	102,000	74,000	38,000
	SM	UL	UL	79,500	43,500	70,500	43,500	229,500	153,000	95,625	76,500	55,500	28,500
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	100,500	67,000	41,875	33,500	14,000	8,500
	S1	UL	UL	100,000	62,000	76,000	48,000	402,000	268,000	167,500	134,000	56,000	34,000
	SM	UL	UL	75,000	46,500	57,000	36,000	301,500	201,000	125,625	100,500	42,000	25,500
F-2	NS	UL	UL	37,500	23,000	28,500	18,000	151,500	101,000	63,125	50,500	21,000	13,000
	S1	UL	UL	150,000	92,000	114,000	72,000	606,000	404,000	252,500	202,000	84,000	52,000
	SM	UL	UL	112,500	69,000	85,500	54,000	454,500	303,000	189,375	151,500	63,000	39,000
H-1	NS[c]	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	NP
	S1												
H-2	NS[c]	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	3,000
	S1												
	SM												
H-3	NS[c]	UL	60,000	26,500	14,000	17,500	13,000	25,500	25,500	25,500	25,500	10,000	5,000
	S1												
	SM												
H-4	NS[c, d]	UL	UL	37,500	17,500	28,500	17,500	72,000	54,000	40,500	36,000	18,000	6,500
	S1	UL	UL	150,000	70,000	114,000	70,000	288,000	216,000	162,000	144,000	72,000	26,000
	SM	UL	UL	112,500	52,500	85,500	52,500	216,000	162,000	121,500	108,000	54,000	19,500
H-5	NS[c, d]	UL	UL	37,500	23,000	28,500	19,000	72,000	54,000	40,500	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	288,000	216,000	162,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	216,000	162,000	121,500	108000	54,000	27,000

(continued)

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FBC 9th edition – Mass Timber Package

TABLE 506.2[a, b]—continued
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, or SM, as applicable)
IN SQUARE FEET

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
I-1	NS[d, e]	UL	55,000	19,000	10,000	16,500	10,000	54,000	36,000	18,000	18,000	10,500	4,500
	S1	UL	220,000	76,000	40,000	66,000	40,000	216,000	144,000	72,000	72,000	42,000	18,000
	SM	UL	165,000	57,000	30,000	49,500	30,000	162,000	108,000	54,000	54,000	31,500	13,500
I-2	NS[d, f]	UL	UL	15,000	11,000	12,000	NP	36,000	24,000	12,000	12,000	9,500	NP
	S1	UL	UL	60,000	44,000	48,000	NP	144,000	96,000	48,000	48,000	38,000	NP
	SM	UL	UL	45,000	33,000	36,000	NP	108,000	72,000	36,000	36,000	28,500	NP
I-3	NS[d, e]	UL	UL	15,000	10,000	10,500	7,500	36,000	24,000	12,000	12,000	7,500	5,000
	S1	UL	UL	60,000	40,000	42,000	30,000	144,000	96,000	48,000	48,000	30,000	20,000
	SM	UL	UL	45,000	30,000	31,500	22,500	108,000	72,000	36,000	36,000	22,500	15,000
I-4	NS[d, g]	UL	60,500	26,500	13,000	23,500	13,000	76,500	51,000	25,500	25,500	18,500	9,000
	S1	UL	121,000	106,000	52,000	94,000	52,000	306,000	204,000	102,000	102,000	74,000	36,000
	SM	UL	181,500	79,500	39,000	70,500	39,000	229,500	153,000	76,500	76,500	55,500	27,000
M	NS	UL	UL	21,500	12,500	18,500	12,500	61,500	41,000	26,625	20,500	14,000	9,000
	S1	UL	UL	86,000	50,000	74,000	50,000	246,000	164,000	102,500	82,000	56,000	36,000
	SM	UL	UL	64,500	37,500	55,500	37,500	184,500	123,000	76,875	61,500	42,000	27,000
R-1	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-2	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-3	NS[d, h]	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S13R												
	S1												
	SM												
R-4	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
S-1	NS	UL	48,000	26,000	17,500	26,000	17,500	76,500	51,000	31,875	25,500	14,000	9,000
	S1	UL	192,000	104,000	70,000	104,000	70,000	306,000	204,000	127,500	102,000	56,000	36,000
	SM	UL	144,000	78,000	52,500	78,000	52,500	229,500	153,000	95,625	76,500	42,000	27,000
S-2	NS	UL	79,000	39,000	26,000	39,000	26,000	115,500	77,000	48,125	38,500	21,000	13,500
	S1	UL	316,000	156,000	104,000	156,000	104,000	462,000	308,000	192,500	154,000	84,000	54,000
	SM	UL	237,000	117,000	78,000	117,000	78,000	346,500	231,000	144,375	115,500	63,000	40,500
U	NS[i]	UL	35,500	19,000	8,500	14,000	8,500	54,000	36,000	22,500	18,000	9,000	5,500
	S1	UL	142,000	76,000	34,000	56,000	34,000	216,000	144,000	90,000	72,000	36,000	22,000
	SM	UL	106,500	57,000	25,500	42,000	25,500	162,000	108,000	67,500	54,000	27,000	16,500

(continued)

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TABLE 506.2[a, b]—continued
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D or SM, as applicable)
IN SQUARE FEET

Note: UL = Unlimited; NP = Not Permitted
For SI: 1 square foot = 0.0929 m^2.

NS = Buildings not equipped throughout with an automatic sprinkler system; S1 = Buildings a maximum of one story above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; SM = Buildings two or more stories above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2.

a. See Chapters 4 and 5 for specific exceptions to the allowable area in this chapter.
b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
d. The NS value is only for use in evaluation of existing building area in accordance with the *Florida Building Code, Existing Building*.
e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.
f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and the *Florida Fire Prevention Code*.
g. New Group I-4 occupancies see Exceptions 2 and 3 of Section 903.2.6.
h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

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SECTION 508
MIXED USE AND OCCUPANCY

Revise section as follows:

508.4.4.1 Construction. Required separations shall be *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both, so as to completely separate adjacent occupancies. *Mass timber* elements serving as *fire barriers* or *horizontal assemblies* to separate occupancies in Type IV-B or IV-C construction shall be separated from the interior of the *building* with an *approved* thermal barrier consisting of *gypsum board* that is not less than 1/2 inch (12.7 mm) in thickness or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.

Exception: The thermal barrier shall not be required on the top of horizontal assemblies serving as occupancy separations.

SECTION 509
INCIDENTAL USES

Add new section as follows:

509.4.1.1 Type IV-B and IV-C construction. Where Table 509 specifies a fire-resistance-rated separation, *mass timber* elements serving as *fire barriers* or *horizontal assemblies* in Type IV-B or IV-C construction shall be separated from the interior of the incidental use with an *approved* thermal barrier consisting of *gypsum board* that is not less than 1/2 inch (12.7mm) in thickness or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.

Exception: The thermal barrier shall not be required on the top of horizontal assemblies serving as incidental use separations.

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CHAPTER 14
EXTERIOR WALLS

SECTION 1405
INSTALLATION OF WALL COVERINGS

Revise section as follows:

1405.5 Wood Veneers. Wood veneers on exterior walls of buildings of Type I, II, III and IV-HT construction shall be not less than 1 inch (25mm) nominal thickness, 0.438-inch (11.1 mm) exterior *hardboard* siding or 0.375-inch (9.5 mm) exterior-type *wood structural panels* or *particleboard* and shall conform to the following:

1. The *veneer* shall not exceed 40 feet (12 190 mm) in height above grade. Where *fire-retardant-treated wood* is used, the height shall not exceed 60 feet (18 290 mm) in height above grade.

2. The *veneer* is attached to or furred from a noncombustible *backing* that is fire-resistance rated as required by other provisions of this code.

3. Where open or spaced wood *veneers* (without concealed spaces) are used, they shall not project more than 24 inches (610 mm) from the *building* wall.

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SECTION 1406
COMBUSTIBLE MATERIALS ON THE EXTERIOR SIDE OF EXTERIOR WALLS

Revise sections as follows:

1406.2.1 Type I, II, III and IV-HT construction. On buildings of Type I, II, III and IV-HT construction, exterior wall coverings shall be permitted to be constructed of combustible materials, complying with the following limitations:

1. Combustible exterior wall coverings shall not exceed 10 percent of an exterior wall surface area where the fire separation distance is 5 feet (1524 mm) or less.
2. Combustible exterior wall coverings shall be limited to 40 feet (12 192 mm) in height above grade plane.
3. Combustible exterior wall coverings constructed of fire-retardant-treated wood complying with Section 2303.2 for exterior installation shall not be limited in wall surface area where the fire separation distance is 5 feet (1524 mm) or less and shall be permitted up to 60 feet (18 288 mm) in height above grade plane regardless of the fire separation distance.
4. Wood veneers shall comply with Section 1405.5.

1406.3 Balconies and similar projections. Balconies and similar projections of combustible construction other than *fire-retardant-treated wood* shall be *fire-resistance* rated where required by Table 601 for floor construction or shall be of heavy timber construction in accordance with Section 2304.11. The aggregate length of the projections shall not exceed 50 percent of the *building*'s perimeter on each floor.

Exceptions:

1. On *buildings* of Type I and II construction, three *stories* or less above *grade plane*, *fire-retardant-treated wood* shall be permitted for balconies, porches, decks and exterior *stairways* not used as required *exits*.
2. Untreated *wood, and plastic composites* that comply with ASTM D7032 and Section 2612, are permitted for pickets and rails or similar guard devices that are limited to 42 inches (1067 mm) in height.
3. Balconies and similar projections on *buildings* of Type III, IV-HT and V construction shall be permitted to be of Type V construction, and shall not be required to have a *fire-resistance rating* where sprinkler protection is extended to these areas.
4. Where sprinkler protection is extended to the balcony areas, the aggregate length of the balcony on each floor shall not be limited.

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CHAPTER 31
SPECIAL CONSTRUCTION

SECTION 3102
MEMBRANE STRUCTURES

Revise sections as follows:

3102.3 Type of construction. *Noncombustible membrane structures* shall be classified as Type IIB construction. Noncombustible frame or cable-supported *structures* covered by an *approved membrane* in accordance with Section 3102.3.1 shall be classified as Type IIB construction. Heavy timber frame-supported *structures* covered by an *approved membrane* in accordance with Section 3102.3.1 shall be classified as Type IV-HT construction. Other *membrane structures* shall be classified as Type V construction.

> **Exception**: Plastic less than 30 feet (9144 mm) above any floor used in *greenhouses*, where *occupancy* by the general public is not authorized, and for aquaculture pond covers is not required to meet the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701.

3102.6.1.1 Membrane. A *membrane* meeting the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701 shall be permitted to be used as the roof or as a *skylight* on buildings of Type IIB, III, IV-HT and V construction, provided the *membrane* is not less than 20 feet (6096 mm) above any floor, balcony or gallery.

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CHAPTER 35
REFERENCED STANDARDS

Revise or add references as follows:

AISI S220—20	**North American Standard for Cold-formed Steel Framing-Nonstructural Members**, 2020 Edition 722.7.2.1
ANSI/APA PRG 320-2019	**Standard for Performance-Rated Cross-Laminated Timber** 602.4
ASTM C920—18	**Standard for Specification for Elastomeric Joint Sealants** 703.9
ASTM C1002—20	**Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs** 722.7.2.2
ASTM D3498—19a	**Standard Specifications for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor Systems** 703.9
ASTM D7032—21	**Standard Specification for Establishing Performance Ratings for Wood-Plastic Composite and Plastic Lumber Deck Boards, Stair Treads, Guards and Handrails** 703.9, 705.2.3.1
ASTM E84—21a	**Standard Test Methods for Surface Burning Characteristics of Building Materials** 202, 602.4.1.1, 602.4.2.1, 602.4.3.1,
ASTM E119—20	**Standard Test Methods for Fire Tests of Building Construction and Materials** 703.8
ASTM E1354—17	**Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products using an Oxygen Consumption Calorimeter** 602.4.1.1, 602.4.2.1, 602.4.3.1
NFPA 241—22	**Standard for Safeguarding Construction, Alteration and Demolition Operations** 3301.1, 3303.2
NFPA 275—22	**Standard Method of Fire Tests for the Evaluation of Thermal Barriers** 508.4.4.1, 509.4.1
NFPA 701—23	**Standard Methods of Fire Tests for Flame Propagation of Textiles and Films** 3102.3, 3102.6.1.1
UL 263—11	**Fire Tests of Building Construction and Materials – with Revisions through August 2021** 703.8
UL 723—18	**Standard for Test for Surface Burning Characteristics of Building Materials** 602.4.1.1, 602.4.2.1, 602.4.3.1

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APPENDIX D
FIRE DISTRICTS

SECTION D102
BUILDING RESTRICTIONS

Revise section as follows:

D102.2.5 Structural fire rating. Walls, floors, roofs and their supporting structural members shall be a minimum of 1-hour fire-resistance-rated construction.

Exceptions:

1. Buildings of Type IV-HT construction.
2. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
3. Automobile parking structures.
4. Buildings surrounded on all sides by a permanently open space of not less than 30 feet (9144 mm).
5. Partitions complying with Section 603.1, Item 11.

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S12276Rationale

FBC – Mass Timber Summary

BACKGROUND

The **Ad Hoc Committee on Tall Wood Buildings (TWB)** was created by the ICC Board in 2015 to explore the science of tall wood buildings and develop code changes for such structures.

The TWB and its various working groups (WGs) held meetings, studied issues, and sought input from expert sources worldwide. The TWB posted these documents and input on its website for interested parties to follow its progress and allow public input throughout.

At its first meeting, the TWB discussed **several performance objectives** to be met with the proposed criteria for tall wood buildings:

- **No collapse** under reasonable scenarios of complete burnout of fuel without considering automatic sprinkler protection.
- **No unusually high radiation exposure** from the subject building to adjoining properties that could present a risk of ignition under reasonably severe fire scenarios.
- **No unusual response to typical radiation exposure** from adjacent properties that could present a risk of ignition of the subject building under reasonably severe fire scenarios.
- **No unusual fire department access issues.**
- **Egress systems** designed to protect building occupants during the design escape time, plus a factor of safety.
- **Highly reliable fire suppression systems** to reduce the risk of failure during reasonably expected fire scenarios. The degree of reliability should be proportional to evacuation time (height) and the risk of collapse.

The comprehensive package of proposals from the **TWB meets these performance objectives.**

DEFINITIONS

Included in the proposal are three new or revised definitions: **Wall, Load-Bearing; Mass Timber;** and **Noncombustible Protection (for Mass Timber).** These definitions are important for understanding the proposed changes to Type IV Construction.

Load-Bearing Wall

The modification to the term **"load-bearing wall"** has been updated to include **"mass timber"** as a category equivalent to other materials. Based on research conducted by wood trade associations, **mass timber walls** (e.g., sawn, glued-laminated, cross-laminated timbers) have the ability to support the minimum 200 pounds per linear foot vertical load requirement required of "load bearing".

Mass Timber

The term **"mass timber"** already exists undefined in previous editions of the Florida Building Code (FBC). The definition proposed represents both legacy heavy timber (a.k.a. Type IV construction) and the three new construction types proposed for **FBC Chapter 6**. The purpose of defining this term is to establish that the term represents various sawn and engineered timber products referenced in **FBC Chapter 23 (Wood)** and PRG-320 "Standard for Performance-Rated Cross-Laminated Timber."

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Noncombustible Protection (For Mass Timber)

The definition of **"Noncombustible Protection (For Mass Timber)"** was created to address the **passive fire protection** requirement of mass timber.

- Mass timber is permitted to have its **own fire-resistance rating** (e.g., Mass Timber only) and/or have a fire-resistance rating based on **a combination of mass timber fire resistance plus protection by noncombustible materials**, as defined in **Section 703.5** (e.g., additional materials that delay combustion, such as gypsum board).
- While it is uncommon to list a code section number within a definition, it was necessary in this case to ensure that the user understands the intent.
- Protection by a **noncombustible material** will act to **delay the combustion** of mass timber.

TYPES OF CONSTRUCTION

The committee recognized tall mass timber buildings worldwide generally fall into three categories:

1. **Fully Protected Mass Timber** – The mass timber is fully protected by noncombustible materials.
2. **Partially Exposed Mass Timber** – Some portions of mass timber may be exposed in limited amounts on walls and/or ceilings.
3. **Unprotected Mass Timber** – The mass timber structure may be fully exposed.

The **TWB** determined that fire testing was necessary to validate these concepts. During its first meeting, members discussed the nature and intent of fire testing to ensure meaningful results for the TWB and, more specifically, for the fire service. A test plan was subsequently developed, consisting of one-bedroom apartments on two levels, each with a corridor leading to a stairway. The purpose of the tests was to evaluate the contribution of mass timber to a fire, the performance of connections and joints, and conditions for responding fire personnel.

The **Fire WG** refined the test plan, which was implemented in a series of five full-scale, multi-story building tests at the **ATF laboratories** in Beltsville, MD. The results, along with testing conducted by others, helped form the basis for the **Codes WG** to develop its code change proposals, including this one, which was approved by the TWB.

MASS TIMBER CONSTRUCTION CLASSIFICATIONS

Type IV-A: Fully Protected Mass Timber

Type IV-A is completely protected with noncombustible materials, primarily layers of **5/8-inch Type X gypsum board**. Fire tests have shown that mass timber construction protected in this way can survive a complete burnout of a residential fuel load **without engaging the mass timber in the fire**.

To ensure uniform protection, the text clearly requires **all** building elements to be protected, including floor surfaces, walls and ceiling surfaces, interior roof surfaces, underside of floor surfaces, and shafts.

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S12276Rationale

Type IV-A is designed to have **the same fire resistance rating as Type I-A construction**, requiring **2-hour and 3-hour structural elements**. The fire resistance rating of structural elements was set conservatively to **sustain fuel loads without sprinkler protection** and **without contributing structural members to the fire**, similar to the IBC strategy for Type I construction.

Type IV-B: Partially Exposed Mass Timber

Type IV-B allows for some exposed **wood surfaces** on ceilings, walls, columns, and beams. However, the amount of exposed wood is **limited** to restrict potential contribution to an interior fire.

Type IV-B has undergone the same fire tests as Type IV-A. Results show a predictable char layer develops on mass timber, similar to traditional sawn lumber, provided **substantial delamination is avoided**. While portions of mass timber may be unprotected, concealed spaces, shafts, and other specified areas must **be fully protected** with noncombustible materials.

Type IV-B is designed to have **the same base fire resistance requirements as Type I-B construction**, and therefore requires **2-hour structural elements**. Unlike Type I-B, the IBC allowance to reduce structural elements to 1-hour protection **is not proposed for Type IV-B**.

Type IV-C: Fully Exposed Mass Timber

Type IV-C construction allows **fully exposed mass timber**, with the key restrictions that concealed spaces, shafts, elevator hoistways, and interior exit stairway enclosures must be protected with noncombustible materials.

This construction type is different from traditional **Heavy Timber (Type IV-HT)** because **Type IV-C requires a 2-hour fire rating**. However, despite this added fire rating, the **height in feet for Type IV-C remains the same as Type IV-HT**. The committee proposed **additional floors** for some occupancy groups in Type IV-C construction.

Modifications to Tables 601 and 602

This proposal includes **modifications to Tables 601 and 602** to set performance requirements for mass timber construction, aligning them with **Type I construction standards**:

- **Type IV-A → Same fire resistance ratings as Type I-A**
- **Type IV-B → Same fire resistance ratings as Type I-B**
- **Type IV-C → Fire resistance is achieved solely through mass timber**

Because **Type IV-C lacks a direct counterpart in Type I construction**, its fire resistance ratings were set to **match those of Type IV-B**. As a result, permitted building heights for Type IV-C are **significantly reduced** in both feet and stories, as reflected in proposed changes to Tables 504.3, 504.4, and 506.2.

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S12276Rationale

Rationale Statement for Proposed Modification to the Florida Building Code, 9th edition (2026)

The proposed modification seeks to incorporate provisions for the use of mass timber in the 9th edition of the Florida Building Code (FBC), aligning it with advancements in building science, fire safety, and structural integrity. This proposal is supported by thousands of hours of research, rigorous fire and structural testing, and extensive modeling by national and international experts and researchers, including the ICC Ad Hoc Committee on Tall Wood Buildings (TWB).

The TWB was established in 2015 in response to concerns from code officials regarding mass timber buildings being constructed without the benefit of codified regulations – precisely the situation in Florida today. To ensure the appropriate degree of rigor, the TWB was composed of a balanced group of stakeholders and subject matter experts to investigate and evaluate the feasibility of tall wood construction and develop comprehensive code provisions addressing fire and life safety concerns. The result was a package of code changes that were successfully integrated into the 2021 International Building Code (IBC), followed by refinements in the 2024 IBC. These provisions now form the foundation for the safe and consistent use of mass timber in 40 states and counting.

Recognizing the critical importance of consistent regulatory frameworks, national consensus codes – including the IBC and NFPA standards – have incorporated mass timber as a safe and viable construction method. The National Association of State Fire Marshals (NASFM) reaffirmed this in a November 2022 position statement, emphasizing:

> "The use of approved mass timber in tall-wood building construction is of the highest concern to NASFM as we stand for the safety of citizens and firefighters. This identified material and construction type has most recently been evaluated in the model code community. **Many facts have been discovered through independent research and testing that have validated this method as meeting the technical requirements of the codes.**" [Emphasis added]

Similarly, the International Association of Fire Chiefs (IAFC) urged jurisdictions to adopt the mass timber provisions of the IBC, stating in January 2020:

> [The IAFC] "Urge communities who are considering new mass-timber buildings to utilize the code provisions found in the 2021 ICC Code documents. There are many opportunities for consideration of buildings that may be taller, larger, or without the protection that was studied. **Communities should continue to use the codes and standards that were established through the model code development process.**" [emphasis added]

Mass timber construction is expanding rapidly across the United States, including in Florida, as developers and architects seek sustainable, efficient, and cost-effective building solutions. However, Florida currently lacks codified mass timber provisions, creating regulatory uncertainty and enforcement challenges for building and fire code officials.

To address this gap, the American Wood Council (AWC) developed the Mass Timber AMM Guide to assist with the 8th edition of the Florida Building Code. This guide, based on the 2024 IBC, provided

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for membership by the Building Officials Association of Florida (BOAF) and additionally available from the AWC, provides essential guidance on mass timber construction. However, because the guide does not carry the force of law, formal adoption of mass timber provisions in the Florida Building Code remains necessary to ensure consistent regulation and enforcement across jurisdictions, provide clarity and uniformity for building and fire code officials, streamline the permitting and inspection processes, and maintain the highest standards of fire and life safety.

By adopting these provisions into the Florida Building Code, Florida will:

1. **Ensure Regulatory Alignment** – Maintain consistency with the latest national model codes and standards, facilitating uniformity and a predictable regulatory environment for developers, architects, engineers, and code officials across jurisdictions.
2. **Enhance Sustainability** – Include an additional construction option utilizing renewable materials, contributing to lower embodied carbon for a more sustainable built environment.
3. **Promote Economic Growth** – Enable innovative construction methods that reduce costs and reduce construction timelines, benefiting both the public and private sectors with projected stimulation of Florida's forestry and manufacturing industries.
4. **Strengthen Regulatory Consistency** – Provide clear and uniform guidelines for building and fire code officials, ensuring efficient enforcement of mass timber provisions across the state.
5. **Maintain Fire and Life Safety** – Ensure the adoption of mass timber includes the rigorous safety measures developed through extensive research and code development, in alignment with the positions of NASFM and the IAFC.

The Need for Action:

Mass Timber buildings are currently being constructed in Florida without the benefit of codified requirements, leaving building and fire code officials without the necessary framework to regulate these structures consistently and safely. Failing to adopt these provisions risks creating a patchwork of enforcement and inconsistent safety standards.

It is critical that Florida act now to provide a building code that will ensure that all mass timber buildings meet the highest standards of fire and life safety by adopting the proposed modifications.

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For more information:

For more information, the following resources provide technical, regulatory, and real-world evidence demonstrating the safety, reliability, and benefits of tall mass timber construction:

- **ICC Ad Hoc Committee on Tall Wood Buildings**: This committee was established to explore the building science of tall wood buildings and develop related code changes. iccsafe.org
    - https://www.iccsafe.org/products-and-services/i-codes/code-development/cs/icc-ad-hoc-committee-on-tall-wood-buildings/
        - Note: The "Meeting Minutes and Documents" and "Resource Documents" sections of the committee webpage above contain the extensive research and technical information reviewed by the ad hoc committee, including original rationale statements for each proposed section.
        - Based on comprehensive analysis of this information, the committee developed a set of proposals that were adopted to establish regulations that were determined to effectively address fire and life safety considerations for tall mass timber buildings.
- **Understanding the Tall Mass Timber Code Changes**: A guide detailing the code changes approved by the ICC Ad Hoc Committee on Tall Wood Buildings, offering insights into the technical requirements and safety considerations for mass timber construction.
    - For Building Code Officials: https://awc.org/wp-content/uploads/2023/11/MTCC-Guide-Print-20180919.pdf
    - For Fire Code Officials: https://awc.org/wp-content/uploads/2022/01/tmt_toolkit.pdf
- **TMT Fire Testing:** A catalog of research and testing on the fire resistance and safety of mass timber components and structures, including related literature and fire test videos. awc.org
    - https://awc.org/woodaware/tmt-fire-testing/
- **Position Statements:**
    - International Association of Fire Chiefs (IAFC): www.iafc.org/about-iafc/positions/position/tall-wood-mass-timber-buildings
    - National Association of State Fire Marshals (NASFM): www.firemarshals.org/NASFM-Documents (on list at bottom of page)

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TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

24

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Date Submitted	02/18/2025	**Section**	2304.11.4	**Proponent**	Cade Booth
Chapter	23	**Affects HVHZ**	No	**Attachments**	Yes
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

t601, 602.4, 703.8, 703.9, t705.5, 718.2.1, 722.7, 403.3.2, [F]3314.1, 2301.3, 2304.10.8, 2304.11.1.1, 2304.11.3, 2304.11.4, 1711.1, t1711.1, 1711.2, 110.3.14, 202, t504.3, t504.4, t506.2, 508.4.4.1, 509.4.1.1, 1405.5, 1406.2.1, 1406.3, 3102.3, 3102.6.1.1, D102.2.5, and refs ch 35.

Summary of Modification

The proposed updates the FBC to include mass timber, aligning it with national standards and advancements in building science, fire safety, and structural integrity. Backed by extensive research and testing, this ensures clear enforcement, cost-effective compliance, and statewide consistency.

Rationale

***PLEASE NOTE: Individual sections have been submitted in addition to and alongside the full chapter portions to allow for focused discussion or otherwise if needed. This proposed modification serves as a placeholder. *** For a comprehensive understanding of the proposed mass timber code modifications, be sure to review the full rationale statement PDF. It includes a summary of mass timber's history, the benefits of adoption for Florida, the need for action, and key supporting information. You'll also find links to technical resources and documents that provide further validation. Don't miss this essential guide to why mass timber belongs in the Florida Building Code! In summary, as mass timber construction continues to gain traction across the U.S., including within Florida, it is crucial for the Florida Building Code (FBC) to be updated to incorporate provisions for this proven and innovative construction method. With 40 states already adopting mass timber regulations based on the International Building Code (IBC), these proposed modifications align Florida with nationally recognized consensus codes. The changes will provide a clear, standardized framework for enforcement, streamline compliance for building owners and developers, and support greater design flexibility, all while maintaining rigorous fire safety and structural integrity standards. Adopting mass timber into the FBC will also help Florida keep pace with emerging construction technologies, ensuring the state can effectively regulate these advancements without compromising safety or performance.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Positive; lowers impact. Including mass timber in the FBC provides a consistent regulatory framework for building and fire code officials. It streamlines enforcement, reduces uncertainty, and improves efficiency in plan reviews and inspections by ensuring uniform standards across jurisdictions.

Impact to building and property owners relative to cost of compliance with code

Positive; lowers impact. The inclusion of mass timber offers a new construction method that can lower costs for building owners. A consistent regulatory approach statewide simplifies approvals, reduces delays, and allows owners to choose cost-effective materials without uncertainty.

Impact to industry relative to the cost of compliance with code

Positive; neutral or lowers impact. Including mass timber in the FBC gives builders and developers more construction options, increasing competition and potentially lowering costs. Consistent enforcement across the state reduces regulatory uncertainty and streamlines the approval process.

Impact to small business relative to the cost of compliance with code

Positive; lowers impact. Small businesses benefit from a uniform regulatory framework, reducing compliance costs. With mass timber, smaller firms can leverage prefabrication, shorter timelines, and cost savings, leading to more cost-effective projects and new business opportunities.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Yes. Mass timber has been thoroughly tested for structural integrity and fire performance, proving its safety and durability. Its inclusion in the Florida Building Code ensures consistent regulation statewide, reducing uncertainty for officials and enhancing safety through uniform enforcement.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Yes, strengthens and improves FBC. Mass timber, included in national codes since 2021, is supported by comprehensive research and testing. It offers a durable, fire-safe alternative that expands construction options without compromising safety, strengthening the code with new, tested materials.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No discrimination and aligns with national standards since its 2021 IBC inclusion. Adopted in 40 states, with 6 more in process, mass timber is not replacing existing methods but adds a tested, proven option, ensuring fairness in material selection without preference or restriction.

Does not degrade the effectiveness of the code

Adopting mass timber strengthens the FBC by adding structural and fire safety criteria validated by testing and research from the ICC TWB. It doesn't alter or weaken requirements for other construction types but ensures consistent enforcement of tested, nationally accepted standards.

2nd Comment Period

S12277-G1

Proponent Cade Booth Submitted 8/22/2025 3:25:55 PM Attachments No

Comment:

As promised, the AWC has offered and provided direct training to TAC members and engaged in multiple discussions to help resolve outstanding concerns. We look forward to continuing the conversation on the mass timber provisions at the second TAC meetings. Allowing protected concealed spaces outlined in 602.4 in Type IV buildings supports adaptive reuse of heavy timber structures and the installation of mechanicals in CLT construction. In addition to standard concealed space requirements, this change requires either sprinkler coverage, elimination of air space with noncombustible insulation, or covering combustible surfaces with 5/8-inch Type X gypsum. These provisions are based on NFPA 13, so in order to use these provisions the building must be fully protected by a compliant sprinkler system. These concealed space requirements are not unique or new to the code and no discussion was noted on them during the first TAC.

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CHAPTER 23

WOOD

SECTION 2304
GENERAL CONSTRUCTION REQUIREMENTS

Revise section as follows:

2304.11.4 Roof decks. Roofs shall be without concealed spaces ~~and roof~~ or with concealed spaces complying with Section 602.4.3. Roof decks shall be constructed in accordance with Section 2304.11.4.1 or 2304.11.4.2. Other types of decking shall be an alternative that provides equivalent fire resistance and structural properties are being provided. Where supported by a wall, roof decks shall be anchored to walls to resist forces determined in accordance with Chapter 16. Such anchors shall consist of steel bolts, lags, screws or approved hardware of sufficient strength to resist prescribed forces.

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FBC 9th edition – Mass Timber Package

Th following document is a comprehensive package of all code modifications related to mass timber proposals. It is provided for your reference as it is essential these proposals be able to be reviewed in context rather than in isolation, as the adoption of new construction types – Type IV-A, IV-B, and IV-C – has broad implications throughout the Florida Building Code. Having context of these provisions together ensures a clear understanding of their interconnections, facilitating informed decision-making regarding the integration of mass timber construction into the code.

The proposed modifications to the Florida Building Code have been organized in a presentation sequence for logic rather than strictly following the order of the code. This approach ensures that the rationale for mass timber construction is presented clearly, allowing stakeholders to understand the technical justification before diving into specific code provisions. This proposal package first establishes the construction types themselves – Types IV-A, IV-B, IV-C – to provide a foundational understanding. It then transitions into details of fire protection, followed by specific provisions necessary to integrate mass timber into the code. Finally, it addresses additional supporting provisions, including inspections, allowable heights and areas, and distinctions where existing code is applicable to the existing Type IV-HT only. The sequence is intended to provide a comprehensive package for consideration and refence for the inclusion of mass timber in the Florida Building Code, 9th edition.

A Table of Contents (in order of appearance in the package) and Index (in order of section reference) have been provided for reference.

Thank you.

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FBC 9th edition – Mass Timber Package

CHAPTER 6
TYPES OF CONSTRUCTION

SECTION 601
GENERAL

Revise table as follows:

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a,b,c]	1[b, c]	0[c]	1[b, c]	0	3[a]	2[a]	2[a]	HT	1	0
Bearing walls												
Exterior[e, f]	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	3	2	2	1/HT[g]	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	$1^1/_2$	1	1	HT	1	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

b. Where every part of the roof construction is 20 feet or more above the floor or mezzanine immediately below, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking, except where any of the following conditions apply.

1. In Group F-1, H, M, and S-1 occupancies.
2. Where the roof is an occupiable space.

Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

c. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members, where a 1-hour or less fire-resistance rating is required.

d. Not less than the fire-resistance rating required by other sections of this code.

e. Not less than the fire-resistance rating based on fire separation distance (see Table 705.5).

f. Not less than the fire-resistance rating as referenced in Section 704.10.

g. Heavy timber bearing walls supporting more than two floors or more than a floor and a roof shall have a *fire-resistance rating* of not less than 1 hour.

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SECTION 602
CONSTRUCTION CLASSIFICATION

Revise and add new sections as follows:

602.4 Type IV. ~~Type IV construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated wood, heavy timber (HT) or structural composite lumber (SCL) without concealed spaces. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, structural composite lumber (SCL), and cross-laminated timber and details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rating or heavy timber complying with Section 2304.11.2.2 shall be permitted.~~ Type IV construction is that type of construction in which the *building elements* are *mass timber* or noncombustible materials and have *fire-resistance ratings* in accordance with Table 601. *Mass timber* elements shall meet the *fire-resistance-rating* requirements of this section based on either the *fire-resistance rating* of the *noncombustible protection*, the *mass timber*, or a combination of both and shall be determined in accordance with Section 703.2. The minimum dimensions and permitted materials for *building elements* shall comply with the provisions of this section and Section 2304.11. *Mass timber* elements of Types IV-A, IV-B and IV-C construction shall be protected with *noncombustible protection* applied directly to the *mass timber* in accordance with Sections 602.4.1 through 602.4.3. The time assigned to the *noncombustible protection* shall be determined in accordance with Section 703.6 and comply with Section 722.7.

Cross-laminated timber shall be labeled as conforming to ANSI/APA PRG 320 as referenced in Section 2303.1.4.

Exterior *load-bearing walls* and *nonload-bearing walls* shall be *mass timber* construction, or shall be of noncombustible construction.

> **Exception:** Exterior *load-bearing walls* and *nonload-bearing walls* of Type IV-HT construction in accordance with Section 602.4.4.

The interior *building elements*, including *nonload-bearing walls* and partitions, shall be of *mass timber* construction or of noncombustible construction.

> **Exception:** Interior *building elements* and nonload-bearing walls and partitions of Type IV-HT construction in accordance with Section 602.4.4.

Combustible concealed spaces are not permitted except as otherwise indicated in Sections 602.4.1 through 602.4.4. Combustible stud spaces within light frame walls of Type IV-HT construction shall not be considered concealed spaces, but shall comply with Section 718.

In *buildings* of Type IV-A, IV-B, and IV-C construction with an occupied floor located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access, up to and including 12 *stories* or 180 feet (54 864 mm) above *grade plane*, *mass timber* interior exit and elevator hoistway enclosures shall be protected in accordance with Section 602.4.1.2. In *buildings* greater than 12 *stories* or 180 feet (54 864 mm) above *grade plane*, interior exit and elevator hoistway enclosures shall be constructed of noncombustible materials.

> **602.4.1 Type IV-A.** *Building elements* in Type IV-A construction shall be protected in accordance with Sections 602.4.1.1 through 602.4.1.6. The required *fire-resistance rating* of noncombustible elements and protected *mass timber* elements shall be determined in accordance with Section 703.2.
>
> > **602.4.1.1 Exterior protection.** The outside face of *exterior walls* of *mass timber* construction shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1). Components of the *exterior wall covering* shall be of noncombustible material except *water-resistive barriers* having a peak heat release rate of less than 150kW/m^2, a total heat release of

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less than 20 MJ/m^2 and an effective heat of combustion of less than 18MJ/kg as determined in accordance with ASTM E1354 and having a *flame spread index* of 25 or less and a *smoke-developed index* of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2.

602.4.1.2 Interior protection. Interior faces of all *mass timber* elements, including the inside faces of exterior *mass timber* walls and *mass timber* roofs, shall be protected with materials complying with Section 703.3.

602.4.1.2.1 Protection time. *Noncombustible protection* shall contribute a time equal to or greater than times assigned in Table 722.7.1(1), but not less than 80 minutes. The use of materials and their respective protection contributions specified in Table 722.7.1(2) shall be permitted to be used for compliance with Section 722.7.1.

602.4.1.3 Floors. The floor assembly shall contain a noncombustible material not less than 1 inch (25 mm) in thickness above the *mass timber*. Floor finishes in accordance with Section 804 shall be permitted on top of the noncombustible material. The underside of floor assemblies shall be protected in accordance with Section 602.4.1.2.

602.4.1.4 Roofs. The *interior surfaces* of *roof assemblies* shall be protected in accordance with Section 602.4.1.2. *Roof coverings* in accordance with Chapter 15 shall be permitted on the outside surface of the *roof assembly*.

602.4.1.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *Florida Building Code, Mechanical*, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected in accordance with Section 602.4.1.2.

602.4.1.6 Shafts. *Shafts* shall be permitted in accordance with Sections 713 and 718. Both the *shaft* side and room side of *mass timber* elements shall be protected in accordance with Section 602.4.1.2.

602.4.2 Type IV-B. *Building elements* in Type IV-B construction shall be protected in accordance with Sections through 602.4.2.6. The required *fire-resistance rating* of noncombustible elements or *mass timber* elements shall be determined in accordance with Section 703.2.

602.4.2.1 Exterior protection. The outside face of *exterior walls* of *mass timber* construction shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1). Components of the *exterior wall covering* shall be of noncombustible material except *water-resistive barriers* having a peak heat release rate of less than 150kW/m^2, a total heat release of less than 20 MJ/m^2 and an effective heat of combustion of less than 18MJ/kg as determined in accordance with ASTM E1354, and having a *flame spread index* of 25 or less and a *smoke-developed index* of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2.

602.4.2.2 Interior protection. Interior faces of all *mass timber* elements, including the inside face of exterior *mass timber* walls and *mass timber* roofs, shall be protected, as required by this section, with materials complying with Section 703.3.

602.4.2.2.1 Protection time. *Noncombustible protection* shall contribute a time equal to or greater than times assigned in Table 722.7.1(1), but not less than 80 minutes. The use of materials and their respective protection contributions specified in Table 722.7.1(2) shall be

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permitted to be used for compliance with Section 722.7.1.

602.4.2.2.2 Protected area. Interior faces of *mass timber* elements, including the inside face of exterior *mass timber* walls and *mass timber* roofs, shall be protected in accordance with Section 602.4.2.2.1.

Exceptions: Unprotected portions of *mass timber* ceilings and walls complying with Section 602.4.2.2.4 and the following:

1. Unprotected portions of *mass timber* ceilings and walls complying with one of the following:

1.1 Unprotected portions of *mass timber* ceilings, including attached beams, shall be permitted and shall be limited to an area less than or equal to 100 percent of the floor area in any *dwelling unit* within a story or *fire area* within a story.

1.2 Unprotected portions of *mass timber* walls, including attached columns, shall be permitted and shall be limited to an area less than or equal to 40 percent of the floor area in any *dwelling unit* within a story or *fire area* within a story.

1.3 Unprotected portions of both walls and ceilings of *mass timber*, including attached columns and beams, in any *dwelling unit* or *fire area* shall be permitted in accordance with Section 602.4.2.2.3.

2. *Mass timber* columns and beams that are not an integral portion of walls or ceilings, respectively, shall be permitted to be unprotected without restriction of either aggregate area or separation from one another.

602.4.2.2.3 Mixed unprotected areas. In each *dwelling unit* or *fire area*, where both portions of ceilings and portions of walls are unprotected, the total allowable unprotected area shall be determined in accordance with Equation 6-1.

$$(U_{tc}/\ U_{ac})+(U_{tw}/U_{aw}) \leq 1 \quad \textbf{(Equation 6-1)}$$

where:

U_{tc} = Total unprotected *mass timber* ceiling areas.

U_{ac} = Allowable unprotected *mass timber* ceiling area conforming to Exception 1.1 of Section 602.4.2.2.2.

U_{tw} = Total unprotected *mass timber* wall areas.

U_{aw} = Allowable unprotected *mass timber* wall area conforming to Exception 1.2 of Section 602.4.2.2.2.

602.4.2.2.4 Separation distance between unprotected mass timber elements. In each *dwelling unit* or *fire area*, unprotected portions of *mass timber* walls shall be not less than 15 feet (4572 mm) from unprotected portions of other walls measured horizontally along the floor.

602.4.2.3 Floors. The floor assembly shall contain a noncombustible material not less than 1 inch (25 mm) in thickness above the *mass timber*. Floor finishes in accordance with Section 804 shall be permitted on top of the noncombustible material. Except where unprotected *mass timber* ceilings are permitted in Section 602.4.2.2.2, the underside of floor assemblies shall be protected in accordance with

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Section 602.4.1.2.

602.4.2.4 Roofs. The *interior surfaces* of roof assemblies shall be protected in accordance with Section 602.4.2.2 except, in nonoccupiable spaces, they shall be treated as a concealed space with no portion left unprotected. *Roof coverings* in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.2.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *Florida Building Code, Mechanical*, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected in accordance with Section 602.4.1.2.

602.4.2.6 Shafts. *Shafts* shall be permitted in accordance with Sections 713 and 718. Both the *shaft* side and room side of *mass timber* elements shall be protected in accordance with Section 602.4.1.2.

602.4.3 Type IV-C. *Building elements* in Type IV-C construction shall be protected in accordance with Sections 602.4.3.1 through 602.4.3.6. The required *fire-resistance rating* of *building elements* shall be determined in accordance with Section 703.2.

602.4.3.1 Exterior protection. The exterior side of walls of combustible construction shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as determined in Table 722.7.1(1). Components of the *exterior wall covering* shall be of noncombustible material except *water-resistive barriers* having a peak heat release rate of less than 150 kW/m^2, a total heat release of less than 20 MJ/m^2 and an effective heat of combustion of less than 18 MJ/kg as determined in accordance with ASTM E1354 and having a *flame spread index* of 25 or less and a *smoke-developed index* of 450 or less as determined in accordance with ASTM E84 or UL 723. The ASTM E1354 test shall be conducted on specimens at the thickness intended for use, in the horizontal orientation and at an incident radiant heat flux of 50 kW/m^2.

602.4.3.2 Interior protection. *Mass timber* elements are permitted to be unprotected.

602.4.3.3 Floors. Floor finishes in accordance with Section 804 shall be permitted on top of the floor construction.

602.4.3.4 Roof coverings. *Roof coverings* in accordance with Chapter 15 shall be permitted on the outside surface of the roof assembly.

602.4.3.5 Concealed spaces. Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *Florida Building Code, Mechanical*, and shall comply with all applicable provisions of Section 718. Combustible construction forming concealed spaces shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1).

602.4.3.6 Shafts. *Shafts* shall be permitted in accordance with Sections 713 and 718. *Shafts* and elevator hoistway and *interior exit stairway enclosures* shall be protected with *noncombustible protection* with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1), on both the inside of the *shaft* and the outside of the *shaft*.

602.4.4 Type IV-HT. Type IV-HT (Heavy Timber) construction is that type of construction in which the *exterior walls* are of noncombustible materials and the interior *building elements* are of solid wood, laminated heavy timber or *structural composite lumber* (SCL), without concealed spaces or with concealed spaces complying with Section 602.4.4.3. The minimum dimensions for permitted materials including solid timber,

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glued-laminated timber, SCL and *cross-laminated timber* (CLT) and the details of Type IV construction shall comply with the provisions of this section and Section 2304.11. *Exterior walls* complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rated or heavy timber conforming with Section 2304.11.2.2 shall be permitted.

~~602.4.1~~ **602.4.4.1. Fire-retardant-treated wood in *exterior walls*.** *Fire-retardant-treated wood* framing and sheathing complying with Section 2303.2 shall be permitted within *exterior wall* assemblies with a 2-hour rating or less.

~~602.4.2~~ **602.4.4.2 Cross-laminated timber in *exterior walls*.** *Cross-laminated timber* not less than 4 inches (102 mm) in thickness complying with Section 2303.1.4 shall be permitted within *exterior wall* assemblies with a 2-hour rating or less. Heavy timber structural members appurtenant to the *CLT exterior wall* shall meet the requirements of Table 2304.11 and be fire-resistance rated as required for the *exterior wall*. The exterior surface of the *cross-laminated timber* and heavy timber elements shall be ~~is~~ protected by one the following:

1. *Fire-retardant-treated wood* sheathing complying with Section 2303.2 and not less than 15/32 inch (12 mm) thick.
2. *Gypsum board* not less than 1/2 inch (12.7 mm) thick; or
3. A noncombustible material.

602.4.4.3 Concealed spaces. Concealed spaces shall not contain combustible materials other than *building elements* and electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the *Florida Building Code, Mechanical*. Concealed spaces shall comply with applicable provisions of Section 718. Concealed spaces shall be protected in accordance with one or more of the following:

1. The building shall be sprinklered throughout in accordance with Section 903.3.1.1 and automatic sprinklers shall also be provided in the concealed space.
2. The concealed space shall be completely filled with noncombustible insulation.
3. Combustible surfaces within the concealed space shall be fully sheathed with not less than 5/8 -inch *Type X gypsum board*.

Exception: Concealed spaces within interior walls and partitions with a 1-hour or greater *fire-resistance rating* complying with Section 2304.11.2.2 shall not require additional protection.

~~602.4.3~~ **602.4.4.4 Exterior structural members.** Where a horizontal separation of 20 feet (6096 mm) or more is provided, wood columns and arches conforming to heavy timber sizes complying with Section 2304.11 shall be permitted to be used externally.

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CHAPTER 7
FIRE AND SMOKE PROTECTION FEATURES

SECTION 703
FIRE-RESISTANCE RATINGS AND FIRE TESTS

Add new sections as follows:

703.8 Determination of noncombustible protection time contribution. The time, in minutes, contributed to the *fire-resistance rating* by the *noncombustible protection* of *mass timber building elements*, components, or assemblies, shall be established through a comparison of assemblies tested using procedures set forth in ASTM E119 or UL 263. The test assemblies shall be identical in construction, loading and materials, other than the *noncombustible protection*. The two test assemblies shall be tested to the same criteria of structural failure with the following conditions:

1. Test Assembly 1 shall be without protection.
2. Test Assembly 2 shall include the representative *noncombustible protection*. The protection shall be fully defined in terms of configuration details, attachment details, *joint* sealing details, accessories and all other relevant details.

The *noncombustible protection* time contribution shall be determined by subtracting the *fire-resistance* time, in minutes, of Test Assembly 1 from the *fire-resistance* time, in minutes, of Test Assembly 2.

703.9 Sealing of adjacent mass timber elements. In *buildings* of Types IV-A, IV-B and IV-C construction, sealant or adhesive shall be provided to resist the passage of air in the following locations:

1. At abutting edges and intersections of *mass timber building elements* required to be fire-resistance rated.
2. At abutting intersections of *mass timber building elements* and *building elements* of other materials where both are required to be fire-resistance rated.

Sealants shall meet the requirements of ASTM C920. Adhesives shall meet the requirements of ASTM D3498.

Exception: Sealants or adhesives need not be provided where they are not a required component of a tested fire-resistance-rated assembly.

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SECTION 705
PROJECTIONS

Revise table as follows:

TABLE 705.5
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U[h]
X < 5[b]	All	3	2	1
5 ≤ X < 10	IA, IVA	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB, IVA, IVB	2	1	1[c]
	IIB, VB	1	0	0
	Others	1	1	1[c]
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
b. See Section 706.1.1 for party walls.
c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
e. For special requirements for Group H occupancies, see Section 415.6.
f. For special requirements for Group S aircraft hangars, see Section 412.4.1.
g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

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SECTION 718
CONCEALED SPACES

Revise section as follows:

718.2.1 Fireblocking materials. *Fireblocking* shall consist of the following materials:

1. Two-inch (51 mm) nominal lumber.
2. Two thicknesses of 1-inch (25 mm) nominal lumber with broken lap joints.
3. One thickness of 0.719-inch (18.3 mm) *wood structural panels* with joints backed by 0.719-inch (18.3 mm) *wood structural panels.*
4. One thickness of 0.75-inch (19.1 mm) *particleboard* with joints backed by 0.75-inch (19 mm) *particleboard.*
5. One-half-inch (12.7 mm) *gypsum board.*
6. One-fourth-inch (6.4 mm) cement-based millboard.
7. Batts or blankets of *mineral wool*, *mineral fiber* or other *approved* materials installed in such a manner as to be securely retained in place.
8. Cellulose insulation-installed as tested for the specific application.
9. *Mass timber* complying with Section 2304.11.
10. One thickness of $^{19}/_{32}$-inch (15.1 mm) *fire-retardant-treated wood* structural panel complying with Section 2303.2.

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SECTION 722
CALCULATED FIRE-RESISTANCE

Add new sections as follows:

722.7 Fire-resistance rating for mass timber. The required *fire resistance* of *mass timber* elements in Section 602.4 shall be determined in accordance with Section 703.2. The *fire-resistance rating* of *building elements* shall be as required in Tables 601 and 705.5 and as specified elsewhere in this code. The *fire-resistance rating* of the *mass timber* elements shall consist of the *fire resistance* of the unprotected element added to the protection time of the *noncombustible protection*.

722.7.1 Minimum required protection. Where required by Sections 602.4.1 through 602.4.3, *noncombustible protection* shall be provided for *mass timber building elements* in accordance with Table 722.7.1(1). The rating, in minutes, contributed by the *noncombustible protection* of *mass timber building elements*, components or assemblies, shall be established in accordance with Section 703.6. The protection contributions indicated in Table 722.7.1(2) shall be deemed to comply with this requirement where installed and fastened in accordance with Section 722.7.2.

TABLE 722.7.1(1)
PROTECTION REQUIRED FROM NONCOMBUSTIBLE COVERING MATERIAL

REQUIRED FIRE-RESISTANCE RATING OF BUILDING ELEMENT PER Table 601 AND Table 602 (hours)	MINIMUM PROTECTION REQUIRED FROM NONCOMBUSTIBLE PROTECTION (minutes)
1	40
2	80
3 or more	120

TABLE 722.7.1(2)
PROTECTION PROVIDED BY NONCOMBUSTIBLE COVERING MATERIAL

NONCOMBUSTIBLE PROTECTION	PROTECTION CONTRIBUTION (minutes)
1/2-inch Type X gypsum board	25
5/8-inch Type X gypsum board	40

722.7.2 Installation of gypsum board noncombustible protection. *Gypsum board* complying with Table 722.7.1(2) shall be installed in accordance with this section.

722.7.2.1 Interior surfaces. Layers of *Type X gypsum board* serving as *noncombustible protection* for *interior surfaces* of wall and ceiling assemblies determined in accordance with Table 722.7.1(1) shall be installed in accordance with the following:

1. Each layer shall be attached with Type S drywall screws of sufficient length to penetrate the *mass timber* at least 1 inch (25 mm) when driven flush with the paper surface of the *gypsum board*.

   Exception: The third layer, where determined necessary by Section 722.7, shall be permitted to be attached with 1-inch (25 mm) No. 6 Type S drywall screws to furring channels in accordance with AISI S220.

2. Screws for attaching the base layer shall be 12 inches (305 mm) on center in both directions.

3. Screws for each layer after the base layer shall be 12 inches (305 mm) on center in both directions and offset from the screws of the previous layers by 4 inches (102 mm) in both directions.

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4. All panel edges of any layer shall be offset 18 inches (457 mm) from those of the previous layer.

5. All panel edges shall be attached with screws sized and offset as in Items 1 through 4 and placed at least 1 inch (25 mm) but not more than 2 inches (51 mm) from the panel edge.

6. All panels installed at wall-to-ceiling intersections shall be installed such that ceiling panels are installed first and the wall panels are installed after the ceiling panel has been installed and is fitted tight to the ceiling panel. Where multiple layers are required, each layer shall repeat this process.

7. All panels installed at a wall-to-wall intersection shall be installed such that the panels covering an *exterior wall* or a wall with a greater *fire-resistance rating* shall be installed first and the panels covering the other wall shall be fitted tight to the panel covering the first wall. Where multiple layers are required, each layer shall repeat this process.

8. Panel edges of the face layer shall be taped and finished with joint compound. Fastener heads shall be covered with joint compound.

9. Panel edges protecting *mass timber* elements adjacent to unprotected *mass timber* elements in accordance with Section 602.4.2.2 shall be covered with 11/4-inch (32 mm) metal corner bead and finished with joint compound.

722.7.2.2 Exterior surfaces. Layers of *Type X gypsum board* serving as *noncombustible protection* for the outside of the exterior *mass timber* walls determined in accordance with Table 722.7.1(1) shall be fastened 12 inches (305 mm) on center each way and 6 inches (152 mm) on center at all joints or ends. All panel edges shall be attached with fasteners located at least 1 inch (25 mm) but not more than 2 inches (51 mm) from the panel edge. Fasteners shall comply with one of the following:

1. Galvanized nails of minimum 12 gage with a 7/16-inch (11 mm) head of sufficient length to penetrate the *mass timber* a minimum of 1 inch (25 mm).

2. Screws that comply with ASTM C1002 (Type S, W or G) of sufficient length to penetrate the *mass timber* a minimum of 1 inch (25 mm).

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CHAPTER 4
SPECIAL DETAILED REQUIREMENTS BASED ON OCCUPANCY AND USE

SECTION 403
HIGH-RISE BUILDINGS

Revise section as follows:

403.3.2 Water supply to required fire pumps. In all *buildings* that are more than 420 feet (128 000 mm) in *building height* and *buildings* of Type IV-A and IV-B construction that are more than 120 feet (36 576 mm) in *building height*, required fire pumps shall be supplied by connections to no fewer than two water mains located in different streets. Separate supply piping shall be provided between each connection to the water main and the pumps. Each connection and the supply piping between the connection and the pumps shall be sized to supply the flow and pressure required for the pumps to operate.

Exception: Two connections to the same main shall be permitted provided the main is valved such that an interruption can be isolated so that the water supply will continue without interruption through no fewer than one of the connections.

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CHAPTER 33
SAFEGUARDS DURING CONSTRUCTION

Add new section as follows:

SECTION 3314
FIRE SAFETY REQUIREMENTS FOR BUILDINGS OF TYPES IV-A, IV-B, AND IV-C CONSTRUCTION

[F] 3314.1 Fire safety requirements for buildings of Types IV-A, IV-B, and IV-C construction. Buildings of Types IV-A, IV-B, and IV-C construction designed to be greater than six stories above grade plane shall comply with the following requirements during construction unless otherwise approved by the fire code official.

1. Standpipes shall be provided in accordance with Section 3313.

2. A water supply for fire department operations, as approved by the fire code official and the fire chief.

3. Where building construction exceeds six stories above grade plane, at least one layer of noncombustible protection where required by Section 602.4 shall be installed on all building elements more than 4 floor levels, including mezzanines, below active *mass timber* construction before erecting additional floor levels.

   Exceptions:
   1. *Shafts* and vertical exit enclosures shall not be considered a part of the active mass timber construction.
   2. Noncombustible material on the top of mass timber floor assemblies shall not be required before erecting additional floor levels.

4. Where building construction exceeds six stories above grade plane required exterior wall coverings shall be installed on all floor levels more than 4 floor levels, including mezzanines, below active mass timber construction before erecting additional floor level.

   Exception: *Shafts* and vertical exit enclosures shall not be considered a part of the active mass timber construction.

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CHAPTER 23
WOOD

SECTION 2301
GENERAL

Revise section as follows:

2301.3 ~~Nominal sizes~~ Dimensions. For the purposes of this chapter, where dimensions of lumber are specified, they shall be deemed to be nominal dimensions unless specifically designated as actual dimensions (see Section 2304.2). Where dimensions of *cross-laminated timber* thickness are specified, they shall be deemed to be actual dimensions.

SECTION 2304
GENERAL CONSTRUCTION REQUIREMENTS

Add new section and revise sections as follows:

2304.10.8 Fire protection of connections. Connections used with *fire-resistance*-rated members and in fire-resistance-rated assemblies of Type IV-A, IV-B or IV-C construction shall be protected for the time associated with the fire-resistance rating. Protection time shall be determined by one of the following:

1. Testing in accordance with Section 703.2 where the connection is part of the *fire resistance* test.

2. Engineering analysis that demonstrates that the temperature rise at any portion of the connection is limited to an average temperature rise of 250°F (139°C), and a maximum temperature rise of 325°F (181°C), for a time corresponding to the required *fire-resistance* rating of the structural element being connected. For the purposes of this analysis, the connection includes connectors, fasteners, and portions of wood members included in the structural design of the connection.

2304.11.1.1 Columns. Minimum dimensions of columns shall be in accordance with Table 2304.11. Columns shall be connected in an *approved* manner. Columns shall be continuous or aligned vertically from floor to floor in ~~superimposed throughout~~ all stories of Type IV-HT construction ~~and connected in an approved manner~~. Girders and beams at column connections shall be closely fitted around columns and adjoining ends shall be cross tied to each other, or intertied by caps or ties, to transfer horizontal *loads* across joints. Wood bolsters shall not be placed on tops of columns unless the columns support roof *loads* only. Where traditional heavy timber detailing is used, connections shall be permitted to be by means of reinforced concrete or metal caps with brackets, by properly designed steel or iron caps, with pintles and base plates, by timber splice plates affixed to the columns by metal connectors housed within the contact faces, or by other *approved* methods.

2304.11.3 Floors. Floors shall be without concealed spaces or with concealed spaces complying with Section 602.4.4. Wood floors shall be constructed in accordance with Section 2304.11.3.1 or 2304.11.3.2.

2304.11.4 Roof decks. Roofs shall be without concealed spaces ~~and roof~~ or with concealed spaces complying with Section 602.4.3. Roof decks shall be constructed in accordance with Section 2304.11.4.1 or 2304.11.4.2. Other types of decking shall be an alternative that provides equivalent *fire resistance* and structural properties are being provided. Where supported by a wall, *roof decks* shall be anchored to walls to resist forces determined in accordance with Chapter 16. Such anchors shall consist of steel bolts, lags, screws or *approved* hardware of sufficient strength to resist prescribed forces.

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CHAPTER 17
SPECIAL INSPECTION AND TESTS

SECTION 1711
MASS TIMBER CONSTRUCTION

Add new sections and table as follows:

1711.1 Mass timber construction. Inspections of mass timber elements in Types IV-A, IV-B and IV-C construction shall be in accordance with Table 1711.1.

TABLE 1711.1
REQUIRED INSPECTIONS OF MASS TIMBER CONSTRUCTION

	TYPE		CONTINUOUS SPECIAL INSPECTION	PERIODIC INSPECTION
1.	Inspection of anchorage and connections of mass timber construction to timber deep foundation systems.		—	X
2.	Inspect erection of mass timber construction.		—	X
3.	Inspection of connections where installation methods are required to meet design loads.			
	Threaded fasteners	Verify use of proper installation equipment.	—	X
		Verify use of pre-drilled holes where required.	—	X
		Inspect screws, including diameter, length, head type, spacing, installation angle and depth.	—	X
	Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads.		X	—
	Adhesive anchors not defined in preceding cell.		—	X
	Bolted connections.		—	X
	Concealed connections.		—	X

1711.2 Sealing of mass timber. Periodic *special inspections* of sealants or adhesives shall be conducted where sealant or adhesive required by Section 703.7 is applied to *mass timber building elements* as designated in the *approved construction documents*.

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CHAPTER 1
SCOPE AND ADMINISTRATION

SECTION 110
INSPECTIONS

Add new section as follows:

110.3.14 Types IV-A, IV-B, and IV-C connection protection inspection. In buildings of Types IV-A, IV-B, and IV-C construction, where connection fire-resistance ratings are provided by wood cover calculated to meet the requirements of Section 2304.10.8, inspection of the wood cover shall be made after the cover is installed, but before any other coverings or finishes are installed.

CHAPTER 2
DEFINITIONS

SECTION 202
DEFINITIONS

Revise and add new definitions as follows:

[BS] WALL, LOAD-BEARING. Any wall meeting either of the following classifications:

1. Any metal or wood stud wall that supports more than 100 pounds per linear foot (1459 N/m) of vertical load in addition to its own weight.
2. Any *masonry*, ~~or~~ concrete, or *mass timber* wall that supports more than 200 pounds per linear foot (2919 N/m) of vertical load in addition to its own weight.

MASS TIMBER. Structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross section dimensions of Type IV construction.

NONCOMBUSTIBLE PROTECTION (FOR MASS TIMBER). Noncombustible material, in accordance with Section 703.5, designed to increase the *fire-resistance rating* and delay the combustion of *mass timber*.

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CHAPTER 5
GENERAL BUILDING HEIGHTS AND AREAS

SECTION 504
BUILDING HEIGHT AND NUMBER OF STORIES

Revise tables as follows:

TABLE 504.3[a]
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A, B, E, F, M, S, U	NS[b]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
H-1, H-2, H-3, H-5	NS[c,d]	UL	160	65	55	65	55	120	90	65	65	50	40
	S												
H-4	NS[c,d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1Condition 1, I-3	NS[d,e]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1Condition 2, I-2	NS[d,e,f]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									
I-4	NS[d,g]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
Rh	NS[d,h]	UL	160	65	55	65	55	65	65	65	65	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60

For SI: 1 foot = 304.8 mm.

Note: UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2;

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.
b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
d. The NS value is only for use in evaluation of existing building height in accordance with the *Florida Building Code, Existing Building*.
e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies Condition 1, see Exception 1 of Section 903.2.6.
f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and the *Florida Fire Prevention Code*.
g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.
h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

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TABLE 504.4[a, b]
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
F-1	NS	UL	11	4	2	3	2	3	3	3	4	2	1
	S	UL	12	5	3	4	3	10	7	5	5	3	2
F-2	NS	UL	11	5	3	4	3	5	5	5	5	3	2
	S	UL	12	6	4	5	4	12	8	6	6	4	3
H-1	NS[c, d]	1	1	1	1	1	1	NP	NP	NP	1	1	NP
	S							1	1	1			
H-2	NS[c, d]	UL	3	2	1	2	1	1	1	1	2	1	1
	S							2	2	2			
H-3	NS[c, d]	UL	6	4	2	4	2	3	3	3	4	2	1
	S							4	4	4			
H-4	NS[c, d]	UL	7	5	3	5	3	5	5	5	5	3	2
	S	UL	8	6	4	6	4	8	7	6	6	4	3
H-5	NS[c, d]	4	4	3	3	3	3	2	2	2	3	3	2
	S							3	3	3			
I-1 Condition 1	NS[d, e]	UL	9	4	3	4	3	4	4	4	4	3	2
	S	UL	10	5	4	5	4	10	7	5	5	4	3
I-1 Condition 2	NS[d, e]	UL	9	4	3	4	3	3	3	3	4	3	2
	S	UL	10	5				10	6	4			
I-2	NS[d, f]	UL	4	2	1	1	NP	NP	NP	NP	1	1	NP
	S	UL	5	3				7	5	1			
I-3	NS[d, e]	UL	4	2	1	2	1	2	2	2	2	2	1
	S	UL	5	3	2	3	2	7	5	3	3	3	2
I-4	NS[d, g]	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
M	NS	UL	11	4	2	4	2	4	4	4	4	3	1
	S	UL	12	5	3	5	3	12	8	6	5	4	2

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TABLE 504.4[a, b]—continued
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
R-1	NS[d, h]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-2	NS[d, h]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4	4								4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-3	NS[d, h]	UL	11	4	4	4	4	4	4	4	4	3	3
	S13R	4	4									4	4
	S	UL	12	5	5	5	5	18	12	5	5	4	4
R-4	NS[d, h]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	5	5	4	3
S-1	NS	UL	11	4	2	3	2	4	4	4	4	3	1
	S	UL	12	5	4	4	4	10	7	5	5	4	2
S-2	NS	UL	11	5	3	4	3	4	4	4	5	4	2
	S	UL	12	6	4	5	4	12	8	5	6	5	3
U	NS	UL	5	4	2	3	2	4	4	4	4	2	1
	S	UL	6	5	3	4	3	9	6	5	5	3	2

Note: UL = Unlimited; NP = Not Permitted; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.
b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
d. The NS value is only for use in evaluation of existing *building height* in accordance with the *Florida Building Code, Existing Building*.
e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.
f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and the *Florida Fire Prevention Code*.
g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.
h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8

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SECTION 506
BUILDING AREA

Revise table as follows:

TABLE 506.2[a, b]
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, or SM, as applicable)
IN SQUARE FEET

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1												
	SM												
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
E	NS	UL	UL	26,500	14,500	23,500	14,500	76,500	51,000	31,875	25,500	18,500	9,500
	S1	UL	UL	106,000	58,000	94,000	58,000	306,000	204,000	127,500	102,000	74,000	38,000
	SM	UL	UL	79,500	43,500	70,500	43,500	229,500	153,000	95,625	76,500	55,500	28,500
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	100,500	67,000	41,875	33,500	14,000	8,500
	S1	UL	UL	100,000	62,000	76,000	48,000	402,000	268,000	167,500	134,000	56,000	34,000
	SM	UL	UL	75,000	46,500	57,000	36,000	301,500	201,000	125,625	100,500	42,000	25,500
F-2	NS	UL	UL	37,500	23,000	28,500	18,000	151,500	101,000	63,125	50,500	21,000	13,000
	S1	UL	UL	150,000	92,000	114,000	72,000	606,000	404,000	252,500	202,000	84,000	52,000
	SM	UL	UL	112,500	69,000	85,500	54,000	454,500	303,000	189,375	151,500	63,000	39,000
H-1	NS[c]	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	NP
	S1												
H-2	NS[c]	21,000	16,500	11,000	7,000	9,500	7,000	10,500	10,500	10,500	10,500	7,500	3,000
	S1												
	SM												
H-3	NS[c]	UL	60,000	26,500	14,000	17,500	13,000	25,500	25,500	25,500	25,500	10,000	5,000
	S1												
	SM												
H-4	NS[c, d]	UL	UL	37,500	17,500	28,500	17,500	72,000	54,000	40,500	36,000	18,000	6,500
	S1	UL	UL	150,000	70,000	114,000	70,000	288,000	216,000	162,000	144,000	72,000	26,000
	SM	UL	UL	112,500	52,500	85,500	52,500	216,000	162,000	121,500	108,000	54,000	19,500
H-5	NS[c, d]	UL	UL	37,500	23,000	28,500	19,000	72,000	54,000	40,500	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	288,000	216,000	162,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	216,000	162,000	121,500	108000	54,000	27,000

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TABLE 506.2[a, b]—continued
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, or SM, as applicable)
IN SQUARE FEET

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
I-1	NS[d, e]	UL	55,000	19,000	10,000	16,500	10,000	54,000	36,000	18,000	18,000	10,500	4,500
	S1	UL	220,000	76,000	40,000	66,000	40,000	216,000	144,000	72,000	72,000	42,000	18,000
	SM	UL	165,000	57,000	30,000	49,500	30,000	162,000	108,000	54,000	54,000	31,500	13,500
I-2	NS[d, f]	UL	UL	15,000	11,000	12,000	NP	36,000	24,000	12,000	12,000	9,500	NP
	S1	UL	UL	60,000	44,000	48,000	NP	144,000	96,000	48,000	48,000	38,000	NP
	SM	UL	UL	45,000	33,000	36,000	NP	108,000	72,000	36,000	36,000	28,500	NP
I-3	NS[d, e]	UL	UL	15,000	10,000	10,500	7,500	36,000	24,000	12,000	12,000	7,500	5,000
	S1	UL	UL	60,000	40,000	42,000	30,000	144,000	96,000	48,000	48,000	30,000	20,000
	SM	UL	UL	45,000	30,000	31,500	22,500	108,000	72,000	36,000	36,000	22,500	15,000
I-4	NS[d, g]	UL	60,500	26,500	13,000	23,500	13,000	76,500	51,000	25,500	25,500	18,500	9,000
	S1	UL	121,000	106,000	52,000	94,000	52,000	306,000	204,000	102,000	102,000	74,000	36,000
	SM	UL	181,500	79,500	39,000	70,500	39,000	229,500	153,000	76,500	76,500	55,500	27,000
M	NS	UL	UL	21,500	12,500	18,500	12,500	61,500	41,000	26,625	20,500	14,000	9,000
	S1	UL	UL	86,000	50,000	74,000	50,000	246,000	164,000	102,500	82,000	56,000	36,000
	SM	UL	UL	64,500	37,500	55,500	37,500	184,500	123,000	76,875	61,500	42,000	27,000
R-1	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-2	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
R-3	NS[d, h]	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S13R												
	S1												
	SM												
R-4	NS[d, h]	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
S-1	NS	UL	48,000	26,000	17,500	26,000	17,500	76,500	51,000	31,875	25,500	14,000	9,000
	S1	UL	192,000	104,000	70,000	104,000	70,000	306,000	204,000	127,500	102,000	56,000	36,000
	SM	UL	144,000	78,000	52,500	78,000	52,500	229,500	153,000	95,625	76,500	42,000	27,000
S-2	NS	UL	79,000	39,000	26,000	39,000	26,000	115,500	77,000	48,125	38,500	21,000	13,500
	S1	UL	316,000	156,000	104,000	156,000	104,000	462,000	308,000	192,500	154,000	84,000	54,000
	SM	UL	237,000	117,000	78,000	117,000	78,000	346,500	231,000	144,375	115,500	63,000	40,500
U	NS[i]	UL	35,500	19,000	8,500	14,000	8,500	54,000	36,000	22,500	18,000	9,000	5,500
	S1	UL	142,000	76,000	34,000	56,000	34,000	216,000	144,000	90,000	72,000	36,000	22,000
	SM	UL	106,500	57,000	25,500	42,000	25,500	162,000	108,000	67,500	54,000	27,000	16,500

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TABLE 506.2[a, b]—continued
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D or SM, as applicable)
IN SQUARE FEET

Note: UL = Unlimited; NP = Not Permitted
For SI: 1 square foot = 0.0929 m^2.

NS = Buildings not equipped throughout with an automatic sprinkler system; S1 = Buildings a maximum of one story above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; SM = Buildings two or more stories above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2.

a. See Chapters 4 and 5 for specific exceptions to the allowable area in this chapter.
b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
d. The NS value is only for use in evaluation of existing building area in accordance with the *Florida Building Code, Existing Building*.
e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.
f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and the *Florida Fire Prevention Code*.
g. New Group I-4 occupancies see Exceptions 2 and 3 of Section 903.2.6.
h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

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SECTION 508
MIXED USE AND OCCUPANCY

Revise section as follows:

508.4.4.1 Construction. Required separations shall be *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both, so as to completely separate adjacent occupancies. *Mass timber* elements serving as *fire barriers* or *horizontal assemblies* to separate occupancies in Type IV-B or IV-C construction shall be separated from the interior of the *building* with an *approved* thermal barrier consisting of *gypsum board* that is not less than 1/2 inch (12.7 mm) in thickness or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.

Exception: The thermal barrier shall not be required on the top of horizontal assemblies serving as occupancy separations.

SECTION 509
INCIDENTAL USES

Add new section as follows:

509.4.1.1 Type IV-B and IV-C construction. Where Table 509 specifies a fire-resistance-rated separation, *mass timber* elements serving as *fire barriers* or *horizontal assemblies* in Type IV-B or IV-C construction shall be separated from the interior of the incidental use with an *approved* thermal barrier consisting of *gypsum board* that is not less than 1/2 inch (12.7mm) in thickness or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.

Exception: The thermal barrier shall not be required on the top of horizontal assemblies serving as incidental use separations.

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CHAPTER 14
EXTERIOR WALLS

SECTION 1405
INSTALLATION OF WALL COVERINGS

Revise section as follows:

1405.5 Wood Veneers. Wood veneers on exterior walls of buildings of Type I, II, III and IV-HT construction shall be not less than 1 inch (25mm) nominal thickness, 0.438-inch (11.1 mm) exterior *hardboard* siding or 0.375-inch (9.5 mm) exterior-type *wood structural panels* or *particleboard* and shall conform to the following:

1. The *veneer* shall not exceed 40 feet (12 190 mm) in height above grade. Where *fire-retardant-treated wood* is used, the height shall not exceed 60 feet (18 290 mm) in height above grade.

2. The *veneer* is attached to or furred from a noncombustible *backing* that is fire-resistance rated as required by other provisions of this code.

3. Where open or spaced wood *veneers* (without concealed spaces) are used, they shall not project more than 24 inches (610 mm) from the *building* wall.

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SECTION 1406
COMBUSTIBLE MATERIALS ON THE EXTERIOR SIDE OF EXTERIOR WALLS

Revise sections as follows:

1406.2.1 Type I, II, III and IV-HT construction. On buildings of Type I, II, III and IV-HT construction, exterior wall coverings shall be permitted to be constructed of combustible materials, complying with the following limitations:

1. Combustible exterior wall coverings shall not exceed 10 percent of an exterior wall surface area where the fire separation distance is 5 feet (1524 mm) or less.
2. Combustible exterior wall coverings shall be limited to 40 feet (12 192 mm) in height above grade plane.
3. Combustible exterior wall coverings constructed of fire-retardant-treated wood complying with Section 2303.2 for exterior installation shall not be limited in wall surface area where the fire separation distance is 5 feet (1524 mm) or less and shall be permitted up to 60 feet (18 288 mm) in height above grade plane regardless of the fire separation distance.
4. Wood veneers shall comply with Section 1405.5.

1406.3 Balconies and similar projections. Balconies and similar projections of combustible construction other than *fire-retardant-treated wood* shall be *fire-resistance* rated where required by Table 601 for floor construction or shall be of heavy timber construction in accordance with Section 2304.11. The aggregate length of the projections shall not exceed 50 percent of the *building*'s perimeter on each floor.

Exceptions:

1. On *buildings* of Type I and II construction, three *stories* or less above *grade plane*, *fire-retardant-treated wood* shall be permitted for balconies, porches, decks and exterior *stairways* not used as required *exits*.
2. Untreated *wood, and plastic composites* that comply with ASTM D7032 and Section 2612, are permitted for pickets and rails or similar guard devices that are limited to 42 inches (1067 mm) in height.
3. Balconies and similar projections on *buildings* of Type III, IV-HT and V construction shall be permitted to be of Type V construction, and shall not be required to have a *fire-resistance rating* where sprinkler protection is extended to these areas.
4. Where sprinkler protection is extended to the balcony areas, the aggregate length of the balcony on each floor shall not be limited.

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CHAPTER 31
SPECIAL CONSTRUCTION

SECTION 3102
MEMBRANE STRUCTURES

Revise sections as follows:

3102.3 Type of construction. *Noncombustible membrane structures* shall be classified as Type IIB construction. Noncombustible frame or cable-supported *structures* covered by an *approved membrane* in accordance with Section 3102.3.1 shall be classified as Type IIB construction. Heavy timber frame-supported *structures* covered by an *approved membrane* in accordance with Section 3102.3.1 shall be classified as Type IV-HT construction. Other *membrane structures* shall be classified as Type V construction.

> **Exception**: Plastic less than 30 feet (9144 mm) above any floor used in *greenhouses*, where *occupancy* by the general public is not authorized, and for aquaculture pond covers is not required to meet the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701.

3102.6.1.1 Membrane. A *membrane* meeting the fire propagation performance criteria of Test Method 1 or Test Method 2, as appropriate, of NFPA 701 shall be permitted to be used as the roof or as a *skylight* on buildings of Type IIB, III, IV-HT and V construction, provided the *membrane* is not less than 20 feet (6096 mm) above any floor, balcony or gallery.

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S12277Text Modification

CHAPTER 35
REFERENCED STANDARDS

Revise or add references as follows:

AISI S220—20	**North American Standard for Cold-formed Steel Framing-Nonstructural Members**, 2020 Edition 722.7.2.1
ANSI/APA PRG 320-2019	**Standard for Performance-Rated Cross-Laminated Timber** 602.4
ASTM C920—18	**Standard for Specification for Elastomeric Joint Sealants** 703.9
ASTM C1002—20	**Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs** 722.7.2.2
ASTM D3498—19a	**Standard Specifications for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor Systems** 703.9
ASTM D7032—21	**Standard Specification for Establishing Performance Ratings for Wood-Plastic Composite and Plastic Lumber Deck Boards, Stair Treads, Guards and Handrails** 703.9, 705.2.3.1
ASTM E84—21a	**Standard Test Methods for Surface Burning Characteristics of Building Materials** 202, 602.4.1.1, 602.4.2.1, 602.4.3.1,
ASTM E119—20	**Standard Test Methods for Fire Tests of Building Construction and Materials** 703.8
ASTM E1354—17	**Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products using an Oxygen Consumption Calorimeter** 602.4.1.1, 602.4.2.1, 602.4.3.1
NFPA 241—22	**Standard for Safeguarding Construction, Alteration and Demolition Operations** 3301.1, 3303.2
NFPA 275—22	**Standard Method of Fire Tests for the Evaluation of Thermal Barriers** 508.4.4.1, 509.4.1
NFPA 701—23	**Standard Methods of Fire Tests for Flame Propagation of Textiles and Films** 3102.3, 3102.6.1.1
UL 263—11	**Fire Tests of Building Construction and Materials – with Revisions through August 2021** 703.8
UL 723—18	**Standard for Test for Surface Burning Characteristics of Building Materials** 602.4.1.1, 602.4.2.1, 602.4.3.1

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S12277Text Modification

APPENDIX D
FIRE DISTRICTS

SECTION D102
BUILDING RESTRICTIONS

Revise section as follows:

D102.2.5 Structural fire rating. Walls, floors, roofs and their supporting structural members shall be a minimum of 1-hour fire-resistance-rated construction.

Exceptions:

1. Buildings of Type IV-HT construction.
2. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
3. Automobile parking structures.
4. Buildings surrounded on all sides by a permanently open space of not less than 30 feet (9144 mm).
5. Partitions complying with Section 603.1, Item 11.

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S12277Rationale

FBC – Mass Timber Summary

BACKGROUND

The **Ad Hoc Committee on Tall Wood Buildings (TWB)** was created by the ICC Board in 2015 to explore the science of tall wood buildings and develop code changes for such structures.

The TWB and its various working groups (WGs) held meetings, studied issues, and sought input from expert sources worldwide. The TWB posted these documents and input on its website for interested parties to follow its progress and allow public input throughout.

At its first meeting, the TWB discussed **several performance objectives** to be met with the proposed criteria for tall wood buildings:

- **No collapse** under reasonable scenarios of complete burnout of fuel without considering automatic sprinkler protection.
- **No unusually high radiation exposure** from the subject building to adjoining properties that could present a risk of ignition under reasonably severe fire scenarios.
- **No unusual response to typical radiation exposure** from adjacent properties that could present a risk of ignition of the subject building under reasonably severe fire scenarios.
- **No unusual fire department access issues.**
- **Egress systems** designed to protect building occupants during the design escape time, plus a factor of safety.
- **Highly reliable fire suppression systems** to reduce the risk of failure during reasonably expected fire scenarios. The degree of reliability should be proportional to evacuation time (height) and the risk of collapse.

The comprehensive package of proposals from the **TWB meets these performance objectives.**

DEFINITIONS

Included in the proposal are three new or revised definitions: **Wall, Load-Bearing; Mass Timber;** and **Noncombustible Protection (for Mass Timber).** These definitions are important for understanding the proposed changes to Type IV Construction.

Load-Bearing Wall

The modification to the term **"load-bearing wall"** has been updated to include **"mass timber"** as a category equivalent to other materials. Based on research conducted by wood trade associations, **mass timber walls** (e.g., sawn, glued-laminated, cross-laminated timbers) have the ability to support the minimum 200 pounds per linear foot vertical load requirement required of "load bearing".

Mass Timber

The term **"mass timber"** already exists undefined in previous editions of the Florida Building Code (FBC). The definition proposed represents both legacy heavy timber (a.k.a. Type IV construction) and the three new construction types proposed for **FBC Chapter 6**. The purpose of defining this term is to establish that the term represents various sawn and engineered timber products referenced in **FBC Chapter 23 (Wood)** and PRG-320 "Standard for Performance-Rated Cross-Laminated Timber."

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Noncombustible Protection (For Mass Timber)

The definition of **"Noncombustible Protection (For Mass Timber)"** was created to address the **passive fire protection** requirement of mass timber.

- Mass timber is permitted to have its **own fire-resistance rating** (e.g., Mass Timber only) and/or have a fire-resistance rating based on **a combination of mass timber fire resistance plus protection by noncombustible materials**, as defined in **Section 703.5** (e.g., additional materials that delay combustion, such as gypsum board).
- While it is uncommon to list a code section number within a definition, it was necessary in this case to ensure that the user understands the intent.
- Protection by a **noncombustible material** will act to **delay the combustion** of mass timber.

TYPES OF CONSTRUCTION

The committee recognized tall mass timber buildings worldwide generally fall into three categories:

1. **Fully Protected Mass Timber** – The mass timber is fully protected by noncombustible materials.
2. **Partially Exposed Mass Timber** – Some portions of mass timber may be exposed in limited amounts on walls and/or ceilings.
3. **Unprotected Mass Timber** – The mass timber structure may be fully exposed.

The **TWB** determined that fire testing was necessary to validate these concepts. During its first meeting, members discussed the nature and intent of fire testing to ensure meaningful results for the TWB and, more specifically, for the fire service. A test plan was subsequently developed, consisting of one-bedroom apartments on two levels, each with a corridor leading to a stairway. The purpose of the tests was to evaluate the contribution of mass timber to a fire, the performance of connections and joints, and conditions for responding fire personnel.

The **Fire WG** refined the test plan, which was implemented in a series of five full-scale, multi-story building tests at the **ATF laboratories** in Beltsville, MD. The results, along with testing conducted by others, helped form the basis for the **Codes WG** to develop its code change proposals, including this one, which was approved by the TWB.

MASS TIMBER CONSTRUCTION CLASSIFICATIONS

Type IV-A: Fully Protected Mass Timber

Type IV-A is completely protected with noncombustible materials, primarily layers of **5/8-inch Type X gypsum board**. Fire tests have shown that mass timber construction protected in this way can survive a complete burnout of a residential fuel load **without engaging the mass timber in the fire**.

To ensure uniform protection, the text clearly requires **all** building elements to be protected, including floor surfaces, walls and ceiling surfaces, interior roof surfaces, underside of floor surfaces, and shafts.

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Type IV-A is designed to have **the same fire resistance rating as Type I-A construction**, requiring **2-hour and 3-hour structural elements**. The fire resistance rating of structural elements was set conservatively to **sustain fuel loads without sprinkler protection** and **without contributing structural members to the fire**, similar to the IBC strategy for Type I construction.

Type IV-B: Partially Exposed Mass Timber

Type IV-B allows for some exposed **wood surfaces** on ceilings, walls, columns, and beams. However, the amount of exposed wood is **limited** to restrict potential contribution to an interior fire.

Type IV-B has undergone the same fire tests as Type IV-A. Results show a predictable char layer develops on mass timber, similar to traditional sawn lumber, provided **substantial delamination is avoided**. While portions of mass timber may be unprotected, concealed spaces, shafts, and other specified areas must **be fully protected** with noncombustible materials.

Type IV-B is designed to have **the same base fire resistance requirements as Type I-B construction**, and therefore requires **2-hour structural elements**. Unlike Type I-B, the IBC allowance to reduce structural elements to 1-hour protection **is not proposed for Type IV-B**.

Type IV-C: Fully Exposed Mass Timber

Type IV-C construction allows **fully exposed mass timber**, with the key restrictions that concealed spaces, shafts, elevator hoistways, and interior exit stairway enclosures must be protected with noncombustible materials.

This construction type is different from traditional **Heavy Timber (Type IV-HT)** because **Type IV-C requires a 2-hour fire rating**. However, despite this added fire rating, the **height in feet for Type IV-C remains the same as Type IV-HT**. The committee proposed **additional floors** for some occupancy groups in Type IV-C construction.

Modifications to Tables 601 and 602

This proposal includes **modifications to Tables 601 and 602** to set performance requirements for mass timber construction, aligning them with **Type I construction standards**:

- **Type IV-A → Same fire resistance ratings as Type I-A**
- **Type IV-B → Same fire resistance ratings as Type I-B**
- **Type IV-C → Fire resistance is achieved solely through mass timber**

Because **Type IV-C lacks a direct counterpart in Type I construction**, its fire resistance ratings were set to **match those of Type IV-B**. As a result, permitted building heights for Type IV-C are **significantly reduced** in both feet and stories, as reflected in proposed changes to Tables 504.3, 504.4, and 506.2.

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S12277Rationale

Rationale Statement for Proposed Modification to the Florida Building Code, 9th edition (2026)

The proposed modification seeks to incorporate provisions for the use of mass timber in the 9th edition of the Florida Building Code (FBC), aligning it with advancements in building science, fire safety, and structural integrity. This proposal is supported by thousands of hours of research, rigorous fire and structural testing, and extensive modeling by national and international experts and researchers, including the ICC Ad Hoc Committee on Tall Wood Buildings (TWB).

The TWB was established in 2015 in response to concerns from code officials regarding mass timber buildings being constructed without the benefit of codified regulations – precisely the situation in Florida today. To ensure the appropriate degree of rigor, the TWB was composed of a balanced group of stakeholders and subject matter experts to investigate and evaluate the feasibility of tall wood construction and develop comprehensive code provisions addressing fire and life safety concerns. The result was a package of code changes that were successfully integrated into the 2021 International Building Code (IBC), followed by refinements in the 2024 IBC. These provisions now form the foundation for the safe and consistent use of mass timber in 40 states and counting.

Recognizing the critical importance of consistent regulatory frameworks, national consensus codes – including the IBC and NFPA standards – have incorporated mass timber as a safe and viable construction method. The National Association of State Fire Marshals (NASFM) reaffirmed this in a November 2022 position statement, emphasizing:

> "The use of approved mass timber in tall-wood building construction is of the highest concern to NASFM as we stand for the safety of citizens and firefighters. This identified material and construction type has most recently been evaluated in the model code community. **Many facts have been discovered through independent research and testing that have validated this method as meeting the technical requirements of the codes.**" [Emphasis added]

Similarly, the International Association of Fire Chiefs (IAFC) urged jurisdictions to adopt the mass timber provisions of the IBC, stating in January 2020:

> [The IAFC] "Urge communities who are considering new mass-timber buildings to utilize the code provisions found in the 2021 ICC Code documents. There are many opportunities for consideration of buildings that may be taller, larger, or without the protection that was studied. **Communities should continue to use the codes and standards that were established through the model code development process.**" [emphasis added]

Mass timber construction is expanding rapidly across the United States, including in Florida, as developers and architects seek sustainable, efficient, and cost-effective building solutions. However, Florida currently lacks codified mass timber provisions, creating regulatory uncertainty and enforcement challenges for building and fire code officials.

To address this gap, the American Wood Council (AWC) developed the Mass Timber AMM Guide to assist with the 8th edition of the Florida Building Code. This guide, based on the 2024 IBC, provided

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S12277Rationale

for membership by the Building Officials Association of Florida (BOAF) and additionally available from the AWC, provides essential guidance on mass timber construction. However, because the guide does not carry the force of law, formal adoption of mass timber provisions in the Florida Building Code remains necessary to ensure consistent regulation and enforcement across jurisdictions, provide clarity and uniformity for building and fire code officials, streamline the permitting and inspection processes, and maintain the highest standards of fire and life safety.

By adopting these provisions into the Florida Building Code, Florida will:

1. **Ensure Regulatory Alignment** – Maintain consistency with the latest national model codes and standards, facilitating uniformity and a predictable regulatory environment for developers, architects, engineers, and code officials across jurisdictions.
2. **Enhance Sustainability** – Include an additional construction option utilizing renewable materials, contributing to lower embodied carbon for a more sustainable built environment.
3. **Promote Economic Growth** – Enable innovative construction methods that reduce costs and reduce construction timelines, benefiting both the public and private sectors with projected stimulation of Florida's forestry and manufacturing industries.
4. **Strengthen Regulatory Consistency** – Provide clear and uniform guidelines for building and fire code officials, ensuring efficient enforcement of mass timber provisions across the state.
5. **Maintain Fire and Life Safety** – Ensure the adoption of mass timber includes the rigorous safety measures developed through extensive research and code development, in alignment with the positions of NASFM and the IAFC.

The Need for Action:

Mass Timber buildings are currently being constructed in Florida without the benefit of codified requirements, leaving building and fire code officials without the necessary framework to regulate these structures consistently and safely. Failing to adopt these provisions risks creating a patchwork of enforcement and inconsistent safety standards.

It is critical that Florida act now to provide a building code that will ensure that all mass timber buildings meet the highest standards of fire and life safety by adopting the proposed modifications.

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S12277Rationale

For more information:

For more information, the following resources provide technical, regulatory, and real-world evidence demonstrating the safety, reliability, and benefits of tall mass timber construction:

- **ICC Ad Hoc Committee on Tall Wood Buildings**: This committee was established to explore the building science of tall wood buildings and develop related code changes. iccsafe.org
    - https://www.iccsafe.org/products-and-services/i-codes/code-development/cs/icc-ad-hoc-committee-on-tall-wood-buildings/
        - Note: The "Meeting Minutes and Documents" and "Resource Documents" sections of the committee webpage above contain the extensive research and technical information reviewed by the ad hoc committee, including original rationale statements for each proposed section.
        - Based on comprehensive analysis of this information, the committee developed a set of proposals that were adopted to establish regulations that were determined to effectively address fire and life safety considerations for tall mass timber buildings.
- **Understanding the Tall Mass Timber Code Changes**: A guide detailing the code changes approved by the ICC Ad Hoc Committee on Tall Wood Buildings, offering insights into the technical requirements and safety considerations for mass timber construction.
    - For Building Code Officials: https://awc.org/wp-content/uploads/2023/11/MTCC-Guide-Print-20180919.pdf
    - For Fire Code Officials: https://awc.org/wp-content/uploads/2022/01/tmt_toolkit.pdf
- **TMT Fire Testing:** A catalog of research and testing on the fire resistance and safety of mass timber components and structures, including related literature and fire test videos. awc.org
    - https://awc.org/woodaware/tmt-fire-testing/
- **Position Statements:**
    - International Association of Fire Chiefs (IAFC): www.iafc.org/about-iafc/positions/position/tall-wood-mass-timber-buildings
    - National Association of State Fire Marshals (NASFM): www.firemarshals.org/NASFM-Documents (on list at bottom of page)

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TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

25

S12171

Date Submitted	02/16/2025	**Section**	2411.3.2.1	**Proponent**	Milad Shabanian
Chapter	24	**Affects HVHZ**	Yes	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Revise section 2411.3.2.1 of FBCB

Summary of Modification

Revise exterior windows and doors provision with focus on water intrusion.

Rationale

See attached document.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
No impact to local entity relative to enforcement of code
Impact to building and property owners relative to cost of compliance with code
No impact to building and property owners relative to cost of compliance with code.
Impact to industry relative to the cost of compliance with code
No impact to building and property owners relative to cost of compliance with code
Impact to small business relative to the cost of compliance with code
No impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This change provides a reasonable solution improving public safety by providing requirements focusing on water intrusion.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Improves building construction and resistance against water intrusion during wind driven rain condition.
Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No it does not.

Does not degrade the effectiveness of the code

No it does not.

Alternate Language

2nd Comment Period

S12171-A2

Proponent T Stafford **Submitted** 8/24/2025 12:49:20 PM **Attachments** No

Rationale:

This comment is one of two that are being submitted for consideration by the Structural TAC as alternatives to the original proposal. This comment maintains the deletion of the overhang exception to water intrusion testing for doors but would permit doors with a limited water rating (LW) as specified in AAMA/WDMA/CSA 101/I.S.2/A440. Products with an LW rating are characterized by a water intrusion test that is less than the minimum test pressure required for the indicated Performance Grade (typically at 0 psf). However, LW products are intended to be used in locations where adequate protection from water exposure is provided. The overhang exception in the current FBC will provide some protection of the door from wind driven rain. However, it clearly cannot protect doors from horizontal wind driven rain that occurs during hurricanes. Therefore, this comment deletes the overhang exception and specifically requires doors with an LW rating to be protected from water exposure as specified by the manufacturer or a registered design professional. This comment reflects a compromise from the original proposal. It requires some level of water intrusion testing but at much lower levels than required for doors installed in areas that are not adequately protected from water exposure.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Local entities will be required to ensure that doors with an LW rating are protected from water exposure as required by the manufacturer or a registered design professional.

Impact to building and property owners relative to cost of compliance with code

No impact to building and property owners relative to cost of compliance with code.

Impact to industry relative to the cost of compliance with code

No impact to industry relative to cost of compliance with code.

Impact to small business relative to the cost of compliance with code

No impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposed modification will provide improved water intrusion protection for doors.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification strengthens the code by providing improved water intrusion protection for doors.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

This proposed modification does not degrade the effectiveness of the code.

2nd Comment Period

S12171-A1

Proponent Jennifer Hatfield **Submitted** 8/23/2025 3:05:05 PM **Attachments** No

Rationale:

As discussed at the June TAC meeting, the proponent and industry asked for initial disapproval so we could work together to provide alternatives to deleting the existing language. This comment provides one option of how to address concerns but without removing a critical component of the code that is necessary in some instances when an owner needs to also consider accessibility and safety concerns that would result from a higher threshold. This alternative language will make it clear that door assemblies must have a limited water rating per the standard and must have an overhang installed. It also increases the overhang requirements for better protection from water intrusion.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Impact to small business relative to the cost of compliance with code

No impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This alternate language provides a reasonable solution to both better protect the public from water intrusion at the same time taking into account accessibility and safety requirements associated with a higher threshold.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Yes, it strengthens the code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not.

Does not degrade the effectiveness of the code

It does not.

S12171-A2Text Modification

Further modify the proposal as follows:

2411.3.2.1 Operative window and door assemblies shall be tested in accordance with the requirements of this section, TAS 202 and the forced entry resistance requirements from AAMA/WDMA/CSA 101/I.S.2/ A440.

Exceptions:

1. (*n*o change*)*

2. Door assemblies labeled with a limited water (LW) rating as specified in AAMA/WDMA/CSA 101/I.S.2/A440 shall be protected from water exposure in accordance with the door system manufacturer's applicable instructions or as determined by a *registered design professional*.

3 ~~2~~. (*no change*)

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S12171-A1Text Modification

Text of Modification

2411.3.2.1 Operative window and door assemblies shall be tested in accordance with the requirements of this section, TAS 202 and the forced entry resistance requirements from AAMA/WDMA/CSA 101/I.S.2/ A440.

Exceptions:

1. (*no change*)

2. Door assemblies labeled with a Limited Water (LW) rating as specified in AAMA/WDMA/CSA 101/I.S.2/A440 shall be permitted to be installed where the overhang (OH) ratio is equal to or more than 1 ~~need not be tested for water infiltration~~. The overhang ratio shall be calculated by the following equation:

OH ratio = OH Length/OH Height

Where:

OH length = The minimum horizontal measure of how far a permanent overhang over a door projects outward in each direction of the exterior surface of the ~~from~~ door frame ~~surface~~ (refer to Figure A). For installations with side walls that have height equal to the overhang height on each side of the door and that extend the full length of the overhang that is perpendicular to the door, the overhang length that is parallel to the door need not be considered (refer to Figure B).

OH height = The maximum vertical measure of the distance from the bottom of the door frame ~~sill~~ to the bottom surface of the permanent overhang over the ~~a~~ door (refer to Figures A and B).

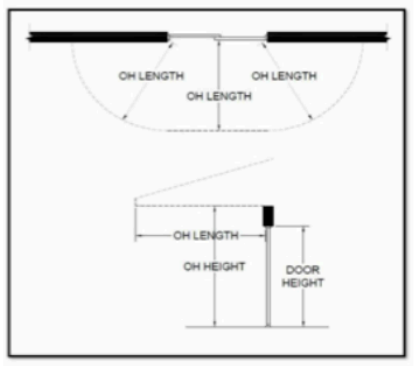


Figure A

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S12171-A1Text Modification

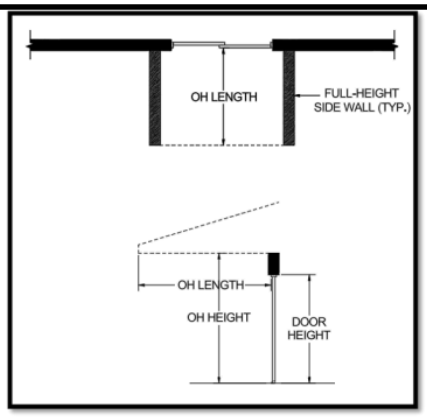


Figure B

3. (*no change*)

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S12171 Text Modification

2411.3.2.1 Operative window and door assemblies shall be tested in accordance with the requirements of this section, TAS 202 and the forced entry resistance requirements from AAMA/WDMA/CSA 101/I.S.2/ A440.

Exceptions:

1. (*no* change*)*

~~2. Door assemblies installed where the overhang (OH) ratio is equal to or more than 1 need not be tested for water infiltration. The overhang ratio shall be calculated by the following equation:~~

~~OH ratio = OH Length/OH Height where:~~

~~OH length = The horizontal measure of how far an overhang over a door projects out from door surface.~~

~~OH height = The vertical measure of the distance from the door sill to the bottom of the overhang over a door.~~

2 ~~3~~. (*no change*)

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S12171Rationale

Rationale:

This proposal is submitted on behalf of the Insurance Institute for Business and Home Safety (IBHS), based on observations from post-event investigations and experiments that highlight the need for this change.

This proposal deletes the exception to water intrusion testing for exterior doors that have an overhang spanning outward over the door of a specified length. AAMA/WDMA/CSA 101/I.S.2/A440 and TAS 202 require windows and doors to be tested for water intrusion. This exception to water intrusion testing in AAMA/WDMA/CSA 101/I.S.2/A440 and TAS 202 is unique to the Florida Building Code. It is not contained in either of the referenced standards nor the *International Codes*. An example of the application of the overhang exception is shown in the following illustration which is taken from Figure 3 of the FEMA *Hurricane Ian in Florida Recovery Advisory 3, Reducing Water Intrusion Through Windows and Doors (2023d)*:

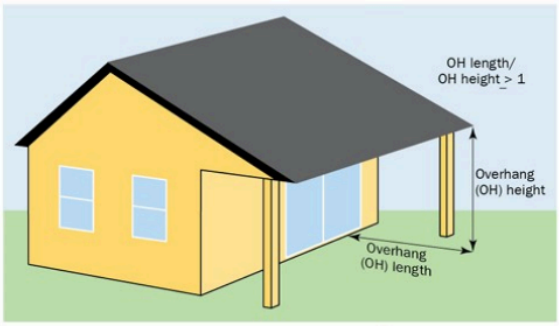


Figure 3: Overhang exception to water penetration testing for doors in the FBCB and FBCR.

This exception originated as a way to comply with the accessibility requirements but still provide some protection from water intrusion due to wind driven rain. A higher threshold or sill riser is often needed to provide the required resistance to water intrusion. However, a higher threshold or sill can in some instances be in conflict with the accessibility requirements for accessible routes. As currently written, this exception provides a blanket exemption to water intrusion testing regardless of whether the door is part of an accessible route or not.

This protection configuration will provide some protection of the door from wind driven rain. However, it clearly cannot protect doors from horizontal wind driven rain that occurs during hurricanes. Interior finishes and contents can be severely damaged by water intrusion through doors.

The FEMA Hurricane Ian in Florida Mitigation Assessment Team (MAT) report documented numerous homeowner reports of water intrusion through doors, particularly sliding glass doors, at nearly all sites visited. (See Section 4.2.3 and Figures 4-9 and 4-10 for examples provided in the FEMA Hurricane Ian in Florida Mitigation Team Assessment Report, FEMA P-2342 (https://www.fema.gov/sites/default/files/documents/fema_rm-hurriance-ian-mat-report-12-2023.pdf). The report notes that at this site, the exterior sliding doors had an overhang length the

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exceeded the minimum length required to comply with the exception in the FBC. However, the homeowner reported significant water intrusion due to wind-driven rain through the sliding door.

This water intrusion can result in costly damage to interior contents and furnishings. The observations from the FEMA Hurricane Ian in Florida MAT led to the report recommending the following in Recommendation FL-12a:

The Florida Building Commission should collaborate with the window industry (Window and Door Manufacturers Association [WDMA], Fenestration and Glazing Industry Alliance, and key manufacturers) and other stakeholders to modify or delete the exceptions to water intrusion testing in the FBC. The FBC exempts doors from water intrusion testing required by American Architectural Manufacturers Association (AAMA)/WDMA/Canadian Standards Association (CSA) 101/I.S.2/A440, and TAS 202 for doors installed in certain conditions. While these installations may provide sufficient protection in areas outside hurricane-prone regions, it will not protect doors from the wind driven horizontal rain that commonly occurs during hurricanes. The entire State of Florida is within a hurricane-prone region.

This proposal, if approved, would implement this recommendation by deleting this exception to the required water intrusion testing in the specified referenced standards.

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Building

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S11967

Date Submitted	02/15/2025	**Section**	35	**Proponent**	Jennifer Hatfield
Chapter	35	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Residential Standards Update proposal.

Summary of Modification

On behalf of the Fenestration & Glazing Industry Alliance (FGIA), this modification provides standard updates for both AAMA and ASTM standards used in the fenestration industry.

Rationale

These are standard editions that have published since the last Florida cycle and/or were not included in the 2024 I-codes. In addition to edits to the edition years, some titles also required updating.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
None
Impact to building and property owners relative to cost of compliance with code
None
Impact to industry relative to the cost of compliance with code
None
Impact to small business relative to the cost of compliance with code
None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Provides for latest standard editions.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Provides for latest standard editions.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not.

Does not degrade the effectiveness of the code

It does not.

Alternate Language

2nd Comment Period

S1967-A1

Proponent Jennifer Hatfield **Submitted** 8/22/2025 1:25:16 PM **Attachments** No

Rationale:

This alternate language comment removes 2025 updates to FMA/AAMA 100 and AAMA/WDMA/CSA 101/I.S.2/A440 (the latter known as NAFS) that are not yet available. Those will be addressed separately, once available, to ensure the rest of the standard updates in this proposal can be updated. In reviewing the NAFS standard it has also come to our attention that the 2022 edition of NAFS cited currently in both the 8th edition Florida Residential and Building Codebooks is not included in the Florida Energy Codebook - we would ask staff to look into updating that for consistency among the Florida codebooks as it was unintentionally missed.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Impact to small business relative to the cost of compliance with code

None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Provides for latest standard editions.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Provides for latest standard editions.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not.

Does not degrade the effectiveness of the code

It does not.

S11967-A1Text Modification

AAMA Standard by FGIA

AAMA 501— ~~15,~~ 24 or 25
Methods of Test for Exterior Walls
1709.8.4

AAMA 506— 16 or 23
~~Voluntary~~ Specifications for Impact and Cycle Testing of Fenestration Products
1609.1.2

AAMA 711— ~~13,~~ 20 or 22
~~Voluntary~~ Specification for Self-Adhering Flashing Used for Installation of Exterior Wall Fenestration Products
1405.4, Table 1507.1.1.1, 1507.1.1.2, 1518.2.1

AAMA 714— ~~15 or~~ 19 or ~~23~~2
~~Voluntary~~ Specification for Liquid Applied Flashing Used to Create a Water-Resistive Seal around Exterior Wall Openings in Buildings
1405.4

AAMA 2502—19 or 24
Comparative Analysis Procedure for Window and Door Products
1709.5.1

AAMA/NSA 2100— 19 or 22
Voluntary Specifications for Sunrooms
202, 2002.6.1, 2002.6.2

AAMA/WDMA/CSA 101/I.S.2/A440— ~~08,~~11, 17 or 22
North American Fenestration Standard/Specification for ~~W~~windows, ~~D~~doors, and ~~S~~skylights
1010.1.6, 1709.5.1, 2405.5, 2411.3.2.1

FMA/AAMA 100—12
Standard Practice for the Installation of Windows with Mounting Flanges for Membrane Drainage Systems ~~or Mounting~~
1405.4.1.4

ASTM Standards

E331—00 (~~2009 or 2016~~ 2023)
Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference
1403.2, 1404.2, 2415.4

E1300— ~~04e01, 07e01, 09e, 12AE1, or~~ 16 or 24
Practice for Determining Load Resistance of Glass in Buildings
1709.5.1, 2404.1, 2404.2, 2404.3.1, 2404.3.2, 2404.3.3, 2404.3.4, 2404.3.5, 2411.2.1.1, 2411.2.1.2, 2411.3.1.2

E1996— ~~2014a,~~ 2017, ~~or~~ 2020 or 2023
Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
449.4.2.5.1, 450.4.2.5.1, 1609.1.2, 1609.1.2.2, 1709.5.1

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S11967Text Modification

AAMA Standard by FGIA

AAMA 501— 15, 24 or 25
Methods of Test for Exterior Walls
1709.8.4

AAMA 506— 16 or 23
~~Voluntary~~ Specifications for Impact and Cycle Testing of Fenestration Products
1609.1.2

AAMA 711— ~~13,~~20 or 22
~~Voluntary~~ Specification for Self-Adhering Flashing Used for Installation of Exterior Wall Fenestration Products
1405.4, Table 1507.1.1.1, 1507.1.1.2, 1518.2.1

AAMA 714— ~~15 or~~ 19 or 2~~3~~2
~~Voluntary~~ Specification for Liquid Applied Flashing Used to Create a Water-Resistive Seal around Exterior Wall Openings in Buildings
1405.4

AAMA 1402—09
Standard Specifications for Aluminum Siding, Soffit and Fascia
1404.5.1

AAMA 2502—19 or 24
Comparative Analysis Procedure for Window and Door Products
1709.5.1

AAMA/NSA 2100— 19 or 22
Voluntary Specifications for Sunrooms
202, 2002.6.1, 2002.6.2

AAMA/WDMA/CSA 101/I.S.2/A440— ~~08, 11,~~17, ~~or~~ 22, or 25
North American Fenestration Standard/Specification for ~~W~~windows, ~~D~~doors, and ~~S~~skylights
1010.1.6, 1709.5.1, 2405.5, 2411.3.2.1

FMA/AAMA 100—~~12~~25
Standard Practice for the Installation of Windows with Mounting Flanges for Membrane Drainage Systems ~~or Mounting~~
R703.4

ASTM Standards

E331—00 (~~2009 or~~ 2016 or 2023)
Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference
R703.1.1, R703.2

E1300— ~~04e01, 07e01, 09e~~09a, 12AE1, ~~or~~ 16 or 24
Practice for Determining Load Resistance of Glass in Buildings
R609.3

E1996—2014a, 2017 or 2020 or 2023
Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
R301.2.1.2, R301.2.1.2.1, R609.3.1, R609.6.1

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Mod11967_TextOfModification.pdf

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Existing Building

27

SP12018

Date Submitted	02/13/2025	**Section**	401.5	**Proponent**	Rebecca Quinn obo FL Div Emerg Mgnt
Chapter	4	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

12019, 12020

Summary of Modification

For clarity, carry into other codes the change made in 8th to require elevation of exterior equipment and exterior appliances that are damaged by flood (see FBC EB Sec. 701.3 and FBCR Sec. R322.1.6).

Rationale

Many buildings in floodplains were built before communities started regulating and requiring buildings to be elevated and constructed to minimize exposure to flooding. During floods, exterior equipment that serves those buildings gets damaged, even when the building itself is not substantially damaged. When buildings are flooded and elevated exterior equipment remains functional, clean up and drying out are easier and faster. This means dangerous mold conditions are less likely to develop and buildings can more quickly be reoccupied. The code change clarifies the existing requirement in FBCEB Sec. 701.3 and FBCR Sec. R322.1.6) by adding it to FBCEB Repairs, FBC Mechanical, and FBC Fuel Gas so that it is clear that the requirement that is already in the code applies, whether it is called an alteration or repair, and whether a permit is issued under only the Mechanical or Fuel Gas codes. Methods used to raise the replacement exterior equipment are the same as the methods used when equipment is installed to serve new construction (pedestal, platforms, platforms that are cantilevered from or knee braced to the structure; wall brackets for mini-splits). FEMA's Mitigation Assessment Team reports prepared after some significant flood events document widespread damage to non-elevated exterior equipment. Elevating equipment at the time of replacement also saves building owners from having to pay for replacement equipment after the subsequent flood event.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None; the 8th Ed requirements already apply to exterior equipment/appliances replaced because of flood damage.

Impact to building and property owners relative to cost of compliance with code

None; the 8th Ed requirements already apply to exterior equipment/appliances replaced because of flood damage.

Impact to industry relative to the cost of compliance with code

None; the 8th Ed requirements already apply to exterior equipment/appliances replaced because of flood damage.

Impact to small business relative to the cost of compliance with code

None; the 8th Ed requirements already apply to exterior equipment/appliances replaced because of flood damage.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

No change because the 8th Ed requirements already apply to exterior equipment/appliances replaced because of flood damage.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

No change because the 8th Ed requirements already apply to exterior equipment/appliances replaced because of flood damage.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No change because the 8th Ed requirements already apply to exterior equipment/appliances replaced because of flood damage.

Does not degrade the effectiveness of the code

No change because the 8th Ed requirements already apply to exterior equipment/appliances replaced because of flood damage.

Alternate Language

2nd Comment Period

SP12018-A2

Proponent Rebecca Quinn obo FL Div Emerg Mgnt **Submitted** 8/7/2025 9:46:40 AM **Attachments** No

Rationale:
At the TACs we asked for disapproval to bring back comment to scale-back original proposal which would have required full-height elevation of exterior equipment and exterior appliances damaged by flood and to fix an unintended consequence in original language. The proposal has always addressed replacement of equipment, not repair (there are no flood requirements if the items can be repaired and restored to service, unless part of repairing buildings that sustain substantial damage). The proposal has always addressed exterior equipment and appliances, not items in crawlspaces. A plain reading is that equipment in a crawlspace is not “exterior.” When we explored scaling back the elevation requirement, we landed on the higher of matching the floor height above grade of the existing building (thus protecting the equipment to the same height at the primary occupied space) or 4 feet above grade. Platforms 4 ft above grade protect equipment from frequently low-level flooding, while allowing for routine maintenance without stairs or ladders. One community recently advised they get push-back against the current full elevation of flood-damaged equipment when equipment must be higher than 4 ft above grade. This comment also clarifies that flood-damaged exterior equipment and appliances that serve nonresidential buildings and nonresidential portions could be “put in a bathtub” – which is a way to describe having equipment inside walled enclosures that are designed to keep water away from the equipment, called “dry floodproofed.” Sometimes this option is called “component protection.” FBCB uses the term “nonresidential” in three sections pertaining to dry floodproofing requirements and it, along with “residential,” are defined in ASCE 24. In addition to ASCE 24 commentary, see guidance in FEMA P-936 Floodproofing Non-Residential Buildings, and FEMA P-348 Protecting Building Utility Systems from Flood Damage: Principles and Practices.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Less resistance from owners when full elevation would require platforms taller than the existing living level or 4 ft.

Impact to building and property owners relative to cost of compliance with code
Somewhat increases risk of damage over current full elevation requirements, but satisfies the original intent to minimize damage by frequent, low-level (not BFE) flooding. Some reduction in costs where full elevation would be higher than this proposed.

Impact to industry relative to the cost of compliance with code
None; some degree of elevation or protection still required.

Impact to small business relative to the cost of compliance with code
None; the 8th Ed requirements already apply to exterior equipment/appliances replaced because of flood damage.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Achieves original intent with respect to frequent, low-level flooding.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Improves enforceability in those situations where full elevation is challenging due to small setbacks

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
No change because the 8th Ed requirements already apply to exterior equipment/appliances replaced because of flood damage.

Does not degrade the effectiveness of the code
Although the elevation requirement is scaled back, the proposed change will still result in reduction in damage and improved ability to reoccupy after low-level flooding.

SP12018-A2Text Modification

FBCEB CHAPTER 7 ALTERATIONS

701.3 Flood hazard areas. In *flood hazard areas*:

1. *Alterations* that constitute *substantial improvement* shall require that the building comply with Section 1612 of the *Florida Building Code, Building*, or Section R322 of the *Florida Building Code, Residential*, as applicable.

2. Unless part of substantial improvement or repair of substantial damage, replacement ~~Replacement~~ of exterior equipment and exterior appliances that are damaged by flood shall meet one of the following: ~~the requirements of Section 1612 of the *Florida Building Code, Building*, or Section R322.1.6 of the *Florida Building Code, Residential*, as applicable.~~

2.1. Be elevated to or above the same height above grade as the first floor of the building, or 4 ft above grade, whichever is higher.

2.2. For nonresidential buildings and nonresidential portions of buildings, be elevated in accordance with 2.1 or located in an enclosure that is dry floodproofed to 4 ft above grade, or the same height above grade as the first floor of the building, whichever is higher, in accordance with the dry floodproofing requirements of ASCE 24 for attendant utilities and equipment.

FBCEB CHAPTER 5, SEC. 503 ALTERATIONS (bring in to pair with 701.3)

[BS] 503.2 Flood hazard areas.

For buildings and structures in *flood hazard areas*: ~~established in Section 1612.3 of the *Florida Building Code, Building*, or Section R322 of the *Florida Building Code, Residential*, as applicable, any~~

1. *Alterations* ~~*alteration*~~ that constitute~~s~~ *substantial improvement* of the existing structure shall comply with the flood design requirements for new construction, and all aspects of the existing structure shall be brought into compliance with the requirements for new construction for flood design.

2. Alterations ~~For buildings and structures in *flood hazard areas* established in Section 1612.3 of the *Florida Building Code, Building*, or Section R322 of the *Florida Building Code, Residential*, as applicable, any alterations~~ that do not constitute *substantial improvement* of the existing structure are not required to comply with the flood design requirements for new construction.

3. Unless part of substantial improvement or repair of substantial damage, replacement of exterior equipment and exterior appliances that are damaged by flood shall meet one of the following:

2.1. Be elevated to or above the same height above grade as the first floor of the building, or 4 ft above grade, whichever is higher.

2.2. For nonresidential buildings and nonresidential portions of buildings, be elevated in accordance with 2.1 or located in an enclosure that is dry floodproofed to 4 ft above grade, or the same height above grade as the first floor of the building, whichever is higher, in accordance with the dry floodproofing requirements of ASCE 24 for attendant utilities and equipment.

NEW ADDITION FBC RESIDENTIAL

R322.1.6 Protection of mechanical, plumbing and electrical systems. Electrical systems, equipment and components; heating, ventilating, air conditioning; plumbing appliances and plumbing fixtures; duct systems; and other service equipment shall be located at or above the elevation required in Section R322.2 or R322.3. ~~Replacement of exterior equipment and exterior appliances damaged by flood shall meet the requirements of this section.~~ If replaced as part of a substantial improvement, electrical systems, equipment and components; heating, ventilating, air conditioning and plumbing appliances and plumbing fixtures; duct systems; and other service equipment shall meet the requirements of this section. Systems, fixtures, and equipment and components shall not be mounted on or penetrate through walls intended to break away under flood loads.

Exceptions:

1. Unless part of substantial improvement or repair of substantial damage, replacement of exterior equipment and exterior appliances that are damaged by flood shall be elevated to or above the same height above grade as the first floor of the building, or 4 ft above grade, whichever is higher.

2. Locating electrical systems, equipment and components; heating, ventilating, air conditioning; plumbing appliances and plumbing fixtures; duct systems; and other service equipment is permitted below the elevation required in Section R322.2 or R322.3 provided that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the required elevation in accordance with ASCE 24. Equipment for pools, spas and water features shall be permitted below the elevation required in Section R322.2 or R322.3 provided it is elevated to the extent practical and is anchored to prevent floatation and resist flood forces and is supplied by branch circuits that have ground-fault circuit interrupter protection. Electrical wiring

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SP12018-A2Text Modification

systems are permitted to be located below the required elevation provided that they conform to the provisions of the electrical part of this code for wet locations.

SP12018Text Modification

401.5 Flood hazard areas. In *flood hazard areas*~~, repairs~~

1. Repairs that constitute *substantial improvement* shall require that the building comply with Section 1612 of the *Florida Building Code, Building* or Section R322 of the *Florida Building Code, Residential*, as applicable.

2. Replacement of exterior equipment and exterior appliances damaged by *flood* shall meet the requirements of Section 1612 of the *Florida Building Code, Building* or Section R322 of the *Florida Building Code, Residential*, as applicable.

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Mod12018_TextOfModification.pdf

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Residential

28

S11869

Date Submitted	02/07/2025	**Section**	202	**Proponent**	Fernando Pages
Chapter	2	**Affects HVHZ**	No	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

R703.3.3 Minimum fastenr length R703.11.1 Instalation R703.11.2 Instalation over foam plastic sheathing R703.13 Insulated vinyl siding, backed vinyl siding R703.13.1 Insulated vinyl siding, backed vinyl siding, and accessories

Summary of Modification

Add Backed Vinyl Siding to the code as a new catergory of vinyl siding, helping distiguish this product from Inuslated Viny Siding.

Rationale

Including a definition for backed siding in the Florida Building Code is necessary to reflect advancements in siding products and ensure clear guidance for designers, contractors, and inspectors. Backed siding is a laminated board product combining vinyl and EPS foam, standardized to meet the Florida Building Code Residential (FBCR) requirements. This product has already been accepted into the International Building Code during the Group A cycle and offers unique performance benefits that warrant its inclusion in the code. The product has already been integrated into the International Building Code, aligning Florida's code with nationally recognized standards. Add ASTM 7445. This modification brings a new and applicable ASTM reference to the Florida Building Code.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Including a definition for backed siding in the Florida Building Code ensures clarity for designers, contractors, and inspectors. It standardizes a laminated vinyl and EPS foam product, aligning with FBCR requirements and facilitating enforcement without adding complexity.

Impact to building and property owners relative to cost of compliance with code

Although backed siding is 20%-30% more expensive than traditional vinyl siding, it remains a cost-effective alternative to other high-end clapboard-style cladding products.

Impact to industry relative to the cost of compliance with code

Cost increase if the material is selceted over Vinyl Siding. No added cost to compliance, the material is installed and inspected just like Vinyl Siding and Insulated Vinyl Siding.

Impact to small business relative to the cost of compliance with code

Cost increase if the material is selceted over Vinyl Siding. No added cost to compliance, the material is installed and inspected just like Vinyl Siding and Insulated Vinyl Siding.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Backed siding enhances impact resistance, making it ideal for Florida’s severe weather. Adding it to the code provides homeowners with a durable, high-performance option aligned with national standards. While costs may increase, the material's resilience and efficiency justify the investment.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The product is standardized and commercially available with third-party certification, ensuring compliance with industry standards. Adding backed siding to the Florida Building Code reflects product advancements and provides clear guidance for designers, contractors, and inspectors.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate.

Does not degrade the effectiveness of the code

Does not degrade the effectivness of the code.

Alternate Language

2nd Comment Period

S11869-A2

Proponent Fernando Pages **Submitted** 8/21/2025 4:10:07 PM **Attachments** Yes

Rationale:

Including distinct definitions for insulated vinyl siding and backed vinyl siding in the Florida Building Code is necessary to reflect product advancements and to clearly differentiate between cladding that serves an insulating function and siding that does not, ensuring precise guidance for designers, contractors, and inspectors. Backed siding is a laminated board product combining vinyl and EPS foam, standardized to meet the Florida Building Code Residential (FBCR) requirements. This product has already been accepted into the International Building Code during the Group A cycle and offers unique performance benefits that warrant its inclusion in the code. The product has already been integrated into the International Building Code, aligning Florida's code with nationally recognized standards. Add ASTM 7445. This modification brings a new and applicable ASTM reference to the Florida Building Code.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Including a definition for backed siding in the Florida Building Code ensures clarity for designers, contractors, and inspectors. It standardizes a laminated vinyl and EPS foam product, aligning with FBCR requirements and facilitating enforcement without adding complexity

Impact to building and property owners relative to cost of compliance with code

Although backed siding is 20%-30% more expensive than traditional vinyl siding, it remains a cost-effective alternative to other high-end clapboard-style cladding products.

Impact to industry relative to the cost of compliance with code

Cost increases if the material is selected over classic Vinyl Siding. No added cost to compliance, the material is installed and inspected just like Vinyl Siding and Insulated Vinyl Siding.

Impact to small business relative to the cost of compliance with code

Cost increase if the material is selceted over Vinyl Siding. No added cost to compliance, the material is installed and inspected just like Vinyl Siding and Insulated Vinyl Siding.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Backed Siding enhances impact resistance, making it ideal for Florida’s severe weather. Adding it to the code provides homeowners with a durable, high-performance option aligned with national standards. While costs may increase, the material's resilience and efficiency justify the investment.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The product is standardized and commercially available with third-party certification, ensuring compliance with industry standards. Adding backed siding to the Florida Building Code reflects product advancements and provides clear guidance for designers, contractors, and inspectors.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate.

Does not degrade the effectiveness of the code

Does not degrade the effectiveness of the code.

S11869-A2Text Modification

See attachments

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S11869-A2Text Modification

Modification # 11869

Code Version	2026
Code Change Cycle	2026 Triennial Original Modification 01/03/2025 - 02/18/2025
Sub Code	Residential
Chapter & Topic	Chapter 2 - Definitions
Section	202
Related Modifications	R703.3.3 Minimum fastener length R703.11.1 Installation R703.11.2 Installation over foam plastic sheathing R703.13 Insulated vinyl siding, backed vinyl siding R703.13.1 Insulated vinyl siding, backed vinyl siding, and accessories

Summary

Add Backed Vinyl Siding to the code as a new category of vinyl siding, helping distinguish this product from Insulated Vinyl Siding.

[ADD ASTM STANDARDS UPLOAD]

Text of Modification

FBCR Definitions [Add definition]

[RB] Backed vinyl siding is a cladding product in which foam plastic backing is factory-applied as an integral component. Where the foam plastic functions as insulation, the product shall be considered *Insulated Vinyl Siding*.

R703.3.3 Minimum fastener length and penetration. [Revise as follows]

Fasteners shall have the greater of the minimum length specified in Table R703.3(1) or as required to provide a minimum penetration into framing as follows:

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S11869-A2Text Modification

1.Fasteners for horizontal aluminum siding, steel siding, particleboard panel siding, wood structural panel siding in accordance with ANSI/APA-PRP 210, fiber-cement panel siding and fiber-cement lap siding installed over foam plastic sheathing shall penetrate not less than 11/2 inches (38 mm) into framing or shall be in accordance with the manufacturer's ~~installation~~ instructions.

2.Fasteners for hardboard panel and lap siding shall penetrate not less than 11/2 inches (38 mm) into framing.

3.Fasteners for vinyl siding, *backed vinyl siding*, and insulated vinyl siding shall be installed in accordance with Section R703.11 or R703.13.

4.Fasteners for vertical or horizontal wood siding shall penetrate not less than 11/2 inches (38 mm) into studs, studs and wood sheathing combined, or blocking.

5.Fasteners for siding material installed over foam plastic sheathing shall have sufficient length to accommodate foam plastic sheathing thickness and to penetrate framing or sheathing and framing combined, as specified in Items 1 through 4.

R703.11.2 Installation over foam plastic sheathing.

Where vinyl siding, *backed vinyl siding* or *insulated vinyl* siding is installed over foam plastic sheathing, the vinyl siding shall comply with Section R703.11 and shall have a wind load design pressure rating in accordance with Table R703.11.2.

Exceptions:

1.Where the foam plastic sheathing is applied directly over wood structural panels, fiberboard, gypsum sheathing or other approved backing capable of independently resisting the design wind pressure, the vinyl siding shall be installed in accordance with Sections R703.11.1 and R703.3.3.

2.Where the vinyl siding manufacturer's product specifications provide an *approved* wind load design pressure rating for installation over foam plastic sheathing, use of this wind load design pressure rating shall be permitted, and the siding shall be installed in accordance with the manufacturer's instructions.

3.Where the foam plastic sheathing and its attachment has a design wind pressure resistance complying with Sections R316.8 and R301.2.1, the vinyl siding shall be installed in accordance with Sections R703.11.1 and R703.3.3.

R703.13 Insulated vinyl siding, backed vinyl siding.

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Insulated vinyl siding and *backed vinyl siding* shall be certified and labeled by an approved agency as conforming to the requirements of ASTM D7793 and D7445, respectively.

Add new standard as follows:

ASTM D7445-24 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding with Foam Plastic Backing (Backed Vinyl Siding)

R703.13.1 Insulated vinyl siding, backed vinyl siding, and accessories.

Insulated vinyl siding, backed vinyl siding, and compatible accessories shall be installed in accordance with Sections R703.11.1, R703.11.2 and or the manufacturer's ~~installation~~ instructions.

Rational

Including distinct definitions for insulated vinyl siding and backed vinyl siding in the Florida Building Code is necessary to reflect product advancements and to clearly differentiate between cladding that serves an insulating function and siding that does not, ensuring precise guidance for designers, contractors, and inspectors. Backed siding is a laminated board product combining vinyl and EPS foam, standardized to meet the Florida Building Code Residential (FBCR) requirements. This product has already been accepted into the International Building Code during the Group A cycle and offers unique performance benefits that warrant its inclusion in the code. The product has already been integrated into the International Building Code, aligning Florida's code with nationally recognized standards.

Add ASTM 7445. This modification brings a new and applicable ASTM reference to the Florida Building Code.

Fiscal

Including a definition for backed siding in the Florida Building Code ensures clarity for designers, contractors, and inspectors. It standardizes a laminated vinyl and EPS foam product, aligning with FBCR requirements and facilitating enforcement without adding complexity.

Owner

Although backed siding is 20%-30% more expensive than traditional vinyl siding, it remains a cost-effective alternative to other high-end clapboard-style cladding products.

Industry

Cost increases if the material is selected over classic Vinyl Siding. No added cost to compliance, the material is installed and inspected just like Vinyl Siding and Insulated Vinyl Siding.

Small business

Cost increases if the material is selected over Vinyl Siding. No added cost to compliance, the material is installed and inspected just like Vinyl Siding and Insulated Vinyl Siding.

Requirements

Backed Siding enhances impact resistance, making it ideal for Florida's severe weather. Adding it to the code provides homeowners with a durable, high-performance option aligned with national standards. While costs may increase, the material's resilience and efficiency justify the investment.

Strengthens

The product is standardized and commercially available with third-party certification, ensuring compliance with industry standards. Adding backed siding to the Florida Building Code reflects product advancements and provides clear guidance for designers, contractors, and inspectors.

Discriminate

Does not discriminate.

Degrade

Does not degrade the effectiveness of the code.

S11869-A2Text Modification

This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.



Designation: D7793 – 24

Standard Specification for Insulated Vinyl Siding[1]

This standard is issued under the fixed designation D7793; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification establishes requirements for insulated vinyl siding, which is vinyl siding with integral foam plastic insulating material, where the vinyl siding is manufactured from rigid PVC compound. Compliance with this standard requires insulated vinyl siding to demonstrate a thermal insulation value of R-2.0 or greater. Other performance requirements and test methods addressed by this standard include materials properties and dimensions, warp, shrinkage, impact strength, expansion, appearance, thermal distortion resistance, flame spread, and windload resistance. Methods of indicating compliance with this specification are also provided.

NOTE 1—Insulated vinyl siding is composed of two major components: the vinyl siding and the insulating material. It is intended that the vinyl siding portion comply with Specification D3679. Applicable portions of Specification D3679 are included in this specification. Additional requirements that pertain only to the insulation as a separate material, or to the combination of vinyl siding and insulation as a whole, are also included. For further explanation, see Appendix X1.

1.2 Insulated vinyl siding shall be tested with the insulation material in place or removed, as specified in the applicable requirement or test method.

1.3 The use of PVC recycled plastic in this product shall be in accordance with the requirements in Section 4.

1.4 Insulated vinyl siding produced to this specification shall be installed in accordance with the manufacturer's installation instructions for the specific product to be installed.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 2—There is no known ISO equivalent to this standard.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C297/C297M Test Method for Flatwise Tensile Strength of Sandwich Constructions
C578 Specification for Rigid, Cellular Polystyrene Thermal Insulation
C591 Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
C1199 Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods
C1289 Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
C1363 Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
D618 Practice for Conditioning Plastics for Testing
D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer
D1042 Test Method for Linear Dimensional Changes of Plastics Caused by Exposure to Heat and Moisture
D1183 Practices for Resistance of Adhesives to Cyclic Laboratory Aging Conditions
D1435 Practice for Outdoor Weathering of Plastics
D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
D2457 Test Method for Specular Gloss of Plastic Films and Solid Plastics

[1] This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.24 on Plastic Building Products.

Current edition approved April 1, 2024. Published April 2024. Originally approved in 2012. Last previous edition approved in 2021 as D7793 – 21. DOI:10.1520/D7793-24.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

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D3679 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding
D3892 Practice for Packaging/Packing of Plastics
D4226 Test Methods for Impact Resistance of Rigid Poly-(Vinyl Chloride) (PVC) Building Products
D5206 Test Method for Windload Resistance of Rigid Plastic Siding
D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens
D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)[3]
D7445 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding with Foam Plastic Backing (Backed Vinyl Siding)
E84 Test Method for Surface Burning Characteristics of Building Materials
E1753 Practice for Use of Qualitative Chemical Spot Test Kits for Detection of Lead in Dry Paint Films
G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

2.2 *American Society of Civil Engineers (ASCE):*[4]
ASCE 7-10 Minimum Design Loads for Buildings and Other Structures

2.3 *International Code Council*
International Building Code
International Residential Code

2.4 *International Code Council–Evaluation Services (ICC-ES):*
AC05 Acceptance Criteria for Sandwich Panel Adhesives

2.5 *International Standards Organization (ISO):*
ISO/IEC Guide 65 General requirements for bodies operating product certification systems

2.6 *Structural Building Components Association:*
ANSI/SBCA FS 100-2012 Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies

2.7 *Vinyl Siding Institute, Inc.*
VSI Vinyl Siding Installation Manual (2015)

2.8 *Federal Standards:*
16 CFR Part 460 Labeling and Advertising of Home Insulation

3. Terminology

3.1 *Definitions:*

3.1.1 *center-pinning*—an installation technique in which the siding panel is fastened tightly through the nail slot at the center length of the panel, in order to cause thermal expansion and contraction to occur equally in both directions from the center.

3.1.2 *cohesive failure*—in the context of tensile testing, internal separation of the adhesive within the adhesive layer, resulting in attachment of adhesive material to the surface of both substrates

3.1.3 *insulation; insulating material*—foam plastic material that is combined at the factory with a vinyl siding profile to form insulated vinyl siding.

3.1.4 *insulated vinyl siding*—a vinyl cladding product sold with manufacturer-installed foam plastic insulating material as an integral part of the cladding product. The vinyl cladding portion of insulated vinyl siding meets the definition of vinyl siding.

3.1.5 *nominal*—the value that a manufacturer consistently uses to represent a specific property or dimension of a vinyl siding product in public claims including, but not limited to, product literature, advertisements, quotations, and certificates of conformance.

3.1.6 *process average thickness*—the rolling, arithmetic mean of average specimen thicknesses measured in accordance with 6.5 for a specific product during all productions runs for the most recent six-month period.

3.1.7 *vertical coverage*—The net vertical distance of the wall covered by a single insulated vinyl siding panel, disregarding any portions of the panel that are overlapped by adjacent panels above or below.

3.1.8 *temperate northern climate*—in weather testing, a North American metropolitan area testing site located within 73 to 100°W longitude and 37 to 45°N latitude.

3.1.9 *vinyl siding*—a shaped material, made principally from rigid poly(vinyl chloride) (PVC), that is used to clad exterior walls of buildings. In this standard, vinyl siding refers to the rigid profile to which the insulation is attached.

3.1.10 *wind load design pressure rating*—the maximum wind pressure that an insulated vinyl siding product is rated to withstand, based on testing under Test Method D5206.

3.1.10.1 *standard wind load design pressure rating*—the wind load design pressure rating for a siding product when installed 1) over a sheathing material designed and attached such that it is capable of resisting 100% of positive and negative wind pressures occurring under design conditions at the building location; and 2) with the standard fastening method specified in building codes, general installation instructions, and the siding manufacturer's instructions.

3.1.10.2 *alternative wind load design pressure rating*—the wind load design pressure rating for a siding product when installed over a sheathing not designed and attached such that it is capable of resisting 100% of positive and negative wind pressures occurring under design conditions at the building location, or when the siding is not fastened in the standard way; as specified by the manufacturer.

3.1.10.3 *Discussion*—The standard test conditions, configuration, and fastening method used in this specification are specified in 6.14, while alternative sheathing and installation conditions are specified by the manufacturer and must be reflected in the product's installation instructions. Alternative ratings apply only when the specified sheathing and fastening conditions are used. See Annex A1 for information on differences between the standard wind load design pressure rating and alternative wind load design pressure ratings, and how to determine standard and alternative design pressure ratings.

[3] The last approved version of this historical standard is referenced on www.astm.org.
[4] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.

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4. Materials and Manufacture

4.1 *Vinyl Siding:*

4.1.1 The vinyl siding, exclusive of foam plastic insulating material, shall be made of one or more layers of poly(vinyl chloride) (PVC) compound. Any layers of materials other than poly (vinyl chloride) (PVC) compound shall be kept to less than 20 % by volume. This limitation does not apply to the insulation material.

4.1.2 Where rigid PVC recycled plastic as defined in Guide D7209 is used, the vinyl siding containing the PVC recycled plastic shall meet all of the requirements of Sections 3, 4, and 5.

4.1.3 The vinyl siding material, exclusive of insulation material, when tested in accordance with Test Method D635, shall not exceed an average extent of burn of 4 in. (100 mm), with an average time of burn not to exceed 10 seconds. A minimum sample thickness of 0.035 in. (0.9 mm) is required. (**Warning—**The flammability testing data, conclusions, and recommendations of Test Method D635 relate solely to the measurement and description of properties for classification of the vinyl siding material in response to flame under controlled laboratory conditions and shall not be used for the description or appraisal of the fire hazard of vinyl siding under actual fire conditions.)

4.2 *Foam Plastic Insulation:*

4.2.1 The foam plastic insulation shall be made of one of the following materials:

4.2.1.1 Expanded polystyrene complying with Specification C578.

4.2.1.2 Extruded polystyrene complying with Specification C578

4.2.1.3 Polyisocyanurate complying with Specification C591 or Specification C1289

4.2.2 The foam plastic insulation shall have a Flame Spread Index not greater than 75 and a Smoke Developed Index not greater than 450 when tested separately under Test Method E84.

4.3 *Adhesives:*

4.3.1 The suitability for outdoor use of an adhesive used to bond the vinyl siding and the insulation, if any, shall be determined by the following procedure.

4.3.1.1 Prepare a minimum of 10 specimens consisting of two Douglas fir-larch blocks or other appropriate substrates, bonded by the adhesive, in accordance with Test Method C297/C297M. Each block is to be 2.0 inches square. The adhesive shall be applied and cured in accordance with the adhesive manufacturer's instructions.

(1) The material selected for use as the substrate shall be capable of withstanding the accelerated aging described in 4.3.1.2 without damage or deterioration of the substrate.

NOTE 3—Other appropriate substrates, such as metal or plastic, compatible with the adhesive according to the manufacturer's guidelines, can be used in place of the Douglas fir-larch blocks. Because in accordance with 4.3.1.4.1 at least 75 % of samples must fail in a cohesive mode, a substrate should be selected that is expected to be stronger than the adhesive and which will form a tight bond with the adhesive.

4.3.1.2 Subject 50 percent of the specimens to accelerated aging under Test Method D1183, Test Condition C, for three cycles. The low-temperature portion of the cycle is not required to be colder than -40°F (-40°C) and the relative humidity during this portion of the cycle shall not be greater than 10 % RH.

4.3.1.3 Condition and test all of the specimens in accordance with Test Method C297/C297M.

4.3.1.4 *Acceptable Performance*—Acceptable performance of the adhesive is demonstrated by one of the following means:

(1) When tested in accordance with 4.3.1.3, the samples demonstrate performance in accordance with either (*a*), (*b*), or (*c*).

(a) For a valid test, the mode of failure for no fewer than 75 % of the specimens shall be cohesive. Only specimens that failed cohesively are counted in the following. The average ultimate tensile strength of the samples that were subjected to accelerated aging shall not be less than 80 % of the average ultimate tensile strength of the specimens that were subjected to conditioning only.

(b) None of five aged specimens fails cohesively under a tensile load less than or equal to 100 psi at a pull rate (crosshead speed) of 0.02 in./min. Only specimens that fail cohesively or do not fail are counted. Specimens that fail non-cohesively under a load at or below 100 psi are discarded and another specimen is tested until five specimens have either failed cohesively, or have not failed at or below 100 psi. Adhesives qualified under this method are limited to use with foam insulation having a tensile strength not greater than 100 psi.

(c) The following applies when the average elongation at yield of the specimens that were subjected to conditioning only is 200 % or greater: the average stress of the aged specimens is not less than 80 percent of that of the specimens that were subjected to conditioning only, when measured at an elongation 75 % of the elongation at yield for each specimen.

(2) As an alternative, adhesives that are covered by a current report, issued by an agency accredited under ISO Guide 65, as a Type I, Class 2 adhesive in accordance with Acceptance Criteria AC05, will have exhibited acceptable performance under the above procedure.

NOTE 4—Compatibility of the adhesive with the vinyl siding and insulation used in the insulated vinyl siding is evaluated separately, under 5.2.4.

4.4 *Insulated Vinyl Siding:*

4.4.1 Insulated vinyl siding shall not contain elemental lead (Pb) or compounds of that material other than traces incidental to raw materials or the manufacturing process. This limitation applies to both PVC substrate and to any cap or film material, as well as the insulation material. Compliance with this requirement shall be demonstrated by one of the methods in 6.16.

5. Physical Requirements

5.1 *Requirements Applicable to Vinyl Siding*—The provisions of 5.1.1 – 5.1.8 apply only to the vinyl siding, exclusive of any insulation material. Where necessary to perform testing, the insulation material shall be removed.

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5.1.1 *Length and Width*—The actual length shall not be less than ¼ in. (6.4 mm) of the nominal length and the actual width shall be within ±1⁄16 in. (1.6 mm) of the nominal width when measured in accordance with 6.3 and 6.4.

5.1.2 *Thickness*—These requirements pertain only to measurements of the portions of the vinyl siding that are exposed after installation of the panel, measured in accordance with the procedure in 6.5. The average thickness of each specimen shall be no less than 0.035 in. No individual measurement shall be thinner than 0.003 in. below the nominal thickness. The process average thickness as defined in 3.1.6 shall be no thinner than 0.001 in. below the nominal thickness.

5.1.3 *Camber*—A full length of vinyl siding (typically 10 or 12 ft (3.05 or 3.61 m)) shall not have a camber greater than ⅛ in. (3.2 mm) when measured in accordance with 6.6.

5.1.4 *Heat Shrinkage*—The average heat shrinkage shall not exceed 3.0 % when determined by the method described in 6.7.

5.1.5 *Impact Resistance*—The vinyl siding shall have a minimum impact strength of 60 in.•lbf (6.78 J) when tested in accordance with 6.8.

5.1.6 *Gloss*—The gloss of smooth and embossed vinyl siding shall be uniform across the exposed surface. The average of all readings for a panel determined in 6.11.2.5 shall not differ from the manufacturer's specified gloss value more than the permitted variation in Table 1, and each individual reading shall not vary more than 10 points from the average. Gloss of smooth and embossed vinyl siding shall be tested in accordance with 6.11.

5.1.7 *Uniformity of Color*—The color specified shall be uniform on the exposed surface of the vinyl siding panels, except in the case of variegated colors. When tested in accordance with 6.13, the total color change, ΔE, between a production specimen and the appropriate reference specimen or agreed-upon color coordinates shall not vary by more than 1.5, and the chromatic coordinates thereof shall not change by more than $\pm\Delta a_H = 1.0$ and $\pm\Delta b_H = 1.0$.

5.1.8 *Weathering*—The vinyl siding shall maintain a uniform color and be free of any visual surface or structural changes such as peeling, chipping, cracking, flaking, and pitting when tested in accordance with 6.10.

5.1.9 *Coefficient of Linear Expansion*—The vinyl siding shall have a coefficient of linear expansion not greater than 4.5 by 10^{-5} in./in./°F (8.1 by 10^{-5} mm/mm/°C) when tested in accordance with 6.9.

5.2 *Requirements Applicable to Insulated Vinyl Siding*—The provisions of 5.2.1–5.2.5 apply to insulated vinyl siding, including the integral foam insulation material. Testing shall be conducted on both the vinyl siding and the insulating material, or with the insulating material in place, as described in the referenced test method.

TABLE 1 Gloss Values

Manufacturer's Specified Gloss Value	Permitted difference from Manufacturer's Specified Gloss Value
Less than or equal to 35	±8
Greater than 35	±10

5.2.1 *Thermal Distortion*—The insulated vinyl siding shall be free of bulges, waves, and ripples, and an overlap shall not open more than ¼ in. (6 mm) when tested to a minimum temperature of 150°F (66°C) in accordance with the procedure in 6.12.

5.2.2 *Wind Load Resistance*—The siding shall withstand a minimum static test pressure and a standard wind load design pressure rating shall be determined.

5.2.2.1 *Minimum Test Pressure*—Insulated vinyl siding shall be able to withstand a minimum test pressure of 22.5 lbf/ft^2 (1077 Pa) when tested in accordance with 6.14. The average maximum sustained static pressure determined in 6.14 shall be equal to or greater than this value. If the manufacturer of insulated vinyl siding provides documentation to support compensation for pressure equalization, the test pressure shall be determined from Annex A1 using the documented pressure equalization factor.

NOTE 5—The static test pressure of 22.5 lbf/ft^2 (1077 Pa) for insulated siding was established to withstand structural loading conditions that occur in wind exposures of approximately 110 mph (177 km/h) (V_{ASD}) for mean roof heights of 30 ft (9.1 m) and less in exposure category B, and corresponds to 30.0 lbf/ft^2 (1436 Pa) negative design pressure, to match the default wind design conditions of Table R703.3(1) in the 2015 International Residential Code. Provision is made for compensation for pressure equalization specific to the product if supporting documentation is provided, using procedures in Annex A1.

NOTE 6—Refer to Annex A1 for an explanation as to how the negative design pressure was established, and for applications where the effective negative design pressure as specified in ASCE 7-10 is different from 30.0 lbf/ft^2 (1436 Pa) (for example, wind-zone areas greater than about 110 mph (177 km/h) (V_{ASD}) (225 km/h (V_{ULT})) or mean roof height above 30 ft (9.1 m), or exposures other than exposure category B).

(1) The design-pressure values can be negative (suction loads) or positive. The negative values are the largest in magnitude and are the values used in this specification.

NOTE 7—In that the insulated vinyl siding is being tested as a weather-resistant exterior product applied to an existing exterior structural wall, forces (negative) working to pull the insulated vinyl siding off the wall, fasteners, or disengage locks will be the most important criteria for testing. Positive wind forces test the integrity of the total wall sections, and do not provide a measure of the performance of the insulated vinyl siding.

5.2.2.2 *Standard Wind Load Design Pressure Rating*—The standard wind load design pressure rating shall be determined from the results of testing in accordance with 6.14, using the procedures described in A1.3.

NOTE 8—The standard design pressure rating is valid for applications where the siding is installed over sheathing and its fastening that are capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location. For applications over other sheathing, a different design pressure rating is applicable, and is determined in accordance with A1.3. Determination of a rating other than the standard design pressure rating is not required by this section.

5.2.2.3 *Alternative Design Pressure Ratings*—Design pressure ratings other than the standard wind load design pressure rating, for use with different sheathing materials or using different installation or fastening, are permitted to be determined in accordance with testing under 6.14, using the procedures in Annex A1.

5.2.3 *Nail Slot Allowance for Thermal Expansion*—For vinyl siding panels utilizing nail slots to allow for thermal

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expansion and contraction, the nail slot shall be sized to allow for the expected range of expansion and contraction over a range of 100°F. Compliance with this requirement shall be demonstrated either by the test method in 6.15 or by sizing of the nail slots according to the specifications in the following sections. The instrument used shall be capable of measuring to the nearest 0.01 in. The manufacturing tolerance shall not exceed -0.030 inches.

5.2.3.1 For panels shorter than 6 ft (1829 mm) in length, the minimum nail slot width shall be ⅜ in. (11.4 mm).

5.2.3.2 For panels 6 ft (1829 mm) in length or longer the minimum nail slot width shall be determined according to the following formula. The minimum width shall be the width resulting from application of the formula, rounded to the next lower quarter-inch. Regardless of the results of the calculation, the minimum nail slot width for panels 6 feet or longer shall be 1 in. (25.4 mm).

$$WS = P_c \times (\alpha \times 100°F \times L) + T_c \quad (1)$$

where:

WS = Minimum width of nail slot, in.
P_c = Center-pinning coefficient: 1 if manufacturer's instructions require panel to be center-pinned; 1.5 if center-pinning is not required
α = Coefficient of linear thermal expansion, 4.5×10^{-5} in./in./°F or actual known coefficient for vinyl siding used, as determined by 6.9
L = Length of panel, inches
T_c = Centering tolerance: 0.25 in.

5.2.4 *Compatibility of Adhesives*—When subjected to cyclical conditioning and tested in accordance with 6.17, samples composed of the vinyl siding and insulation bonded with the adhesive, if any, used in the insulated vinyl siding shall not exhibit a decrease in average ultimate tensile strength greater than 20 %, compared to samples not subjected to cyclical conditioning. This requirement is not applicable to insulated vinyl siding that does not contain any adhesive.

5.2.5 *Thermal Insulation Value*—The thermal insulation value (R-value) of the insulated vinyl siding shall be not less than R-2.0 when measured in accordance with 6.18.

5.2.6 *Flame Spread*—Insulated vinyl siding shall have a Flame Spread Index not greater than 200 when tested underin accordance with 6.19.

6. Test Methods

6.1 *General*—The inspection and test procedures contained in this section are used to determine the conformance of products to the requirements of this specification.

NOTE 9—Each producer who represents its products as conforming to this specification typically uses statistically based sampling plans that are appropriate for each manufacturing process to verify on-going compliance. Specifications for quality control programs are beyond the scope of this Standard Specification.

6.2 *Conditioning and Test Conditions*—Condition the test specimen in accordance with Procedure A of Practice D618 and test under those conditions, unless otherwise specified herein.

6.3 *Length*—Lay the specimen on a flat surface and measure with a steel tape that has been verified as accurate to within ±1⁄16 in. (1.6 mm) against a calibrated standard. Measure the length of a vinyl siding panel to the nearest 1⁄16 in. (1.6 mm) at the center, the butt edge, and the bottom of the top lock. The average of the three measurements is the actual length.

6.4 *Width*—Interlock two specimens, each at least 26 in. (660 mm) long, in the normal mode for installation. Lay the two specimens on a flat surface. Measure to the nearest 1⁄16 in. (1.6 mm), the distance between the lowest butt edge of the top specimen and the lowest butt edge of the bottom specimen. Commencing approximately one in. (25 mm) from one end of the specimens, make five measurements at 6-in. (152-mm) intervals, making sure that the measurement is made perpendicular to the butt edge. Average the measurements. The average constitutes the exposed width of vinyl siding.

6.5 *Thickness*—Thickness shall be measured in accordance with Test Method A of Test Method D5947. The micrometer shall be calibrated in accordance with Section 8 of Test Method D5947. The thickness of the vinyl siding shall be measured at a minimum of five locations equally spaced across the entire portion of the vinyl siding that will be exposed after installation. All measurements shall be taken to the nearest 0.001 in. Calculate and report the average of these measurements. Also report the thinnest individual measurement.

6.6 *Camber*—Place a full length of vinyl siding (typically 10 or 12 ft (3.05 or 3.61 m)) on a flat surface alongside a straightedge at least as long as the vinyl siding specimen. Measure the maximum space between the edge of the vinyl siding specimen and the straightedge for each edge to the nearest 1⁄16 in. (1.6 mm).

6.7 *Heat Shrinkage:*

6.7.1 *Apparatus:*

6.7.1.1 *Scriber,* similar to that described in Test Method D1042, with the exception that the needle points shall be separated by 10 ± 0.01 in. (254 ± 0.254 mm).

6.7.1.2 *Test Media,* a controlled-temperature water bath of 5 gal (10 L) or more, equipped with an efficient stirrer that will maintain uniform temperature throughout. Heater and temperature-control devices must maintain the water at 160 ± 1°F (71 ± 0.5°C). Use a wire rack to raise and lower specimens into the water bath. As an alternative to the use of a water bath, heat the specimens for 30 min in a uniformly heated forced-air oven maintained at a temperature of 160 ± 1°F (71 ± 0.5°C).

6.7.1.3 Make measurements with any device capable of measuring the distance between two scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2 *Procedure:*

6.7.2.1 Cut three specimens from the vinyl siding panel, each 1 in. (25.4 mm) wide by 12 in. (305 mm) long. Cut one specimen from the center and one from each of the extreme edges of the flat surface. The long axis shall be parallel to the machine direction.

6.7.2.2 Condition specimens at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 10 % relative humidity for at least 24 hours.

6.7.2.3 Make a slight mark with the scribe on each specimen so that a reference point will be clearly visible.

6.7.2.4 Place specimens in the test medium.

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6.7.2.5 Remove specimens after 30 min and place on a flat surface until cool.

6.7.2.6 Repeat conditioning in accordance with 6.7.2.2.

6.7.2.7 Make a second mark with the scribe on each specimen, using the same center.

6.7.2.8 Measure the distance, D, between the scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2.9 Calculate the percent shrinkage as (D/10) × 100.

6.7.2.10 Report the average shrinkage of the three specimens tested.

6.8 *Impact Resistance*—Test impact resistance of vinyl siding in accordance with Test Method D4226, Procedure A, impactor head configuration H.25. 4 in.-lb increments (0.5 in. height increments with 8 lb falling weight) shall be used. Minimum sample dimensions shall be 1.5 by 1.5 in. Samples shall be tested with the normally exposed surface facing up. Insulated vinyl siding shall be tested with any insulation material removed. Conditioning time for quality-control tests shall be at least one hour.

6.8.1 For purposes of evaluating failure of the specimen under subsection 3.2.1 of Test Method D4226, a ductile tear of less than 0.2 in. (5 mm) in length shall not be considered a failure. Any brittle break of any dimensions is considered a failure.

6.9 *Coefficient of Linear Expansion*—Conduct this test in accordance with Test Method D696, separately for samples of the vinyl siding and samples of the insulation.

6.9.1 *Alternative Specimen Preparation for Vinyl Siding Samples*—Specimens prepared from strips cut from extruded vinyl siding are permitted to be used in testing under Test Method D696. Where such specimens are used, they shall be cut with the long dimension parallel to the long axis of the vinyl siding panel. Guides shall be used in accordance with Test Method D696 to prevent bending or twisting of the specimen in the dilatometer.

6.10 *Weatherability:*

6.10.1 A minimum of three samples shall be exposed at each of at least three test sites. Test sites shall be located in a northern temperate climate, represented by Cleveland, Ohio or Louisville, Kentucky; a hot, humid climate represented by Miami, Florida; and a hot, dry climate represented by Phoenix, Arizona. The samples shall be exposed for a minimum of 24 months.

6.10.2 Samples shall consist of a flat section of vinyl siding with minimum dimensions of 2 by 3¾ in. (25 by 95 mm).

6.10.3 Samples shall be representative of the product to be evaluated. Samples shall be taken either from commercial products or from laboratory samples. Laboratory samples shall be produced in the same manner as the commercial products to be evaluated.

NOTE 10—Production of laboratory samples in the same manner includes use of the same method of forming the product. For example, if the commercial product is extruded, the laboratory specimen shall be extruded; if the commercial product is injection molded, the laboratory specimen shall be injection molded, and so forth.

6.10.4 Select a minimum of four specimens per sample per test site to allow for three test specimens and one file specimen for each sample evaluated.

6.10.5 Mark each specimen permanently to ensure retention of identity during and after exposure testing.

NOTE 11—Use of a vibrating engraver leaves a permanent mark that satisfies this criterion.

6.10.6 All exposures shall be conducted at an angle of 45° South, plywood-backed, in accordance with Practice D1435 and G147.

6.10.7 After a minimum of 24 months of exposure, remove the samples and inspect each exposed test specimen for appearance and surface condition. Record observations and inspection date in a permanent record.

6.11 *Gloss:*

6.11.1 *Apparatus*—Measure gloss using a 75° geometry glossmeter that meets the requirements of the Apparatus section of Test Method D2457.

6.11.2 *Procedure:*

6.11.2.1 Gloss measurements shall be made in accordance with the procedure in Section 9 of Test Method D2457, unless otherwise specified herein.

6.11.2.2 Measure gloss on one piece of vinyl siding on at least three widely separated sections across the width of the exposed surface of the panel. At least one reading shall be taken on each face of the panel. Use a new surface area for each reading to avoid scratches caused by instrument contact. The area tested must be flat. If a flat area on the exposed surface cannot be found due to the style or depth of embossing of the panel being tested, then a non-exposed area of the panel shall be chosen in its place. Such locations shall be representative of the gloss of the area that will be exposed after installation.

6.11.2.3 Measure gloss parallel to the direction of embossing. When the embossing pattern is not apparent, measure the gloss in the direction of extrusion.

6.11.2.4 Each reading shall be within the appropriate limit specified in 5.1.6.

6.11.2.5 The average of all readings shall be used to represent the gloss of the sample.

6.12 *Thermal Distortion:*

6.12.1 *Test Specimen/Apparatus:*

6.12.1.1 The test specimen shall consist of three courses of insulated vinyl siding, a minimum of 6 ft (1.83 m) in length, mounted on a flat, rigid frame in accordance with the manufacturer's installation instructions.

(1) Horizontal Siding—The middle course shall consist of two lengths of insulated vinyl siding, both with a factory-fabricated end, one section overlapping the other section. The end of the overlapping section shall be located not less than 3 in. (76 mm) and not more than 6 in. (152 mm) from the center of the course. Unless specified otherwise by the manufacturer's installation instructions, the insulation of the two lengths of insulated vinyl siding shall be butted firmly together.

(2) Vertical Siding—The middle course shall consist of a single, uninterrupted insulated vinyl siding panel, without overlap.

6.12.1.2 A thermocouple or other heat-sensing element shall be located at the horizontal midpoint of the back side of the middle course of insulated vinyl siding. The heat-sensing

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element shall be in contact with the back of the vinyl cladding. Any insulation or backing material removed to facilitate placement of the heat sensing element shall be replaced.

6.12.1.3 Radiant-heat rod, 600 W for each linear foot (0.31 m), mounted parallel to the middle course and approximately 32 in. (810 mm) away from the surface of the insulated vinyl siding.

6.12.1.4 Temperature-control device, used to regulate the temperature of the radiant-heat rod, shall be able to maintain the conditions specified in 6.12.2.1.

6.12.1.5 Gap measurement device. A cylindrical pin gauge, ¼ ± 0.005 in. (6 ± 0.127 mm) in diameter is used to evaluate the size of any gap in the overlapped sections of horizontal insulated vinyl siding during the heating period. The pin gauge is attached to a rod such that the gauge can be inserted into a gap while held parallel to the plane of the insulated vinyl siding. The rod shall be sufficiently long to permit insertion of the gauge from beyond the edge to the test frame, not interfere with the exposure of the sample to radiant heat, and otherwise not interfere with conduct of the test.

6.12.2 *Procedure:*

6.12.2.1 Heat the test panel (middle course of insulated vinyl siding) at a rate of 3.0 to 6.0°F/min (1.7 to 3.3°C/min) until a minimum temperature of 150°F (66°C) is achieved as measured by the heat-sensing element on the midpoint of the backside of the middle course. For temperatures equal to or greater than 130°F (54°C), the rate of heating is permitted to be not less than 2.0°F/min (1.1°C/min), provided that the average heating rate from the ambient temperature to 150°F (66°C) is within 3.0 to 6.0°F/min (1.7 to 3.3°C/min). When a temperature of 150°F (66°C) is attained, shut off the heat source.

6.12.2.2 During this heating period, observe the middle course of the insulated vinyl siding for surface distortion and observe for any opening or gap at the end of the overlapped section. If the overlap appears to have opened to approximately ¼ in. (6 mm), attempt to insert the gap measurement device into the opening. If the device can be inserted into the opening to any depth at any location along the overlap, the opening shall be considered to be at least ¼ in. (6 mm).

6.12.2.3 *Failure is defined as:*

(1) the appearance of bulges, waves, or ripples on any surface of the middle course of the insulated vinyl siding; or

(2) occurrence of a gap or opening ¼ in. (6 mm) or greater at any point along the end of the overlapped section, as determined by use of the gap measurement device, at any time before a temperature of 150°F (66°C) is reached.

6.13 *Color Uniformity*—Calculate the difference between the L_H, a_H, and b_H color coordinates for a production specimen to those of either the appropriate reference specimen or the agreed upon color coordinates for that specific color product in accordance with Test Method D2244. Calculate the total difference ΔE between the production specimen and the reference specimen in accordance with Test Method D2244.

6.14 *Wind Load Resistance*—Conduct the test on wind load resistance of finished insulated vinyl siding in accordance with Test Method D5206. The average maximum sustained static test pressure determined from this testing is used in 5.2.3. For purposes of determining compliance with the minimum test pressure and standard design pressure requirements in 5.2.3, the test structure shall be constructed with vertical studs 16 inches on center. The siding shall be tested with insulation attached to the vinyl siding. The siding in the test installation shall be installed over wood sheathing with a nominal thickness of 7/16 to ½ inch, and fastened as follows:

6.14.1 *Fastener Type*—Roofing nail, smooth shank, 0.120 in. (⅛ in. nominal; 3.2 mm) shank diameter, 5/16 in. (7.9 mm) head diameter, length as necessary to penetrate into sheathing and stud a total of 1 ¼ in. (32 mm). For vertical siding, length as necessary to penetrate the thickness of the sheathing plus ¼ in. (6.4 mm).

6.14.2 *Fastener Spacing*—Every 16 in. (406 mm) into center of stud for horizontal siding. For vertical siding, every 12 inches into sheathing only.

6.14.3 Fasteners shall not be driven tightly against the siding. Allow approximately 1/32 in. (0.8 mm) clearance between the fastener head and siding surface.

NOTE 12—The installation details described 6.14 conform to the minimum requirements of the 2015 International Residential Code and the VSI Vinyl Siding Installation Manual.

6.15 *Nail Slot Allowance for Thermal Expansion*—As an alternative to conformance with the nail slot width specification in 5.2.3.1 or 5.2.3.2, provision for thermal expansion and contraction shall be demonstrated through the following test procedure.

6.15.1 *Samples*—At least three samples of each profile in which the insulated vinyl siding is produced shall be provided. The length of each sample shall be at least 50 % of the longest length in which the profile is produced, and not shorter than 12 ft (3658 mm).

6.15.2 *Test Chamber*—The test chamber shall consist of an environmentally controlled room or compartment capable of providing an air temperature range of at least 0 to 100°F (-18 to 38°C) without exposure of the panel to radiant energy from heating or cooling elements. Air temperature shall be controlled such that a rate of temperature change of 2°F (1.11°C) per minute can be achieved over the full temperature range, and the minimum and maximum temperatures can be maintained for at least 15 minutes. Means for circulating air to provide a uniform air temperature throughout the chamber shall be provided. A vertical wall shall be provided for mounting of samples. The wall shall be insulated such that, with no panels mounted, the inner surface of the wall does not deviate more than 10°F (5.5°C) from the air temperature at the high and low temperature extremes after a holding period of five minutes. The test chamber shall be of sufficient size to accommodate the longest panel to be tested, including expected thermal expansion of the panel. Means shall be provided to measure the actual temperature of the surface of each panel at a minimum of three evenly-spaced locations along the length of the panel.

6.15.3 *Length Measurement*—A means for measuring the length of each sample throughout the temperature range shall be provided. The method utilized for length measurement shall not be influenced by the temperature of the chamber and shall have a minimum resolution of no greater than 0.0625 in. (1.59 mm).

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6.15.4 *Procedure*—Install the sample panels on the wall inside the test chamber, following the manufacturer's instructions for fastener type, spacing, location and tightness. At ambient temperature measure and record the length of each panel and the temperature of the panel, averaged from a minimum of three locations along the length of the panel.

6.15.4.1 *Test Cycle*—Test cycles shall be performed by raising the air temperature to 100 ± 5°F (38 ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding the air temperature at 100°F (38 ± 2.75°C) for 15 minutes, lowering the air temperature to 0 ± 5°F (-18 ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding at 0°F (-18 ± 2.75°C) for 15 minutes, and returning to ambient temperature at an average rate of 2°F per minute.

6.15.4.2 *Conditioning*—Close the test chamber and perform at least two conditioning cycles using the procedure in 6.15.4.1. No interruption is required between conditioning cycles.

6.15.4.3 *Test*—Following completion of the conditioning cycles, conduct three test cycles using the procedure in 6.15.4.1. It is acceptable for the test cycles to follow immediately upon completion of the final conditioning cycle, and no interruption is required between test cycles. After a minimum holding period of 15 minutes at the high and low extremes of each test cycle, measure and record the length of each panel and the temperature of the panel, averaged from a minimum of three locations along the length of the panel.

6.15.5 *Normalization*—From among the length measurements recorded for all three cycles, identify the shortest and longest length of each panel, and the average panel temperature at the time that length was recorded. Determine the maximum difference in length, ΔL, and the maximum difference in temperature, ΔT, by subtracting the smaller from the larger. Normalize the change in length to the full length of the panel over a 100°F (38°C) temperature range using the following formula:

$$E_t = \Delta L \times (100/\Delta T) \times (L_f/L_t) \quad (2)$$

where:

E_t = Total thermal expansion and contraction of a full length panel over a range of 100°F (38°C)
ΔL = maximum change in length of the tested panel,
ΔT = maximum change in temperature of the tested panel,
L_f = longest length in which the panel is produced, and
L_t = actual length of the panel as tested.

6.15.6 *Acceptable Performance*—When tested according to this procedure, the result of ($E_t \times 2$) + 0.25 in. for each of the three samples for each profile shall not be greater than the width of the nail slot. If the manufacturer's installation instructions require the panel to be center-pinned, the result of E_t + 0.25 in. for each of the three samples for each profile shall not be greater than the width of the nail slot.

6.16 *Lead Content:*

6.16.1 Testing for lead content shall be conducted on insulated vinyl siding using a rhodizinate-type lead swab test kit conforming to Practice E1753. Testing shall be performed in accordance with the test kit manufacturer's instructions. The insulated vinyl siding shall be deemed to comply with 4.4.1 if the test shows a negative or not-detected result; that is, the test does not indicate the presence of lead. The test shall be conducted separately on the substrate and on any cap or film material, and on the insulation material.

6.16.2 As an alternative to the method in 6.16.1, and as a means of resolving any ambiguous results from that method, an analytical method capable of detecting lead at least as low as 0.02 percent by sample weight shall be employed. Under this alternative, neither the substrate nor any cap or film shall contain a concentration of lead in excess of 0.02 percent by weight.

6.17 *Compatibility of Adhesives:*

6.17.1 *Sample Preparation*—Combine a flat, 2 by 2 in. section of vinyl siding with a 2 by 2 by 0.75 in. sample of insulation, using the adhesive used in the insulated vinyl siding. The top and bottom surfaces of the insulation are to be parallel. The application rate, thickness, and distribution of the adhesive are to be consistent with its application in the insulated vinyl siding. Prepare a total of at least ten such samples.

6.17.2 *Cyclical Conditioning*—Subject half of the samples to the following conditioning. In an appropriate environmental conditioning chamber, starting at room temperature, increase the temperature of air surrounding the sample to 150°F (66°C) and hold for 15 minutes. Over a period of time not greater than 15 minutes, decrease the surrounding air temperature to -10°F (-23°C), and hold for 15 minutes. Return the surrounding air temperature to 150°F (66°C) over a period of time not greater than 15 minutes. This cycle is repeated for a total of 30 cycles.

6.17.2.1 *Tensile Testing*—Condition and test all of the samples in accordance with Test Method C297/C297M Any of the failure modes listed in Test Method C297/C297M (other than failure at the bond to the loading blocks) shall be counted in calculating the average ultimate tensile strength. Separately determine the average ultimate tensile strength for the samples subjected to cyclical conditioning, and for those not subjected to such conditioning.

6.18 *Thermal Insulation Value*—The thermal insulation value for the insulated vinyl siding shall be determined in accordance with Test Method C1363. Test conditions, test sample selection, configuration and installation, and procedure shall be as specified in the following sections.

6.18.1 *Wind Direction and Velocity*—Testing of the base wall and insulated vinyl siding samples shall be with the exterior wind direction perpendicular to the plane of the test wall. The calibration procedure in Section 6 of Test Method C1199 shall be used to establish standard room and weather side surface heat transfer coefficients.

6.18.2 *Test Temperatures*—Testing shall be performed at an exterior temperature of 50°F and an interior temperature of 100°F.

6.18.3 *Base Wall*—The base wall for attachment of the insulated vinyl siding shall provide for overall test sample dimensions of 96 ± 6 in. (2438 ± 152 mm) in both the vertical and horizontal axis. The construction of the wall shall be sufficient to hold the test installation without flexing under the imposed wind. The weather side surface of the base wall shall include a solid surface composed of uniform sheet material

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capable of securely holding standard roofing nails or the fasteners specified by the manufacturer for installation of the insulated vinyl siding under test. The wall shall be fully sealed to prevent movement of air between the chambers.

NOTE 13—The precise materials and construction of the base wall are not specified because its thermal characteristics will be directly measured to establish baseline conditions from which the performance of the insulated vinyl siding alone can be distinguished. A standard framed wall composed of nominal 2 by 4 in. studs on 16 in. (406 mm) centers, covered by nominal ½ in. plywood or oriented strand board (OSB) has been found to be suitable for most test applications.

6.18.4 *Sample Selection*—reserved for any requirements needed for specifying the sample to be used, how many replicates, etc. (if needed).

6.18.5 *Test Installation*—The area covered by the insulated vinyl siding shall be 96 ± 6 in. (2438 ± 152 mm) in both the vertical and horizontal axis. The test installation shall be composed of the number of insulated vinyl siding panels needed to cover the test installation area, and any siding accessories normally used for installation of that insulated vinyl siding.

6.18.5.1 *Overlaps*—The test installation shall include both courses that cover the full width of the test wall with a single panel, and courses composed of two or more adjacent, overlapping panels. The number of courses containing overlapped panels shall be as specified below.

(1) Panels shorter than full width of the test wall—Where the insulated vinyl siding is commercially available in panels shorter in length than the full width of the testing installation, each course shall contain adjacent, overlapped panels. For panels equal to or longer than one-half the test installation width, each course shall contain two panels, with one joint between them. For shorter panels, the number of panels and joints per course is determined by the length of the panels and the overlapping of panels specified in the manufacturer's installation instructions.

(2) Vertical Siding—The test installation for vertical insulated vinyl siding shall contain no overlap joints.

(3) Horizontal Siding—The number of courses with overlap joints for horizontal insulated vinyl siding shall be based on the vertical coverage of the profile, in accordance with Table 1 or the following formula. For test walls with a insulated vinyl siding installation height other than 96 in (2438 mm), or for insulated vinyl siding profiles not listed in Table 2, the number of courses with overlap joints shall be determined according to the following formula:

$$L = 0.375\left(\frac{H}{V}\right) \quad (3)$$

where:

L = Number of courses with overlap joints in test installation; rounded to the nearest integer
H = Height of test installation, inches
V = Vertical coverage of one panel, inches

(4) The specified number of courses with overlaps joints shall be evenly distributed vertically across the test installation. Adjacent courses shall not contain overlap joints.

TABLE 2 Courses with Overlaps Joints

Siding Type	Vertical Coverage (in.)	Number of Courses Including Overlaps
Single 6.5	6.5	6
Single 7	7	5
Double 4	8	5
Single 8	8	5
Double 4.5	9	4
Triple 3	9	4
Double 5	10	4
Quad 2.5	10	4
Double 6	12	3
Triple 4	12	3
Double 6.5	13	3
Double 7	14	3
Quad 4.5	18	2
Triple 6	18	2

6.18.5.2 The bottom edge of the insulated vinyl siding shall be secured with a starter strip or equivalent trim specified by the manufacturer. The sides and top edge of the insulated vinyl siding shall be bound by J-channels or equivalent trim specified by the manufacturer.

6.18.5.3 The insulated vinyl siding and trim shall be installed in the order in which they are installed in the field, in accordance with the manufacturer's installation instructions. Fastening of the insulated vinyl siding and trim to the wall shall be as specified in the manufacturer's installation instructions.

6.18.5.4 *Sealing of Test Installation*—No part of the test installation, including insulated vinyl siding panels, joints, overlaps and perimeter, shall be sealed other than by the means integral to manufacturer-supplied siding panels or trim. Any actions specified in the manufacturer's installation instructions to secure or enable an integral sealing means shall be carried out.

6.18.6 *Procedure*—Conduct a test of the base wall alone, with no insulated vinyl siding installed, in accordance with Test Method C1363. Determine the R-value of the base wall. Install the insulated vinyl siding and conduct a test under the same conditions, and determine the R-value of the base wall-insulated vinyl siding assembly. Determine the R-value of the insulated vinyl siding by subtracting the R-value of the base wall alone from that of the base wall-insulated vinyl siding assembly. Report the R-value of the insulated vinyl siding, rounded to the nearest tenth.

6.18.6.1 Reuse of the R-value determined for the base wall is permitted for subsequent tests of insulated vinyl siding. The R-value of the base wall shall be reestablished by testing if the test configuration is changed, the base wall has been removed and reinstalled, ambient temperature or humidity has changed or fluctuated significantly, or any other event has occurred that is likely to affect the R-value of the base wall.

6.19 *Flame Spread*—Conduct the test on flame spread of finished insulated vinyl siding in accordance with Test Method E84. The test specimen shall either be self-supporting by its own structural characteristics or held in place by added supports along the test specimen surface, or secured from the back side.

7. Packaging and Package Marking

7.1 The insulated vinyl siding shall be packed in such a manner as to provide reasonable protection against damage in ordinary handling, transportation, and storage.

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7.2 Provisions of Practice D3892 shall apply to this specification.

7.3 To aid identification of insulated vinyl siding conforming to all requirements of this specification, producers and distributors shall include a statement of compliance in conjunction with their name and address on product labels, invoices, sales literature, and the like. The following statement is suggested when sufficient space is available: "This insulated vinyl siding conforms to all the requirements established in ASTM Specification D7793 developed cooperatively with the industry and published by ASTM. Full responsibility for the conformance of this product to the specification is assumed by (name and address of producer or distributor)."

7.4 The following abbreviated statement is suggested when available space on labels is insufficient for the full statement: "Conforms to ASTM Specification D7793 (name and address of producer or distributor)."

7.5 The package shall be marked or labeled with the R-value determined in 6.18.

NOTE 14—Marking or labeling done in compliance with 16 CFR Part 460 will normally satisfy this requirement. That and other government regulations may require additional information and statements which are not required by this standard.

7.6 The standard wind load design pressure rating determined in accordance with 5.2.3.2 shall be stated on the product or on the product package by one of the means in 7.6.1 or 7.6.2.

7.6.1 The package shall be marked or labeled with the standard wind load design pressure rating. The marking shall be in the format "Standard Wind Load Design Pressure Rating: ##.# psf (ASD)".

7.6.2 The standard design pressure rating shall be included on a line imprint or other marking on the front (outward-facing) surface of all siding panels. It is not required that the marking be visible after installation, provided that the marking can be revealed and read by detaching the lower edge lock of an adjacent course, without removal of any fasteners. The standard design pressure marking shall be stated at least once per panel. The marking shall be in the format "Std Design Pressure Rating: ##.# psf (ASD)".

7.6.3 At the option of the manufacturer, additional marking or labeling of the package or product with alternative wind load design pressure ratings determined in accordance with 5.2.2.3 for use with alternative sheathings, wall configurations or fastening methods is permitted. The marking shall use the format specified in 7.6, shall indicate the type of sheathing or wall configuration for which it is applicable, and shall refer to the manufacturer's instructions for more information and any installation requirements.

8. Keywords

8.1 insulated siding; insulated vinyl siding; plastic building products; plastic weatherability; recycled plastic; rigid PVC siding; specification; vinyl siding

ANNEX

(Mandatory Information)

A1. WIND LOAD RESISTANCE TEST DESIGN FACTORS

A1.1 Wind Load Criteria

A1.1.1 ASCE 7-10 is the basis for determining the design pressures used in this specification. Design wind loads are determined on an ASD basis in this specification.

NOTE A1.1—In previous editions of ASCE 7, wind loads were determined using wind speed maps based on a 50-year return period. In ASCE 7-10, maps based on a 700-year return period are used which, for any given location, produce a wind speed approximately 30 % greater than that of the previous maps. This larger magnitude (higher return period) wind speed, referred to as the ultimate wind speed, (V_{ULT}), is used directly (with a load factor of 1.0) to determine nominal wind loads on a Strength Design (LRFD) or "ultimate" wind load basis. When Allowable Stress Design (ASD) is used, ASCE 7-10 provides for these ultimate wind loads, determined from the ultimate wind speed map velocities, to be multiplied by a load factor of 0.6. Alternatively, the adjustment can be made directly to the wind velocity, which is the approach taken in this method (see A1.1.2). This procedure produces results consistent with past ASD wind loads.

A1.1.2 It is necessary to determine whether the wind velocity to be used is based on the maps in ASCE 7-10 or on older maps designed for direct application of ASD. Wind velocity, V, based on ASD is used in this method. Wind speeds determined using the maps in ASCE 7-10, referred to as V_{ULT}, are converted to ASD wind speeds, V_{ASD}, by multiplying by the square root of 0.6. Wind speeds based on maps using an ASD basis do not require conversion (see A1.3) Thus:

$$V = V_{ASD} = V_{ULT} \times \sqrt{0.6} \quad \text{(A1.1)}$$

The V determined in this section is used in the following calculations.

A1.1.3 The velocity pressures, q, used in this specification have been computed using the following equation:

$$q = 0.00256\, K_z K_d V^2 I (lb/sq.\ ft) = 0.613\, K_z K_d V^2 I (N/m^2) \quad \text{(A1.2)}$$

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where:

V = wind velocity, mph (km/h). The basic wind speed corresponds to a 3-s gust speed at 33 ft (10.1 m) above ground in exposure category C, as described in ASCE 7-10. A velocity of $V = V_{ASD}$ = 110 mph (177 km/h) was used in this specification. (See Note A1.2 and Note A1.3.)

I = "importance factor" as described in editions of ASCE 7 prior to ASCE 7-10. A value of 1.0 is used. This factor is not used where the wind speed has been determined from a map in ASCE 7-10. (See Note A1.4.)

K_z = "velocity pressure coefficient" as described in ASCE 7-10. A "K_z" of 0.70 is used in the wind pressure calculations, which is the value from ASCE 7-10 for a mean roof height of 30 ft (9.1 m) above ground level and Exposure Category B.

K_d = "wind directionality factor" as described in ASCE 7-10. A "K_d" of 0.85 is used.

A1.1.4 Thus for the given velocity and factors, the velocity pressure, q = 18.43 lbf/ft^2 (882 Pa).

NOTE A1.2—As explained in Note A1.1, the wind velocity used in this method is converted from the V_{ULT} given by wind speed maps in ASCE 7-10 to V_{ASD} using the equation in A1.1.2. A V_{ULT} wind speed of approximately 140 mph from the maps is equivalent to a V_{ASD} of 110 mph, which is the velocity V used in this specification.

NOTE A1.3—In ASCE 7-10 the default wind speeds are given for exposure category C, and a table is provided to adjust this wind speed for other exposure categories. Since most insulated vinyl siding is installed on buildings located in exposure category B, the velocity pressure coefficient, K_z is included in the equation to make this adjustment.

NOTE A1.4—Editions of ASCE 7 prior to ASCE 7-10 included an importance factor to represent the relative significance of the building and the consequences of its loss. Because most insulated vinyl siding is installed on residential and light commercial buildings, the importance factor was set at 1.0 by default. ASCE 7-10 has removed the importance factor from the velocity pressure equation, and instead provides a different wind speed map for each of the building importance categories (referred to as risk categories in ASCE 7-10). Thus the importance factor will already have been incorporated into the wind speed determined from the appropriate map, and the importance factor is not used for determining velocity pressure using wind speeds from ASCE 7-10 maps.

A1.1.5 ASCE 7-10 recommends various internal and external pressure coefficients, which include gust response factors. These coefficients vary with the effective area of the cladding component, the location of the cladding component relative to building corners, and the configuration of the building (open versus enclosed). The internal and external pressure coefficients are taken from Table 26.11-1 and Figure 30.4-1 of ASCE 7-10. The effective area is taken as 10 square feet (the area of one piece of siding), an enclosed building is assumed, and factors for the building corners are used. The pressure coefficients are as follows:

$$\textit{Internal Pressure Coefficient} = \pm 0.18 \qquad \text{(A1.3)}$$

$$\textit{External Pressure Coefficient} = +1.00 \textit{ and } -1.40$$

A1.1.6 The design pressure is calculated by multiplying the velocity pressures by the algebraic sum of the internal and external pressure coefficients.

A1.2 Design Pressure

NOTE A1.5—Because the wind velocity has already been adjusted from an ultimate basis to an ASD basis at the beginning of these calculations, the design pressure determined in this step is an ASD load. This correlates to the design pressure requirements stated in tables in the 2015 International Residential Code and other codes which have also been adjusted to an ASD basis. However, the required design pressures in some other codes and design standards have not been adjusted to an ASD basis. Where required design pressures are based on ultimate wind loads determined from ASCE 7-10 wind speeds, those loads must be multiplied by 0.60 to match the design pressure determined from this equation. A1.2

$$\textit{Positive Design Pressure} = (18.43)\,(1.00+0.18) = 21.74\ \textit{psf} \qquad \text{(A1.4)}$$

$$\textit{Negative Design Pressure} = (18.43)(-1.40-0.18) = -29.12\ \textit{psf}$$

A1.2.1 The negative values (suction loads) are the largest in magnitude and are the design values used in this specification. Research conducted by various organizations[5,6] has shown that a certain amount of pressure equalization occurs through residential siding products installed with sheathing under high dynamic pressures. In light of this pressure equalization, the design pressure in the ASCE 7-10 wind load standards is reduced by a factor of 0.5 for insulated vinyl siding.

A1.2.2 Therefore, the required test pressures are calculated as follows:

$$P_t = D_P \times PEF \times 1.5 \qquad \text{(A1.5)}$$

where:

P_t = test pressure, lbf/ft^2 (Pa),

D_P = design pressure, lbf/ft^2 (Pa),

PEF = pressure equalization factor, insulated vinyl siding, 0.5, and

1.5 = safety factor.

A1.2.2.1 If documentation in support of the use of compensation for pressure equalization other than 0.5 is provided, use the calculation in A1.2.2, substituting the appropriate pressure equalization factor.

A1.2.3 Using the above equations, in a 110 mph (177 km/h) (V_{ASD}) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, the required minimum uniform load test pressure for insulated vinyl siding is 21.84 lbf/ft^2 (1046 Pa).

A1.2.3.1 For compliance with 5.2.2, the referenced design pressure has been rounded to -30.0 lbf/ft^2 (1436 Pa) to match the standard design conditions specified by the 2015 International Residential Code. When tested under Test Method D5206, the siding must attain an average maximum sustained static test pressure equal to or greater than the corresponding minimum test pressure of 22.5 lb/ft^2 (1077 Pa).

A1.2.4 For applications where the effective design pressure is greater than -30.0 lbf/ft^2 (1436 Pa) (for example, wind zone areas greater than 110 mph (177 km/h) (V_{ASD}), mean roof height over 30 ft (9.1 m), or exposure conditions other than Exposure B), refer to ASCE 7-10 for the effective design pressure. To be shown to be suitable for the application, when

[5] Vinyl Siding Pressure Equalization Factor, Architectural Testing, Inc. Report No. 01-40776.01, September 2002.

[6] Morrison, M.J., Cope A.D. "Wind Performance and Evaluation Methods of Multi-Layered Wall Assemblies." *Structures Congress*, 2735-2748, Portland, OR, 2015.

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tested under Test Method D5206 the siding must attain an average maximum sustained static test pressure equal to or greater than the minimum test pressure determined by the formula in A1.2.2, using the design pressure, D_P, determined for the application using the procedure in A1.1.2 through A1.2.

A1.2.5 These loading conditions apply only to siding installed without an air space directly over sheathing of a type and fastening method that is capable of independently resisting both positive and negative wind design pressures at the building location. Examples of such sheathing include oriented strand board (OSB) and plywood fastened to resist the design wind pressures. For applications where the siding is installed over open studding, without sheathing, rapid pressure equalization does not occur and pressure equalization factor (PEF) is set to 1.0. In these applications, the load the siding will see is equal to the total design pressure. The static test pressure required for products used under these conditions is as follows:

$$P_t = D_P \times PEF \times 1.5 \quad \text{(A1.6)}$$

where:

P_t = static test pressure, lbf/ft^2 (Pa),
D_P = design pressure, lbf/ft^2 (Pa), and
PEF = pressure equalization factor, 1.0, and
1.5 = safety factor.

A1.2.5.1 Therefore in a 110 mph (177 km/h) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, siding installed without sheathing would require a uniform load test pressure of 43.72 lbf/ft^2 (2093 Pa).

NOTE A1.6—Building codes and insulated vinyl siding installation instructions require insulated vinyl siding to be installed over sheathing, so calculation of minimum test pressure for siding installed without sheathing is essentially moot. However, the calculation has been retained for completeness and comparison with other installation conditions.

A1.2.6 When siding is installed over sheathing that is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, a greater percentage of the total wind pressure is transferred to the siding and its fasteners. This has the effect of partially or completely countering the effect of the pressure equalization factor. In these cases a value between 0.5 and 1.0 is used for the pressure equalization factor (PEF).

A1.2.6.1 In addition, in cases where failure of the siding would result in failure of the exterior wall covering assembly (that is, siding and sheathing) a safety factor of greater than 1.5 is indicated.

A1.2.6.2 If the adjusted PEF for a given combination of siding and sheathing is known, and an appropriate safety factor is used, a minimum test pressure can be determined using the equation in A1.2.1. However, it is normally more appropriate to make an adjustment for alternative sheathings when determining the design pressure rating, as discussed in A1.3.

NOTE A1.7—Where the sheathing is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, the layer of siding over the sheathing, and its fastening through the sheathing, act to reinforce the sheathing such that the whole wall covering (siding-sheathing) assembly is capable of resisting such wind pressures. Because the siding is tested by itself (not as part of a siding-sheathing assembly) in Test Method D5206, the adjustment of test pressure (before the test) or of the design pressure (after the test) ensures that the wind load resistance of the assembly as a whole is reflected in the rating of the siding.

NOTE A1.8—In some high wind hazard regions, such as south Florida, the exterior wall covering assembly may also be required to meet wind-borne debris impact resistance criteria which would affect the choice of sheathing material to be used together with siding. Such considerations are beyond the scope of this standard.

A1.3 Wind Design Pressure Rating (Maximum Allowable Pressure)

A1.3.1 A design pressure rating is the maximum wind pressure that a particular siding product is rated to be able to withstand. It is used in building design and building codes to determine the acceptability of a siding product for use under the design wind conditions for a specific application. To be acceptable, a siding's design pressure rating must be equal to or greater than the design pressure for the specific building at the specific location. The design pressure rating is determined from the average maximum sustained static test pressure for a siding product produced by testing under Test Method D5206, the pressure equalization factor, and a safety factor.

A1.3.2 *Standard Design Pressure Rating*—The standard design pressure rating is used for applications where the siding is installed over a sheathing type and fastening method that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location.

A1.3.2.1 The standard design pressure rating assumes that the siding is fastened to the building in the standard manner, with the minimum fastener type, size, spacing, and penetration depth prescribed in Chapter 7 of the International Residential Code and the VSI Vinyl Siding Installation Manual. The installation of the siding for testing under Test Method D5206 must be consistent with these minimum fastening requirements. However, this does not prevent additional testing, using different fastening, to support design pressure ratings for other applications, such as special high wind installations.

A1.3.2.2 The pressure equalization factor and safety factor are the same as those used to determine the test pressure in A1.2.1, using the following equation:

$$D_{Rstd} = \frac{P_m}{(PEF \times SF)} \quad \text{(A1.7)}$$

where:

D_{Rstd} = standard design pressure rating, lbf/ft^2 (Pa),
P_m = average maximum sustained static test pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, 0.5, and
SF = safety factor, 1.5.

A1.3.3 *Alternative Design Pressure Ratings*—Design pressure ratings for applications other than the standard conditions described above can be developed. Common circumstances where this is done include the use of alternative fastening methods in order to achieve a higher design pressure rating, and cases where the sheathing is not capable of independently resisting wind pressures under design conditions, which necessitates a reduction in the siding's design pressure rating.

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A1.3.3.1 *Alternative Fastening*—Where an alternative fastening method is specified by the manufacturer, the siding is permitted to be tested under Test Method D5206 using the specified fastening. The resulting average maximum sustained static test pressure is used in the above equation to determine the alternative design pressure rating. In order for this alternative rating to be realized, the siding must be installed using the alternative method, and the rating must be clearly tied to installation requirements in manufacturer's literature and instructions.

A1.3.3.2 *Alternative Sheathing*—An adjusted design pressure rating for use of the siding over sheathings not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, as discussed in A1.2.6, can be calculated using the above equation if the appropriate PEF and safety factor are specified.

A1.3.3.3 Alternative PEF and safety factor values have been documented (see 2009 and 2012 International Residential Code, section R703.11.2) for one type of sheathing, foam plastic insulating sheathing complying with ANSI/SBCA FS 100. Two wall assembly cases are considered: 1) where the interior surface of the wall is covered with gypsum wall board or equivalent; and 2) where the interior surface of the wall is not covered with gypsum wall board or equivalent. In both cases the siding is installed directly over foam sheathing, which is then attached directly to framing, without intervening sheathing. The PEF and safety factor for each case are as follows:

Case	PEF	Safety Factor
Case 1	0.7	2.0
Case 2	1.0	2.0

A1.3.3.4 Adjustment of the standard design pressure rating is not necessary when foam plastic insulating sheathing is installed directly over sheathing that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, or where the sheathing is fastened in a way that allows it to independently resist the design wind pressure. For such cases the standard design pressure rating is applied.

A1.4 Design Wind Speeds

A1.4.1 The wind velocity maps in ASCE 7-10 provide one source of design wind speeds for particular geographic regions. The velocities on these maps are stated in terms of "ultimate," 700-year return interval speeds. To be used in the procedure in this Annex, those velocities need to be converted to the ASD equivalent in accordance with A1.1.2, and the resulting velocity V used in the equation in A1.1.3. The 2012 and 2015 International Building Code and 2015 International Residential Code also contain maps based on ultimate wind speeds.

A1.4.2 Other maps are available that do not require conversion of wind velocities. Examples include the wind map in the 2012 International Residential Code, on which the velocities have already been converted from those on the ASCE 7-10 maps. Maps from previous editions of ASCE 7 used ASD velocities and do not require conversion. However, only editions since 1995 used the 3-second gust basis that is used in this Annex. The 1998, 2002, and 2005 editions of ASCE 7 continued the use of 3-second gust wind basis, but with improved hazard modeling of hurricane wind speeds first made in the 1998 edition. These previous editions also do not have the benefit of further improved hurricane hazard modeling that was incorporated into the maps used in ASCE 7-10.

APPENDIX

(Nonmandatory Information)

X1. VINYL SIDING, BACKED SIDING, AND INSULATED VINYL SIDING

X1.1 Relationships among types of vinyl siding

X1.1.1 Conventional vinyl siding is covered by ASTM D3679, Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding. D3679 includes provisions for the materials and performance of vinyl siding, including minimum PVC composition and percentage of recycled material, dimensional requirements, impact resistance, resistance to surface distortion and deterioration, thermal expansion, windload resistance, etc.

X1.1.2 Backed vinyl siding is vinyl siding that includes an integral foam plastic backing material, and is covered by Specification D7445. That specification includes many of the same requirements as are found in D3679, which are applied to the vinyl siding "skin" of the product. Additional requirements, which apply to the foam backing itself, or to the full product including both siding and foam, are also included in Specification D7445

X1.1.3 Insulated vinyl siding, which is the subject of this standard specification, may be thought of as backed vinyl siding that is able to meet enhanced requirements. Chief among those is the requirement that insulated vinyl siding demonstrate a minimum thermal resistance, or R-value. While the foam backing of backed vinyl siding may, or may not, impart some R-value, it is not required to demonstrate that. To be considered "insulated vinyl siding" the product must demonstrate that it delivers the minimum R-value.

X1.1.4 As with backed vinyl siding, insulated vinyl siding is composed of a vinyl siding "skin" and foam plastic insulation. The vinyl siding portion must meet specific requirements for vinyl siding, which parallel with those in D3679. As with backed vinyl siding, insulated vinyl siding is subjected to additional requirements that apply to the foam or to the full product including siding and foam. In some cases the minimum

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specification or performance level is higher for insulated vinyl siding compared to backed vinyl siding. This is consistent with the intent that insulated vinyl siding be understood as offering enhanced performance and tangible benefits over the more basic backed vinyl siding.

REFERENCES

(1) ASHRAE Handbook of Fundamentals, American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. Chapter 26, 1977.

(2) "Wind Forces on Structures," Transactions of the American Society of Civil Engineers, Vol 126, Part II, 1961, pp. 1124–1198.

(3) AAMA, CW 11-85, American Architectural Manufacturers Assn., Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing, American Architectural Manufacturers Assn., 1827 Walden Office Square - Suite 550, Schaumburg, IL.

(4) Thom, H. C. S., New Distribution of Extreme Winds in the United States , American Society of Civil Engineers, Environmental Engineering Conference Preprint 431, Dallas, TX, Feb. 6, 1967.

(5) Sachs, Peter, Wind Forces in Engineering, Pergamon Press, Elmsford, NY 1972.

(6) MacDonald, A. J., Wind Loading on Buildings, Applied Sciences Publishers, Ltd., Essex, England, 1975.

(7) Houghton, E., and Carruthers, N., Wind Forces on Buildings and Structures , John Wiley & Sons, New York, NY, 1976.

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D7793 - 21) that may impact the use of this standard. (April 1, 2024)

(1) Revised 1.4.
(2) Removed withdrawn Practice D4756 from Referenced Documents section.

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This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.



Designation: D7445 – 24

An American National Standard

Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding with Foam Plastic Backing (Backed Vinyl Siding)[1]

This standard is issued under the fixed designation D7445; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification establishes requirements for vinyl siding with integral foam plastic backing, where the siding is manufactured from rigid PVC compound. Performance requirements and test methods addressed by this standard include materials properties and dimensions, warp, shrinkage, impact strength, expansion, appearance, flame spread, and wind load resistance. Methods of indicating compliance with this specification are also provided.

NOTE 1—Backed vinyl siding is composed of two major components: the siding and the backing. It is intended that the siding portion comply with Specification D3679. Applicable portions of Specification D3679 are included in this specification. Additional requirements that pertain only to the backing as a separate material, or to the combination of siding and backing as a whole, are also included.

1.2 Backed vinyl siding shall be tested with the backing material in place or removed, as specified in the applicable requirement or test method.

1.3 The use of PVC recycled plastic in this product shall be in accordance with the requirements in Section 4.

1.4 Siding produced to this specification shall be installed in accordance with Practice D4756. Reference shall also be made to the manufacturer's installation instructions for the specific product to be installed.

NOTE 2—Information with regard to siding maintenance shall be obtained from the manufacturer.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 3—There is no known ISO equivalent to this standard.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing
D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer
D883 Terminology Relating to Plastics
D1042 Test Method for Linear Dimensional Changes of Plastics Caused by Exposure to Heat and Moisture
D1435 Practice for Outdoor Weathering of Plastics
D1600 Terminology for Abbreviated Terms Relating to Plastics (Withdrawn 2024)[3]
D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
D2457 Test Method for Specular Gloss of Plastic Films and Solid Plastics
D3679 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding
D3892 Practice for Packaging/Packing of Plastics
D4226 Test Methods for Impact Resistance of Rigid Poly-(Vinyl Chloride) (PVC) Building Products
D4756 Practice for Installation of Rigid Poly(Vinyl Chloride) (PVC) Siding and Soffit (Withdrawn 2023)[3]
D5206 Test Method for Windload Resistance of Rigid Plastic Siding

[1] This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.24 on Plastic Building Products.

Current edition approved X 1, 2024. Published X 2024. Originally approved in 1979. Last previous edition approved in 2018 as D7445 – 18. DOI: 10.1520/D7445-24.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

***A Summary of Changes section appears at the end of this standard**

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D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens
D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)[3]
D7793 Specification for Insulated Vinyl Siding
E84 Test Method for Surface Burning Characteristics of Building Materials
E631 Terminology of Building Constructions
E1753 Practice for Use of Qualitative Chemical Spot Test Kits for Detection of Lead in Dry Paint Films
G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

2.2 *ASCE Standard:*[4]
ASCE 7-10 Minimum Design loads for Buildings and Other Structures

2.3 *International Code Council:*[5]
International Building Code
International Residential Code

2.4 *Vinyl Siding Institute, Inc.:*[6]
VSI Vinyl Siding Installation Manual (2015)

2.5 *Structural Building Components Association:*[7]
ANSI/SBCA FS 100-2012 Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies

3. Terminology

3.1 Definitions are in accordance with Terminologies D883, E631, and D1600, unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *backed vinyl siding*—a vinyl cladding product sold with manufacturer-installed foam plastic backing material as an integral part of the cladding product. The vinyl cladding portion of backed vinyl siding meets the definition of vinyl siding. Backed vinyl siding is intended to be installed only with the integral backing.

3.2.2 *backing material; foam plastic backing*—a layer or layers of plastic that has been intentionally expanded to produce a reduced-density plastic containing voids consisting of open or closed cells distributed throughout the plastic.

3.2.3 *nominal*—the value that a manufacturer consistently uses to represent a specific property or dimension of a vinyl siding product in public claims including, but not limited to, product literature, advertisements, quotations, and certificates of conformance.

3.2.4 *process average thickness*—the rolling, arithmetic mean of average specimen thicknesses measured according to 6.5 for a specific product during all productions runs for the most recent six month period.

3.2.5 *wind load design pressure rating*—the maximum wind pressure that a backed vinyl siding product is rated to withstand, based on testing under Test Method D5206.

3.2.5.1 *standard wind load design pressure rating*—the wind load design pressure rating for a siding product when installed 1) over a sheathing material designed and attached such that it is capable of resisting 100 % of positive and negative wind pressures occurring under design conditions at the building location; and 2) with the standard fastening method specified in building codes, general installation instructions, and the siding manufacturer's instructions.

3.2.5.2 *alternative wind load design pressure rating*—the wind load design pressure rating for a siding product when installed over a sheathing not designed and attached such that it is capable of resisting 100 % of positive and negative wind pressures occurring under design conditions at the building location, or when the siding is not fastened in the standard way; as specified by the manufacturer.

3.2.5.3 *Discussion*—The standard test conditions, configuration, and fastening method used in this specification are specified in 6.14, while alternative sheathing and installation conditions are specified by the manufacturer and must be reflected in the product's installation instructions. Alternative ratings apply only when the specified sheathing and fastening conditions are used. See Annex A1 for information on differences between the standard wind load design pressure rating and alternative wind load design pressure ratings, and how to determine standard and alternative design pressure ratings.

3.2.6 *temperate northern climate*—in weather testing, a North American metropolitan area testing site located within 73 to 100°W longitude and 37 to 45°N latitude.

3.2.7 *vinyl siding*—a shaped material, made principally from rigid poly(vinyl chloride) (PVC), that is used to clad exterior walls of buildings; in this standard, vinyl siding refers to the rigid profile to which the backing material is attached.

3.2.7.1 *Discussion*—Any exception to a homogeneous rigid PVC compound is present in a coextruded or laminated capstock.

4. Materials and Manufacture

4.1 The vinyl siding, exclusive of backing material, shall be made of one or more layers of poly(vinyl chloride) (PVC) compound. Any layers of materials other than poly (vinyl chloride) (PVC) compound shall be kept to less than 20 % by volume. This limitation does not apply to the backing material.

4.2 Where rigid PVC recycled plastic as defined in Guide D7209 is used, the siding containing the PVC recycled plastic shall meet all of the requirements of 3,Terminology; 4, Materials and Manufacture; and 5, Physical Requirements.

4.3 The poly(vinyl chloride) siding material, exclusive of backing material, when tested in accordance with Test Method D635, shall not exceed an average extent of burn of 4 in. (100 mm), with an average time of burn not to exceed 10 s. A minimum sample thickness of 0.035 in. (0.9 mm) is required. **Warning—**The flammability testing data, conclusions, and recommendations of Test Method D635 relate solely to the

[4] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.
[5] Available from International Code Council (ICC), 500 New Jersey Ave., NW, 6th Floor, Washington, DC 20001, http://www.iccsafe.org.
[6] National Housing Center, 1201 15th Street NW, Suite 220, Washington, DC 20005, http://www.vinylsiding.org
[7] 6300 Enterprise Lane, Madison, WI 53719, http://www.sbcindustry.com

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measurement and description of properties for classification of the poly(vinyl chloride) siding material in response to flame under controlled laboratory conditions and shall not be used for the description or appraisal of the fire hazard of vinyl siding under actual fire conditions.

4.4 The foam plastic backing shall have a Flame Spread Index not greater than 75 and a Smoke Developed Index not greater than 450 when tested separately under method E84.

4.5 The PVC compound when extruded into siding shall maintain uniform color and be free of any visual surface or structural changes, such as peeling, chipping, cracking, flaking, or pitting.

4.6 The PVC compound shall be compounded so as to provide the heat stability and weather exposure stability required for the siding market application.

4.7 Backed vinyl siding shall not contain elemental lead (Pb) or compounds of that material other than traces incidental to raw materials or the manufacturing process. This limitation applies to both PVC substrate and to any cap or film material, as well as the backing material. Compliance with this requirement shall be demonstrated by one of the methods in 6.16.

5. Physical Requirements

5.1 *Requirements Applicable to Vinyl Siding*—The provisions of 5.1.1 – 5.1.8 apply only to the vinyl siding, exclusive of any backing material. Where necessary to perform testing, the backing material shall be removed.

5.1.1 *Length and Width*—The nominal length and width of the siding shall be as agreed upon between the purchaser and the seller. The actual length shall not be less than ¼ in. (6.4 mm) of the nominal length and the actual width shall be within ± 1⁄16 in. (1.6 mm) of the nominal width when measured in accordance with 6.3 and 6.4.

5.1.2 *Thickness*—These requirements pertain only to measurements of the portions of the siding that are exposed after installation of the panel, measured in accordance with the procedure in 6.5. The average thickness of each specimen shall be no less than 0.035 in. No individual measurement shall be thinner than 0.003 in. below the nominal thickness. The process average thickness as defined in 3.2.4 shall be no thinner than 0.001 in. below the nominal thickness.

5.1.3 *Camber*—A full length of siding (typically 10 or 12 ft (3.05 or 3.61 m)) shall not have a camber greater than ⅛ in. (3.2 mm) when measured in accordance with 6.6.

5.1.4 *Heat Shrinkage*—The average heat shrinkage shall not exceed 3.0 % when determined by the method described in 6.7.

5.1.5 *Impact Resistance*—Siding shall have a minimum impact strength of 60 in.·lbf (6.78 J) when tested in accordance with 6.8.

5.1.6 *Coefficient of Linear Expansion*—The siding shall have a coefficient of linear expansion not greater than 4.5 by 10^{-5}in./in./°F (8.1 by 10^{-5} mm/mm/°C) when tested in accordance with 6.9.

5.1.7 *Gloss*—The gloss of smooth and embossed vinyl siding shall be uniform across the exposed surface. The average of all readings for a panel determined in 6.11.2.5 shall not differ from the manufacturer's specified gloss value more than the permitted variation in Table 1, and each individual reading shall not vary more than 10 points from the average. Gloss of smooth and embossed vinyl siding shall be tested in accordance with 6.11.

5.1.8 *Uniformity of Color*—The color specified shall be uniform on the exposed surface of the vinyl siding panels, except on the case of variegated colors. When tested in accordance with 6.13, the total color change, ΔE, between a production specimen and the appropriate reference specimen or agreed-upon color coordinates shall not vary by more than 1.5, and the chromatic coordinates thereof shall not change by more than $\pm\Delta a_H = 1.0$ and $\pm\Delta b_H = 1.0$.

5.1.9 *Weathering:*

5.1.9.1 The vinyl siding shall maintain a uniform color and be free of any visual surface or structural changes such as peeling, chipping, cracking, flaking, and pitting when tested in accordance with 6.10.

NOTE 4—Weathering-conformance-testing requirements are to reflect performance of a "typical" extrusion siding profile representing a specific color of PVC compound and a specific extrusion technology. In no case is there an implied requirement for testing all the various shaped and sized siding profiles produced in this color. The lengthy outdoor weatherability testing for new products may be performed concurrently with market development and sales of siding to existing markets. Completion of weatherability testing prior to marketing of the product is not required.

5.2 *Requirements Applicable to Backed Vinyl Siding*—The provisions of 5.2.1 – 5.2.3 apply to backed vinyl siding, including the integral foam backing material. Testing shall be conducted with the backing material in place, as described in the referenced test method.

5.2.1 *Surface Distortion*—The *backed vinyl* siding shall be free of bulges, waves, and ripples when tested to a minimum temperature of 150°F (66°C) in accordance with the procedure in 6.12. This distortion is called "oil-canning."

5.2.2 *Wind Load Resistance*—The siding shall withstand a minimum static test pressure and a standard wind load design pressure rating shall be determined.

5.2.2.1 *Minimum Test Pressure*—Backed siding shall be able to withstand a minimum test pressure of 22.5 lbf/ft^2 (1077 Pa) when tested in accordance with 6.14. The average maximum sustained static test pressure determined in 6.14 shall be equal to or greater than this value. If the manufacturer of backed siding provides documentation to support compensation for pressure equalization, the test pressure shall be determined from Annex A1 using the documented pressure equalization factor.

NOTE 5—The static test pressure of 22.5 lbf/ft^2 (1077 Pa) for backed siding was established to withstand structural loading conditions that occur in wind exposures of approximately 110 mph (177 km/h) (V_{ASD}) for mean roof heights of 30 ft (9.1 m) and less in exposure category B, and corresponds to 30.0 lbf/ft^2 (1436 Pa) negative design pressure, to match the default wind design conditions of Table R703.3(1) in the 2015 International Residential Code. Provision is made for compensation for pressure equalization specific to the product if supporting documentation

TABLE 1 Gloss Values

Manufacturer's Specified Gloss Value	Permitted Difference from Manufacturer's Specified Gloss Value
Less than or equal to 35	±8
Greater than 35	±10

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is provided, using procedures in Annex A1.

NOTE 6—Refer to Annex A1 for an explanation as to how the negative design pressure was established, and for applications where the effective negative design pressure as specified in ASCE 7-10 is different from 30.0 lbf/ft^2 (1436 Pa) (for example, wind-zone areas greater than about 110 mph (177 km/h) (V_{ASD}) (225 km/h (V_{ULT})) or mean roof height above 30 ft (9.1 m), or exposures other than exposure category B).

(1) The design-pressure values can be negative (suction loads) or positive. The negative values are the largest in magnitude and are the values used in this specification.

NOTE 7—In that the siding is being tested as a weather-resistant exterior product applied to an existing exterior structural wall, forces (negative) working to pull the siding off the wall, fasteners, or disengage locks will be the most important criteria for testing. Positive wind forces test the integrity of the total wall sections, and do not provide a measure of the performance of the siding.

5.2.2.2 *Standard Wind Load Design Pressure Rating*—The standard wind load design pressure rating shall be determined from the results of testing in accordance with 6.14, using the procedures described in A1.3.

NOTE 8—The standard design pressure rating is valid for applications where the siding is installed over sheathing and its fastening that are capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location. For applications over other sheathing, a different design pressure rating is applicable, and is determined in accordance with A1.3. Determination of a rating other than the standard design pressure rating is not required by this section.

5.2.2.3 *Alternative Design Pressure Ratings*—Design pressure ratings other than the standard wind load design pressure rating, for use with different sheathing materials or using different installation or fastening, are permitted to be determined in accordance with testing under 6.14, using the procedures in Annex A1.

5.2.3 *Nail Slot Allowance for Thermal Expansion*—For siding panels utilizing nail slots to allow for thermal expansion and contraction, the nail slot shall be sized to allow for the expected range of expansion and contraction over a range of 100°F. Compliance with this requirement shall be demonstrated either by the test method in 6.15 or by sizing of the nail slots according to the specifications in the following sections. The instrument used shall be capable of measuring to the nearest 0.01 in. The manufacturing tolerance shall not exceed -0.030 in.

5.2.3.1 For panels shorter than 6 ft (1829 mm) in length, the minimum nail slot width shall be ⅜ in. (11.4 mm).

5.2.3.2 For panels 6 ft (1829 mm) in length or longer the minimum nail slot width shall be determined according to the following formula. The minimum width shall be the width resulting from application of the formula, rounded to the next lower quarter-inch. Regardless of the results of the calculation, the minimum nail slot width for panels 6 feet or longer shall be 1 in (25.4 mm).

$$WS = P_c \times (\alpha \times 100\,°F \times L) + T_c \quad (1)$$

WS = minimum width of nail slot, in.,
P_c = center-pinning coefficient: 1 if manufacturer's instructions require panel to be center-pinned; 1.5 if center-pinning is not required,
α = coefficient of linear thermal expansion, 4.5×10^{-5} in./in./°F or actual known coefficient for material used, as determined by 6.9,
L = length of panel, inches, and
T_c = centering tolerance: 0.25 in.

5.2.4 *Flame Spread*—Backed vinyl siding shall have a Flame Spread Index not greater than 200 when tested in accordance with 6.17.

6. Test Methods

6.1 *General*—The inspection and test procedures contained in this section are used to determine the conformance of products to the requirements of this specification. Each producer who represents its products as conforming to this specification shall be permitted to use statistically based sampling plans that are appropriate for each manufacturing process, but shall keep the essential records necessary to document, with a high degree of assurance, his claim that all of the requirements of this specification have been met. Additional sampling and testing of the product, as agreed upon between the purchaser and the manufacturer, are not precluded by this section.

6.2 *Conditioning and Test Conditions*—Condition the test specimen in accordance with Procedure A of Practice D618 and test under those conditions, unless otherwise specified herein.

6.3 *Length*—Lay the specimen on a flat surface and measure with a steel tape. Measure the length of a siding panel to the nearest 1/16 in. (1.6 mm) at the center, the butt edge, and the bottom of the top lock. The average of the three measurements is the actual length.

6.4 *Width*—Interlock two long specimens, each at least 26 in. (600 mm) long, in the normal mode for installation. Lay the two specimens on a flat surface. Measure to the nearest 1/16 in. (1.6 mm), the distance between the lowest butt edge of the top specimen and the lowest butt edge of the bottom specimen. Commencing approximately 1 in. (25 mm) from one end of the specimens, make five measurements at 6 in. (152 mm) intervals, making sure that the measurement is made perpendicular to the butt edge. Average the measurements. The average constitutes the exposed width of siding.

6.5 Thickness shall be measured in accordance with Test Method A of Test Method D5947. The micrometer shall be calibrated in accordance with Section 8 of Test Method D5947. The thickness of the siding shall be measured at a minimum of 5 locations equally spaced across the entire portion of the siding that will be exposed after installation. All measurements shall be taken to the nearest 0.001 in. Calculate and report the average of these measurements. Also report the thinnest individual measurement.

6.6 *Camber*—Place a full length of siding (typically 10 or 12 ft (3.05 or 3.61 m)) on a flat surface alongside a straightedge at least as long as the siding specimen. Measure the maximum space between edge of the siding specimen and the straightedge for each edge to the nearest 1/16 in. (1.6 mm).

6.7 *Heat Shrinkage:*
6.7.1 *Apparatus:*

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6.7.1.1 *Scriber,* similar to that described in Test Method D1042, with the exception that the needle points shall be separated by 10 ± 0.01 in. (254 ± 0.254 mm).

6.7.1.2 *Test Media,* a controlled-temperature water bath of 5 gal (10 L) or more, equipped with an efficient stirrer that will maintain uniform temperature throughout. Heater and temperature-control devices must maintain the water at 160 ± 1°F (71 ± 0.5°C). Use a wire rack to raise and lower specimens into the water bath. As an alternative to the use of a water bath, the specimens may be heated for 30 min in a uniformly heated forced-air oven maintained at a temperature of 160 ± 1°F (71 ± 0.5°C).

6.7.1.3 Make measurements with any device capable of measuring the distance between two scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2 *Procedure:*

6.7.2.1 Cut three specimens from the siding panel, each 1 in. (25.4 mm) wide by 12 in. (305 mm) long. Cut one specimen from the center and one from each of the extreme edges of the flat surface. The long axis shall be parallel to the machine direction.

6.7.2.2 Condition specimens at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity for at least 24 h.

6.7.2.3 Make a slight mark with the scribe on each specimen so that a reference point will be clearly visible.

6.7.2.4 Place specimens in the test medium.

6.7.2.5 Remove specimens after 30 min and place on a flat surface until cool.

6.7.2.6 Repeat conditioning in accordance with 6.7.2.2.

6.7.2.7 Make a second mark with the scribe on each specimen, using the same center.

6.7.2.8 Measure the distance, *D*, between the scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2.9 Calculate the percent shrinkage as (*D*/10) × 100.

6.7.2.10 Report the average shrinkage of the three specimens tested.

6.8 *Impact Resistance*—Test impact resistance of siding in accordance with Test Method D4226, Procedure A, impactor head configuration H.25. 4 in.-lb increments (0.5 in. height increments with 8 lb falling weight) shall be used. Minimum sample dimensions shall be 1.5 by 1.5 in. Samples shall be tested with the normally exposed surface facing up. Backed siding shall be tested with any backing material removed. Conditioning time for quality-control tests shall be at least 1 h.

6.8.1 For purposes of evaluating failure of the specimen under section 3.2.1 of Test Method D4226, a ductile tear of less than 0.2 in. (5 mm) in length shall not be considered a failure. Any brittle break of any dimensions is considered a failure.

6.9 *Coefficient of Linear Expansion*—Conduct this test in accordance with Test Method D696.

6.10 *Weatherability:*

6.10.1 A minimum of three samples shall be exposed at each of at least three test sites. Test sites shall be located in a northern temperate climate, represented by Cleveland, Ohio or Louisville, Kentucky; a hot, humid climate represented by Miami, Florida; and a hot, dry climate represented by Phoenix, Arizona. The samples shall be exposed for a minimum of 24 months.

6.10.2 Samples shall consist of a flat section of siding with minimum dimensions of 2 in. by 3 ¾ in. (25 mm by 95 mm).

6.10.3 Samples shall be representative of the product to be evaluated.

NOTE 9—Samples prepared in the laboratory in the same manner as commercial samples are permitted to be used as an alternative to a commercial part. If the commercial product is extruded, the laboratory specimen must be extruded; if the commercial product is injection molded, the laboratory specimen must be injection molded, and so forth.

6.10.4 Select a minimum of 4 specimens per sample per test site to allow for 3 test specimens and 1 file specimen for each sample evaluated.

6.10.5 Mark each specimen permanently to ensure retention of identity during and after exposure testing.

NOTE 10—Use of a vibratool leaves a permanent mark that satisfies this criterion.

6.10.6 All exposures shall be conducted at an angle of 45° South, plywood backed, in accordance with Practice D1435 and G147.

6.10.7 After a minimum of 24 months of exposure, remove the samples and inspect each exposed test specimen for appearance and surface condition. Record observations and inspection date in a permanent record.

6.11 *Gloss:*

6.11.1 *Apparatus*—Measure gloss using a 75° geometry glossmeter that meets the requirements of the Apparatus section of Test Method D2457.

6.11.2 *Procedure:*

6.11.2.1 Gloss measurements shall be made in accordance with the procedure in Section 9 of Test Method D2457, unless otherwise specified herein.

6.11.2.2 Measure gloss on one piece of siding on at least three widely separated sections across the width of the exposed surface of the panel. At least one reading shall be taken on each face of the panel. Use new surface area for each reading to avoid scratches caused by instrument contact. The area tested must be flat. If a flat area on the exposed surface cannot be found due to the style or depth of embossing of the panel being tested, then a non-exposed area of the panel shall be chosen in its place. Such locations shall be representative of the gloss of the area that will be exposed after installation.

6.11.2.3 Measure gloss parallel to the direction of embossing. When the embossing pattern is not apparent, measure the gloss in the direction of extrusion.

6.11.2.4 Each reading shall be within the appropriate limit specified in 5.1.7.

6.11.2.5 The average reading of all readings shall be used to represent the gloss of the sample.

6.12 *Surface Distortion:*

6.12.1 *Test Specimen/Apparatus:*

6.12.1.1 The test specimen shall consist of three courses of backed vinyl siding, a minimum of 6 ft (1.83 m) in length, mounted on a flat rigid frame in accordance with the manufacturer's recommended installation instructions.

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(1) Horizontal Siding—The middle course shall consist of two lengths of backed vinyl siding, both with a factory-fabricated end, one section overlapping the other section. The end of the overlapping section shall be located not less than 3 in. (76 mm) and not more than 6 in. (152 mm) from the center of the course. Unless specified otherwise by the manufacturer's installation instructions, the insulation of the two lengths of backed vinyl siding shall be butted firmly together.

(2) Vertical Siding—The middle course shall consist of a single, uninterrupted backed vinyl siding panel, without overlap.

6.12.1.2 A thermocouple or other heat-sensing element shall be located at the horizontal midpoint of the backside of the middle course of backed vinyl siding. The heat-sensing element shall be in contact with the back of the vinyl cladding. Any backing material removed to facilitate placement of the heat sensing element shall be replaced.

6.12.1.3 *Radiant-Heat Rod,* 600 W for each linear foot (0.31 m), mounted parallel to the middle course and approximately 32 in. (810 mm) away from the surface of the backed vinyl siding.

6.12.1.4 *Temperature-Control Device,* used to regulate the temperature of the radiant-heat rod, shall be able to maintain the conditions specified in 6.12.2.1.

6.12.1.5 *Gap Measurement Device*—A cylindrical pin gauge, ¼ ± 0.005 in. (6 ± 0.127 mm) in diameter is used to evaluate the size of any gap in the overlapped sections of horizontal backed vinyl siding during the heating period. The pin gauge is attached to a rod such that the gauge can be inserted into a gap while held parallel to the plane of the backed vinyl siding. The rod shall be sufficiently long to permit insertion of the gauge from beyond the edge to the test frame, not interfere with the exposure of the sample to radiant heat, and otherwise not interfere with conduct of the test.

6.12.2 *Procedure:*

6.12.2.1 Heat the test panel (middle course of backed vinyl siding) at a rate of 3.0 to 6.0°F/min (1.7 to 3.3°C/min) until a minimum temperature of 150°F (66°C) is achieved as measured by the heat-sensing element on the midpoint of the backside of the middle course. For temperatures equal to or greater than 130°F (54°C), the rate of heating is permitted to be not less than 2.0°F/min (1.1°C/min), provided that the average heating rate from the ambient temperature to 150°F (66°C) is within 3.0 to 6.0°F/min (1.7 to 3.3°C/min). When a temperature of 150°F (66°C) is attained, shut off the heat source.

6.12.2.2 During this heating period, observe the middle course of the backed vinyl siding for surface distortion and observe for any opening or gap at the end of the overlapped section. If the overlap appears to have opened to approximately ¼ in. (6 mm), attempt to insert the gap measurement device into the opening. If the device can be inserted in to the opening to any depth at any location along the overlap, the opening shall be considered to be at least ¼ in. (6 mm).

6.12.2.3 Failure is defined as:

(1) the appearance of bulges, waves, or ripples on any surface of the middle course of the backed vinyl siding;

(2) occurrence of a gap or opening ¼ in. (6 mm) or greater at any point along the end of the overlapped section, as determined by use of the gap measurement device, at any time or before a temperature of 150°F (66°C) is reached.

6.13 *Color Uniformity*—Calculate the difference between the L_H, a_H, and b_H color coordinates for a production specimen to those of either the appropriate reference specimen or the agreed upon color coordinates for that specific color product in accordance with Test Method D2244. Calculate the total difference ΔE between the production specimen and the reference specimen in accordance with Test Method D2244.

6.14 *Wind Load Resistance*—Conduct the test on wind load resistance of finished siding in accordance with Test Method D5206. The average maximum sustained static test pressure determined from this testing is used in 5.2.2. For purposes of determining compliance with the minimum test pressure and standard design pressure requirements in 5.2.2, the test structure shall be constructed with vertical studs 16 in. on center. The siding shall be tested with the foam plastic backing attached to the vinyl siding. The siding in the test installation shall be installed over wood sheathing with a nominal thickness of 7/16 to ½ in., and fastened as follows:

6.14.1 *Fastener type*—Roofing nail, smooth shank, 0.120 in. (⅛ in. nominal; 3.2 mm) shank diameter, 5/16 in. (7.9 mm) head diameter, length as necessary to penetrate into sheathing and stud a total of 1 ¼ in. (32 mm). For vertical siding, length as necessary to penetrate the thickness of the sheathing plus ¼ in. (6.4 mm).

6.14.2 *Fastener Spacing*—Every 16 in. (406 mm) into center of stud for horizontal siding. For vertical siding, every 12 in. into sheathing only.

6.14.3 Fasteners shall not be driven tightly against the siding. Allow approximately 1/32 in. (0.8 mm) clearance between the fastener head and siding surface.

NOTE 11—The installation details described 6.14 conform to the minimum requirements of the 2015 International Residential Code and the VSI Vinyl Siding Installation Manual.

6.15 *Nail Slot Allowance for Thermal Expansion*—As an alternative to conformance with the nail slot width specification in 5.2.3.1 or 5.2.3.2, provision for thermal expansion and contraction shall be demonstrated through the following test procedure.

6.15.1 *Samples*—At least 3 samples of each profile in which the siding is produced shall be provided. The length of each sample shall be at least 50 % of the longest length in which the profile is produced, and not shorter than 12 ft (3658 mm).

6.15.2 *Test Chamber*—The test chamber shall consist of an environmentally controlled room or compartment capable of providing an air temperature range of at least 0°F to 100°F (-18°C to 38°C) without exposure of the panel to radiant energy from heating or cooling elements. Air temperature shall be controlled such that a rate of temperature change of 2°F (1.11°C) per minute can be achieved over the full temperature range, and the minimum and maximum temperatures can be maintained for at least 15 minutes. Means for circulating air to provide a uniform air temperature throughout the chamber shall be provided. A vertical wall shall be provided for mounting of samples. The wall shall be insulated such that, with no panels mounted, the inner surface of the wall does not

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deviate more than 10°F (5.5°C) from the air temperature at the high and low temperature extremes after a holding period of 5 minutes. The test chamber shall be of sufficient size to accommodate the longest panel to be tested, including expected thermal expansion of the panel. Means shall be provided to measure the actual temperature of the surface of each panel at a minimum of 3 evenly-spaced locations along the length of the panel.

6.15.3 *Length Measurement*—A means for measuring the length of each sample throughout the temperature range shall be provided. The method utilized for length measurement shall not be influenced by the temperature of the chamber and shall have a minimum resolution of no greater than 0.0625 in. (1.59 mm).

6.15.4 *Procedure*—Install the sample panels on the wall inside the test chamber, following the manufacturer's instructions for fastener type, spacing, location and tightness. At ambient temperature measure and record the length of each panel and the temperature of the panel, averaged from a minimum of 3 locations along the length of the panel.

6.15.4.1 *Test Cycle*—Test cycles shall be performed by raising the air temperature to 100°F ± 5°F (38°C ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding the air temperature at 100°F (38°C ± 2.75°C) for 15 minutes, lowering the air temperature to 0°F ± 5°F (-18°C ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding at 0 °F (-18°C ± 2.75°C) for 15 minutes, and returning to ambient temperature at an average rate of 2 °F per minute.

6.15.4.2 *Conditioning*—Close the test chamber and perform at least 2 conditioning cycles using the procedure in 6.15.1. No interruption is required between conditioning cycles.

6.15.4.3 *Test*—Following completion of the conditioning cycles, conduct 3 test cycles using the procedure in 6.15.4.1. It is acceptable for the test cycles to follow immediately upon completion of the final conditioning cycle, and no interruption is required between test cycles. After a minimum holding period of 15 minutes at the high and low extremes of each test cycle, measure and record the length of each panel and the temperature of the panel, averaged from a minimum of 3 locations along the length of the panel.

6.15.5 *Normalization*—From among the length measurements recorded for all three cycles, identify the shortest and longest length of each panel, and the average panel temperature at the time that length was recorded. Determine the maximum difference in length, ΔL, and the maximum difference in temperature, ΔT, by subtracting the smaller from the larger. Normalize the change in length to the full length of the panel over a 100 °F (38 °C) temperature range using the following formula:

$$E_t = \Delta L \times (100/\Delta T) \times (L_f/L_t) \quad (2)$$

E_t = total thermal expansion and contraction of a full length panel over a range of 100°F (38°C),
ΔL = maximum change in length of the tested panel,
ΔT = maximum change in temperature of the tested panel,
L_f = longest length in which the panel is produced, and
L_t = actual length of the panel as tested.

6.15.6 *Acceptable Performance*—When tested according to this procedure, the result of $(E_t \times 2) + 0.25$ in. for each of the 3 samples for each profile shall not be greater than the width of the nail slot. If the manufacturer's installation instructions require the panel to be center-pinned, the result of $E_t + 0.25$ in. for each of the 3 samples for each profile shall not be greater than the width of the nail slot.

6.16 *Lead Content:*

6.16.1 Testing for lead content shall be conducted on backed vinyl siding using a rhodizinate-type lead swab test kit conforming to Practice E1753. Testing shall be performed in accordance with the test kit manufacturer's instructions. The backed vinyl siding shall be deemed to comply with 4.7 if the test shows a negative or not-detected result; that is, the test does not indicate the presence of lead. The test shall be conducted separately on the substrate and on any cap or film material.

6.16.2 As an alternative to the method in 6.16.1, and as a means of resolving any ambiguous results from that method, an analytical method capable of detecting lead at least as low as 0.02 percent by sample weight shall be employed. Under this alternative, neither the substrate nor any cap or film shall contain a concentration of lead in excess of 0.02 percent by weight.

6.17 *Flame Spread*—Conduct the test on flame spread of finished backed vinyl siding in accordance with Test Method E84. The test specimen shall either be self-supporting by its own structural characteristics or held in place by added supports along the test specimen surface, or secured from the back side.

7. Packaging and Package Marking

7.1 The siding shall be packed in such a manner as to provide reasonable protection against damage in ordinary handling, transportation, and storage.

7.2 Provisions of Practice D3892 shall apply to this specification.

7.3 To aid identification of siding conforming to all requirements of this specification, producers and distributors shall include a statement of compliance in conjunction with their name and address on product labels, invoices, sales literature, and the like. The following statement is suggested when sufficient space is available:

This PVC siding conforms to all the requirements established in ASTM Specification D7445, developed cooperatively with the industry and published by ASTM.

Full responsibility for the conformance of this product to the specification is assumed by (name and address of producer or distributor).

7.4 The following abbreviated statement is suggested when available space on labels is insufficient for the full statement: Conforms to ASTM Specification D7445 (name and address of producer or distributor).

7.5 The standard wind load design pressure rating determined in accordance with 5.2.2.2 shall be stated on the product or on the product package by one of the means in 7.5.1 or 7.5.2.

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7.5.1 The package shall be marked or labeled with the standard wind load design pressure rating. The marking shall be in the format "Standard Wind Load Design Pressure Rating: ##.# psf (ASD)".

7.5.2 The standard design pressure rating shall be included on a line imprint or other marking on the front (outward-facing) surface of all siding panels. It is not required that the marking be visible after installation, provided that the marking can be revealed and read by detaching the lower edge lock of an adjacent course, without removal of any fasteners. The standard design pressure marking shall be stated at least once per panel. The marking shall be in the format "Std Design Pressure Rating: ##.# psf (ASD)".

7.5.3 At the option of the manufacturer, additional marking or labeling of the package or product with alternative wind load design pressure ratings determined in accordance with 5.2.2.3 for use with alternative sheathings, wall configurations or fastening methods is permitted. The marking shall use the format specified in 7.5, shall indicate the type of sheathing or wall configuration for which it is applicable, and shall refer to the manufacturer's instructions for more information and any installation requirements.

8. Keywords

8.1 plastic building products; plastic weatherability; recycled plastic; rigid PVC siding; specification

ANNEX

(Mandatory Information)

A1. WIND LOAD RESISTANCE TEST DESIGN FACTORS

A1.1 *Wind Load Criteria:*

A1.1.1 ASCE 7-10 is the basis for determining the design pressures used in this specification. Design wind loads are determined on an ASD basis in this specification.

NOTE A1.1—In previous editions of ASCE 7, wind loads were determined using wind speed maps based on a 50-year return period. In ASCE 7-10, maps based on a 700-year return period are used which, for any given location, produce a wind speed approximately 30 % greater than that of the previous maps. This larger magnitude (higher return period) wind speed, referred to as the ultimate wind speed, (V_{ULT}), is used directly (with a load factor of 1.0) to determine nominal wind loads on a Strength Design (LRFD) or "ultimate" wind load basis. When Allowable Stress Design (ASD) is used, ASCE 7-10 provides for these ultimate wind loads, determined from the ultimate wind speed map velocities, to be multiplied by a load factor of 0.6. Alternatively, the adjustment can be made directly to the wind velocity, which is the approach taken in this method (see A1.1.2). This procedure produces results consistent with past ASD wind loads.

A1.1.2 It is necessary to determine whether the wind velocity to be used is based on the maps in ASCE 7-10 or on older maps designed for direct application of ASD. Wind velocity, V, based on ASD is used in this method. Wind speeds determined using the maps in ASCE7-10, referred to as V_{ULT}, are converted to ASD wind speeds, V_{ASD}, by multiplying by the square root of 0.6. Wind speeds based on maps using an ASD basis do not require conversion (see A1.3). Thus:

$$V = V_{ASD} = V_{ULT} \times \sqrt{0.6} \quad \text{(A1.1)}$$

The V determined in this section is used in the following calculations.

A1.1.3 The velocity pressures, q, used in this specification have been computed using the following equation:

$$q = 0.00256\, K_z K_d V^2 I(\ lb/sq\ ft\ ) = 0.613\, K_z\, K_d\, V^2 I\ (N/m^2) \quad \text{(A1.2)}$$

V = wind velocity, mph (km/h). The basic wind speed corresponds to a 3-s gust speed at 33 ft (10.1 m) above ground in exposure category C, as described in ASCE 7-10. A velocity of $V = V_{ASD}$ = 110 mph (177 km/h) was used in this specification. (See Note A1.2and Note A1.3.)

I = "importance factor" as described in editions of ASCE 7 prior to ASCE 7-10. A value of 1.0 is used. This factor is not used where the wind speed has been determined from a map in ASCE 7-10. (See Note A1.4.)

K_z = "velocity pressure coefficient" as described in ASCE 7-10. A "K_z" of 0.70 was used in the wind pressure calculations, which is the value from ASCE 7-10 for a mean roof height of 30 ft (9.1 m) above ground level and Exposure Category B.

K_d = "wind directionality factor" as described in ASCE 7-10. A "K_d" of 0.85 is used.

A1.1.4 Thus, for the given velocity and factors, the velocity pressure = 18.43 lbf/ft^2 (882 Pa).

NOTE A1.2—As explained in Note A1.1, the wind velocity used in this method is converted from the V_{ULT} given by wind speed maps in ASCE 7-10 to V_{ASD} using the equation in A1.1.2. A V_{ULT} wind speed of approximately 140 mph from the maps is equivalent to a V_{ASD} of 110 mph, which is the velocity V used in this specification.

NOTE A1.3—In ASCE 7-10 the default wind speeds are given for exposure category C, and a table is provided to adjust this wind speed for other exposure categories. Since most backed vinyl siding is installed on buildings located in exposure category B, the velocity pressure coefficient, K_z is included in the equation to make this adjustment.

NOTE A1.4—Editions of ASCE 7 prior to ASCE 7-10 included an importance factor to represent the relative significance of the building and the consequences of its loss. Because most backed vinyl siding is installed on residential and light commercial buildings, the importance factor was set at 1.0 by default. ASCE 7-10 has removed the importance factor from the velocity pressure equation, and instead provides a different wind speed map for each of the building importance categories (referred to as risk categories in ASCE 7-10). Thus the importance factor will already have been incorporated into the wind speed determined from the appropriate

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map, and the importance factor is not used for determining velocity pressure using wind speeds from ASCE 7-10 maps.

A1.1.5 ASCE 7-10 recommends various internal and external pressure coefficients, which include gust response factors. These coefficients vary with the effective area of the cladding component, the location of the cladding component relative to building corners, and the configuration of the building (open versus enclosed). The internal and external pressure coefficients are taken from Table 26.11-1 and Figure 30.4-1 of ASCE 7-10. The effective area is taken as 10 square ft (the area of one piece of siding), an enclosed building is assumed, and factors for the building corners are used. The pressure coefficients are as follows:

$$\textit{Internal Pressure Coefficient} = \pm 0.18 \quad \text{(A1.3)}$$

$$\textit{External Pressure Coefficient} = +1.00 \textit{ and } -1.40$$

The design pressure is calculated by multiplying the velocity pressures by the algebraic sum of the internal and external pressure coefficients.

A1.2 *Design Pressure:*

NOTE A1.5—Because the wind velocity has already been adjusted from an ultimate basis to an ASD basis at the beginning of these calculations, the design pressure determined in this step is an ASD load. This correlates to the design pressure requirements stated in tables in the 2015 International Residential Code and other codes which have also been adjusted to an ASD basis. However, the required design pressures in some other codes and design standards have not been adjusted to an ASD basis. Where required design pressures are based on ultimate wind loads determined from ASCE 7-10 wind speeds, those loads must be multiplied by 0.60 to match the design pressure determined from this equation.

$$\textit{Positive Design Pressure} = (18.43)(1.00+0.18) = 21.74\ \textit{psf} \quad \text{(A1.4)}$$

$$\textit{Negative Design Pressure} = (18.43)(-1.40-0.18) = -29.12\ \textit{psf}$$

A1.2.1 The negative values (suction loads) are the largest in magnitude and are the design values used in this specification. Research conducted by various organizations[8,9] has shown that a certain amount of pressure equalization occurs through residential siding products installed with sheathing under high dynamic pressures. In light of this pressure equalization, the design pressure in the ASCE 7-10 wind load standards is reduced by a factor of 0.5 for backed siding.

A1.2.2 Therefore, the required test pressures are calculated as follows:

$$P_t = D_P \times PEF \times 1.5 \quad \text{(A1.5)}$$

where:

P_t = test pressure, lbf/ft^2 (Pa),
D_P = design pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, backed siding, 0.5, and
1.5 = safety factor.

A1.2.2.1 If documentation in support of the use of compensation for pressure equalization other than 0.5 is provided, use the calculation in A1.2.2, substituting the appropriate pressure equalization factor.

A1.2.3 Using the above equations, in a 110 mph (177 km/h) (V_{ASD}) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, the required minimum uniform load test pressure for backed siding is 21.84 lbf/ft^2 (1046 Pa).

A1.2.3.1 For compliance with 5.2.2, the referenced design pressure has been rounded to -30.0 lbf/ft^2 (1436 Pa) to match the standard design conditions specified by the 2015 International Residential Code. When tested under Test Method D5206, the siding must attain an average maximum sustained static test pressure equal to or greater than the corresponding minimum test pressure of 22.5 lb/ft^2 (1077 Pa).

A1.2.4 For applications where the effective design pressure is greater than -30.0 lbf/ft^2 (1436 Pa) (for example, wind zone areas greater than 110 mph (177 km/h) (V_{ASD}), mean roof height over 30 ft (9.1 m), or exposure conditions other than Exposure B), refer to ASCE 7-10 for the effective design pressure. To be shown to be suitable for the application, when tested under Test Method D5206 the siding must attain an average maximum sustained static test pressure equal to or greater than the minimum test pressure determined by the formula in A1.2.2, using the design pressure, D_P, determined for the application using the procedure in A1.1.2 through A1.2.

A1.2.5 These loading conditions apply only to siding installed without an air space directly over sheathing of a type and fastening method that is capable of independently resisting both positive and negative wind design pressures at the building location. Examples of such sheathing include oriented strand board (OSB) and plywood fastened to resist the design wind pressures. For applications where the siding is installed over open studding, without sheathing, rapid pressure equalization does not occur. In these applications, the load the siding will see is equal to the total design pressure and the pressure equalization factor (PEF) is set to 1.0. The static test pressure required for products used under these conditions is as follows:

$$P_t = D_P \times PEF \times 1.5 \quad \text{(A1.6)}$$

where:

P_t = static test pressure, lbf/ft^2 (Pa),
D_P = design pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, 1.0, and
1.5 = safety factor.

A1.2.5.1 Therefore in a 110 mph (177 km/h) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, siding installed without sheathing would require a uniform load test pressure of 43.72 lbf/ft^2 (2093 Pa).

NOTE A1.6—Building codes and backed vinyl siding installation instructions require backed vinyl siding to be installed over sheathing, so calculation of minimum test pressure for siding installed without sheathing is essentially moot. However, the calculation has been retained for completeness and comparison with other installation conditions.

A1.2.6 When siding is installed over sheathing that is not capable of independently resisting both positive and negative

[8] Vinyl Siding Pressure Equalization Factor, Architectural Testing, Inc. Report No. 01–40776.01, September 2002.

[9] Morrison M.J., Cope A.D. "Wind Performance and Evaluation Methods of Multi-Layered Wall Assemblies." Structures Congress, 2735-2748, Portland, OR, 2015.

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wind pressures occurring under design conditions at the building location, a greater percentage of the total wind pressure is transferred to the siding and its fasteners. This has the effect of partially or completely countering the effect of the pressure equalization factor. In these cases a value between 0.5 and 1.0 is used for the pressure equalization factor (PEF).

A1.2.6.1 In addition, in cases where failure of the siding would result in failure of the exterior wall covering assembly (that is, siding and sheathing) a safety factor of greater than 1.5 is indicated.

A1.2.6.2 If the adjusted PEF for a given combination of siding and sheathing is known, and an appropriate safety factor is used, a minimum test pressure can be determined using the equation in A1.2.1. However, it is normally more appropriate to make an adjustment for alternative sheathings when determining the design pressure rating, as discussed in A1.3.

NOTE A1.7—Where the sheathing is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, the layer of siding over the sheathing, and its fastening through the sheathing, act to reinforce the sheathing such that the whole wall covering (siding-sheathing) assembly is capable of resisting such wind pressures. Because siding is tested by itself (not as part of a siding-sheathing assembly) in Test Method D5206, the adjustment of test pressure (before the test) or of the design pressure (after the test) ensures that the wind load resistance of the assembly as a whole is reflected in the rating of the siding.

NOTE A1.8—In some high wind hazard regions, such as south Florida, the exterior wall covering assembly may also be required to meet wind-borne debris impact resistance criteria which would affect the choice of sheathing material to be used together with siding. Such considerations are beyond the scope of this standard.

A1.3 *Wind Design Pressure Rating (Maximum Allowable Pressure):*

A1.3.1 A design pressure rating is the maximum wind pressure that a particular backed vinyl siding product is rated to be able to withstand. It is used in building design and building codes to determine the acceptability of a siding product for use under the design wind conditions for a specific application. To be acceptable, a siding's design pressure rating must be equal to or greater than the design pressure for the specific building at the specific location. The design pressure rating is determined from the average maximum sustained static test pressure for a siding product produced by testing under Test Method D5206, the pressure equalization factor, and a safety factor.

A1.3.2 *Standard Design Pressure Rating*—The standard design pressure rating is used for applications where the siding is installed over a sheathing type and fastening method that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location.

A1.3.2.1 The standard design pressure rating assumes that the siding is fastened to the building in the standard manner, with the minimum fastener type, size, spacing, and penetration depth prescribed in Chapter 7 of the International Residential Code and the VSI Vinyl Siding Installation Manual. The installation of the siding for testing under Test Method D5206 must be consistent with these minimum fastening requirements. However, this does not prevent additional testing, using different fastening, to support design pressure ratings for other applications, such as special high wind installations.

A1.3.2.2 The pressure equalization factor and safety factor are the same as those used to determine the test pressure in A1.2.1, using the following equation:

$$D_{Rstd} = \frac{P_m}{(PEF \times SF)} \quad (0)$$

where:

D_{Rstd} = standard design pressure rating, lbf/ft^2 (Pa),
P_m = average maximum sustained static test pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, 0.5, and
SF = safety factor, 1.5.

A1.3.3 *Alternative Design Pressure Ratings*—Design pressure ratings for applications other than the standard conditions described above can be developed. Common circumstances where this is done include the use of alternative fastening methods in order to achieve a higher design pressure rating, and cases where the sheathing is not capable of independently resisting wind pressures under design conditions, which necessitates a reduction in the siding's design pressure rating.

A1.3.3.1 *Alternative Fastening*—Where an alternative fastening method is specified by the manufacturer, the siding is permitted to be tested under Test Method D5206 using the specified fastening. The resulting average maximum sustained static test pressure is used in the above equation to determine the alternative design pressure rating. In order for this alternative rating to be realized, the siding must be installed using the alternative method, and the rating must be clearly tied to installation requirements in manufacturer's literature and instructions.

A1.3.3.2 *Alternative Sheathing*—An adjusted design pressure rating for use of the siding over sheathings not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, as discussed in A1.2.6, can be calculated using the above equation if the appropriate PEF and safety factor are specified.

A1.3.3.3 Alternative PEF and safety factor values have been documented (see 2009 and 2012 International Residential Code, section R703.11.2) for one type of sheathing, foam plastic insulating sheathing complying with ANSI/SBCA FS 100. Two wall assembly cases are considered: 1) where the interior surface of the wall is covered with gypsum wall board or equivalent; and 2) where the interior surface of the wall is not covered with gypsum wall board or equivalent. In both cases the siding is installed directly over foam sheathing, which is then attached directly to framing, without intervening sheathing. The PEF and safety factor for each case are as follows:

Case	PEF	Safety Factor
Case 1	0.7	2.0
Case 2	1.0	2.0

A1.3.3.4 Adjustment of the standard design pressure rating is not necessary when foam plastic insulating sheathing is installed directly over sheathing that is capable of independently resisting both positive and negative wind pressures

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occurring under design conditions at the building location, or where the sheathing is fastened in a way that allows it to independently resist the design wind pressure. For such cases the standard design pressure rating is applied.

A1.4 *Design Wind Speeds:*

A1.4.1 The wind velocity maps in ASCE 7-10 provide one source of design wind pressures for particular geographic regions. The velocities on these maps are stated in terms of "ultimate", 700-year return interval speeds. To be used in the procedure in this Annex, those velocities need to be converted to the ASD equivalent in accordance with A1.1.2, and the resulting velocity *V* used in the equation in A1.1.3. The 2012 and 2015 International Building Code and 2015 International Residential Code also contain maps based on ultimate wind speeds.

A1.4.2 Other maps are available that do not require conversion of wind velocities. Examples include the wind map in the 2012 International Residential Code, on which the velocities have already been converted from those on the ASCE 7-10 maps. Maps from previous editions of ASCE 7 used ASD velocities and do not require conversion. However, only editions since 1995 used the 3-second gust basis that is used in this annex. The 1998, 2002, and 2005 editions of ASCE 7 continued the use of 3-second gust wind basis, but with improved hazard modeling of hurricane wind speeds first made in the 1998 edition. These previous editions also do not have the benefit of further improved hurricane hazard modeling that was incorporated into the maps used in ASCE 7-10.

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SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D7445–18) that may impact the use of this standard. (X 1, 2024)

(1) Revised 1.1.

(2) Added 5.2.4 and 6.17.

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FBCR Definitions [Add defenition]

[RB] Backed vinyl siding is a cladding product with a manufacturer-installed foam plastic backing material as an integral part. Where used as insulation, refer to *insulated vinyl siding*.

-

R703.3.3 Minimum fastener length and penetration. [Revise as follows]

Fasteners shall have the greater of the minimum length specified in Table R703.3(1) or as required to provide a minimum penetration into framing as follows:

1.Fasteners for horizontal aluminum siding, steel siding, particleboard panel siding, wood structural panel siding in accordance with ANSI/APA-PRP 210, fiber-cement panel siding and fiber-cement lap siding installed over foam plastic sheathing shall penetrate not less than $1^1/_2$ inches (38 mm) into framing or shall be in accordance with the manufacturer's installation instructions.

2.Fasteners for hardboard panel and lap siding shall penetrate not less than $1^1/_2$ inches (38 mm) into framing.

3.Fasteners for vinyl siding, *backed vinyl siding*, and insulated vinyl siding shall be installed in accordance with Section R703.11 or R703.13.

4.Fasteners for vertical or horizontal wood siding shall penetrate not less than $1^1/_2$ inches (38 mm) into studs, studs and wood sheathing combined, or blocking.

5.Fasteners for siding material installed over foam plastic sheathing shall have sufficient length to accommodate foam plastic sheathing thickness and to penetrate framing or sheathing and framing combined, as specified in Items 1 through 4.

R703.11.2 Installation over foam plastic sheathing.

Where vinyl siding, *backed vinyl siding* or insulated vinyl siding is installed over foam plastic sheathing, the ~~vinyl~~ siding shall comply with Section R703.11 and shall have a wind load design pressure rating in accordance with Table R703.11.2.

Exceptions:

1.Where the foam plastic sheathing is applied directly over wood structural panels, fiberboard, gypsum sheathing or other approved backing capable of independently resisting the design wind pressure, the ~~vinyl~~ siding shall be installed in accordance with Sections R703.11.1 and R703.3.3.

2.Where the ~~vinyl~~ siding manufacturer's product specifications provide an *approved* wind load design pressure rating for installation over foam plastic sheathing, use of this wind load design pressure rating shall be permitted and the siding shall be installed in accordance with the manufacturer's instructions.

3.Where the foam plastic sheathing and its attachment has a design wind pressure resistance complying with Sections R316.8 and R301.2.1, the ~~vinyl~~ siding shall be installed in accordance with Sections R703.11.1 and R703.3.3.

R703.13 Insulated vinyl siding, backed vinyl siding.

Insulated vinyl siding and *backed vinyl siding* shall be certified and labeled by an approved agency as conforming to the requirements of ASTM D7793 and D7445, respectively.

Add new standard as follows:

ASTM D7445-24 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding with Foam Plastic Backing (Backed Vinyl Siding)

R703.13.1 Insulated vinyl siding, backed vinyl siding, and accessories.

Insulated vinyl siding, *backed vinyl siding*, and compatible accessories shall be installed in accordance with Sections R703.11.1, R703.11.2 ~~and~~ or the manufacturer's installation instructions.

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This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: D7793 – 20

Standard Specification for Insulated Vinyl Siding[1]

This standard is issued under the fixed designation D7793; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification establishes requirements for insulated vinyl siding, which is vinyl siding with integral foam plastic insulating material, where the vinyl siding is manufactured from rigid PVC compound. Compliance with this standard requires insulated vinyl siding to demonstrate a thermal insulation value of R-2.0 or greater. Other performance requirements and test methods addressed by this standard include materials properties and dimensions, warp, shrinkage, impact strength, expansion, appearance, thermal distortion resistance, flame spread, and windload resistance. Methods of indicating compliance with this specification are also provided.

NOTE 1—Insulated vinyl siding is composed of two major components: the vinyl siding and the insulating material. It is intended that the vinyl siding portion comply with Specification D3679. Applicable portions of Specification D3679 are included in this specification. Additional requirements that pertain only to the insulation as a separate material, or to the combination of vinyl siding and insulation as a whole, are also included. For further explanation, see Appendix X1.

1.2 Insulated vinyl siding shall be tested with the insulation material in place or removed, as specified in the applicable requirement or test method.

1.3 The use of PVC recycled plastic in this product shall be in accordance with the requirements in Section 4.

1.4 Insulated vinyl siding produced to this specification shall be installed in accordance with Practice D4756. Reference shall also be made to the manufacturer's installation instructions for the specific product to be installed.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 2—There is no known ISO equivalent to this standard.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C297/C297M Test Method for Flatwise Tensile Strength of Sandwich Constructions
C578 Specification for Rigid, Cellular Polystyrene Thermal Insulation
C591 Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
C1199 Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods
C1289 Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
C1363 Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
D618 Practice for Conditioning Plastics for Testing
D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer
D1042 Test Method for Linear Dimensional Changes of Plastics Caused by Exposure to Heat and Moisture
D1183 Practices for Resistance of Adhesives to Cyclic Laboratory Aging Conditions
D1435 Practice for Outdoor Weathering of Plastics
D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
D2457 Test Method for Specular Gloss of Plastic Films and Solid Plastics

[1] This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.24 on Plastic Building Products.

Current edition approved . Published December 2020. Originally approved in 2012. Last previous edition approved in 2017 as D7793 – 17. DOI:10.1520/D7793-20.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

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D3679 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding
D3892 Practice for Packaging/Packing of Plastics
D4226 Test Methods for Impact Resistance of Rigid Poly-(Vinyl Chloride) (PVC) Building Products
D4756 Practice for Installation of Rigid Poly(Vinyl Chloride) (PVC) Siding and Soffit
D5206 Test Method for Windload Resistance of Rigid Plastic Siding
D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens
D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)[3]
D7445 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding with Foam Plastic Backing (Backed Vinyl Siding)
E84 Test Method for Surface Burning Characteristics of Building Materials
E1753 Practice for Use of Qualitative Chemical Spot Test Kits for Detection of Lead in Dry Paint Films
G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

2.2 *American Society of Civil Engineers (ASCE):*[4]
ASCE 7-10 Minimum Design Loads for Buildings and Other Structures

2.3 *International Code Council*
International Building Code
International Residential Code

2.4 *International Code Council–Evaluation Services (ICC-ES):*
AC05 Acceptance Criteria for Sandwich Panel Adhesives

2.5 *International Standards Organization (ISO):*
ISO/IEC Guide 65 General requirements for bodies operating product certification systems

2.6 *Structural Building Components Association:*
ANSI/SBCA FS 100-2012 Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies

2.7 *Vinyl Siding Institute, Inc.*
VSI Vinyl Siding Installation Manual (2015)

2.8 *Federal Standards:*
16 CFR Part 460 Labeling and Advertising of Home Insulation

3. Terminology

3.1 *Definitions:*

3.1.1 *center-pinning*—an installation technique in which the siding panel is fastened tightly through the nail slot at the center length of the panel, in order to cause thermal expansion and contraction to occur equally in both directions from the center.

3.1.2 *cohesive failure*—in the context of tensile testing, internal separation of the adhesive within the adhesive layer, resulting in attachment of adhesive material to the surface of both substrates

3.1.3 *insulation; insulating material*—foam plastic material that is combined at the factory with a vinyl siding profile to form insulated vinyl siding.

3.1.4 *insulated vinyl siding*—a vinyl cladding product sold with manufacturer-installed foam plastic insulating material as an integral part of the cladding product. The vinyl cladding portion of insulated vinyl siding meets the definition of vinyl siding.

3.1.5 *nominal*—the value that a manufacturer consistently uses to represent a specific property or dimension of a vinyl siding product in public claims including, but not limited to, product literature, advertisements, quotations, and certificates of conformance.

3.1.6 *process average thickness*—the rolling, arithmetic mean of average specimen thicknesses measured in accordance with 6.5 for a specific product during all productions runs for the most recent six-month period.

3.1.7 *vertical coverage*—The net vertical distance of the wall covered by a single insulated vinyl siding panel, disregarding any portions of the panel that are overlapped by adjacent panels above or below.

3.1.8 *temperate northern climate*—in weather testing, a North American metropolitan area testing site located within 73 to 100°W longitude and 37 to 45°N latitude.

3.1.9 *vinyl siding*—a shaped material, made principally from rigid poly(vinyl chloride) (PVC), that is used to clad exterior walls of buildings. In this standard, vinyl siding refers to the rigid profile to which the insulation is attached.

3.1.10 *wind load design pressure rating*—the maximum wind pressure that an insulated vinyl siding product is rated to withstand, based on testing under Test Method D5206.

3.1.10.1 *standard wind load design pressure rating*—the wind load design pressure rating for a siding product when installed 1) over a sheathing material designed and attached such that it is capable of resisting 100% of positive and negative wind pressures occurring under design conditions at the building location; and 2) with the standard fastening method specified in building codes, general installation instructions, and the siding manufacturer's instructions.

3.1.10.2 *alternative wind load design pressure rating*—the wind load design pressure rating for a siding product when installed over a sheathing not designed and attached such that it is capable of resisting 100% of positive and negative wind pressures occurring under design conditions at the building location, or when the siding is not fastened in the standard way; as specified by the manufacturer.

3.1.10.3 *Discussion*—The standard test conditions, configuration, and fastening method used in this specification are specified in 6.14, while alternative sheathing and installation conditions are specified by the manufacturer and must be reflected in the product's installation instructions. Alternative

[3] The last approved version of this historical standard is referenced on www.astm.org.
[4] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.

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ratings apply only when the specified sheathing and fastening conditions are used. See Annex A1 for information on differences between the standard wind load design pressure rating and alternative wind load design pressure ratings, and how to determine standard and alternative design pressure ratings.

4. Materials and Manufacture

4.1 *Vinyl Siding:*

4.1.1 The vinyl siding, exclusive of foam plastic insulating material, shall be made of one or more layers of poly(vinyl chloride) (PVC) compound. Any layers of materials other than poly (vinyl chloride) (PVC) compound shall be kept to less than 20 % by volume. This limitation does not apply to the insulation material.

4.1.2 Where rigid PVC recycled plastic as defined in Guide D7209 is used, the vinyl siding containing the PVC recycled plastic shall meet all of the requirements of Sections 3, 4, and 5.

4.1.3 The vinyl siding material, exclusive of insulation material, when tested in accordance with Test Method D635, shall not exceed an average extent of burn of 4 in. (100 mm), with an average time of burn not to exceed 10 seconds. A minimum sample thickness of 0.035 in. (0.9 mm) is required. (**Warning—**The flammability testing data, conclusions, and recommendations of Test Method D635 relate solely to the measurement and description of properties for classification of the vinyl siding material in response to flame under controlled laboratory conditions and shall not be used for the description or appraisal of the fire hazard of vinyl siding under actual fire conditions.)

4.2 *Foam Plastic Insulation:*

4.2.1 The foam plastic insulation shall be made of one of the following materials:

4.2.1.1 Expanded polystyrene complying with Specification C578.

4.2.1.2 Extruded polystyrene complying with Specification C578

4.2.1.3 Polyisocyanurate complying with Specification C591 or Specification C1289

4.2.2 The foam plastic insulation shall have a Flame Spread Index not greater than 75 and a Smoke Developed Index not greater than 450 when tested separately under Test Method E84.

4.3 *Adhesives:*

4.3.1 The suitability for outdoor use of an adhesive used to bond the vinyl siding and the insulation, if any, shall be determined by the following procedure.

4.3.1.1 Prepare a minimum of 10 specimens consisting of two Douglas fir-larch blocks or other appropriate substrates, bonded by the adhesive, in accordance with Test Method C297/C297M. Each block is to be 2.0 inches square. The adhesive shall be applied and cured in accordance with the adhesive manufacturer's instructions.

(1) The material selected for use as the substrate shall be capable of withstanding the accelerated aging described in 4.3.1.2 without damage or deterioration of the substrate.

NOTE 3—Other appropriate substrates, such as metal or plastic, compatible with the adhesive according to the manufacturer's guidelines, can be used in place of the Douglas fir-larch blocks. Because in accordance with 4.3.1.4.1 at least 75 % of samples must fail in a cohesive mode, a substrate should be selected that is expected to be stronger than the adhesive and which will form a tight bond with the adhesive.

4.3.1.2 Subject 50 percent of the specimens to accelerated aging under Test Method D1183, Test Condition C, for three cycles. The low-temperature portion of the cycle is not required to be colder than -40°F (-40°C) and the relative humidity during this portion of the cycle shall not be greater than 10 % RH.

4.3.1.3 Condition and test all of the specimens in accordance with Test Method C297/C297M.

4.3.1.4 *Acceptable Performance*—Acceptable performance of the adhesive is demonstrated by one of the following means:

(1) When tested in accordance with 4.3.1.3, the samples demonstrate performance in accordance with either (*a*), (*b*), or (*c*).

(a) For a valid test, the mode of failure for no fewer than 75 % of the specimens shall be cohesive. Only specimens that failed cohesively are counted in the following. The average ultimate tensile strength of the samples that were subjected to accelerated aging shall not be less than 80 % of the average ultimate tensile strength of the specimens that were subjected to conditioning only.

(b) None of five aged specimens fails cohesively under a tensile load less than or equal to 100 psi at a pull rate (crosshead speed) of 0.02 in./min. Only specimens that fail cohesively or do not fail are counted. Specimens that fail non-cohesively under a load at or below 100 psi are discarded and another specimen is tested until five specimens have either failed cohesively, or have not failed at or below 100 psi. Adhesives qualified under this method are limited to use with foam insulation having a tensile strength not greater than 100 psi.

(c) The following applies when the average elongation at yield of the specimens that were subjected to conditioning only is 200 % or greater: the average stress of the aged specimens is not less than 80 percent of that of the specimens that were subjected to conditioning only, when measured at an elongation 75 % of the elongation at yield for each specimen.

(2) As an alternative, adhesives that are covered by a current report, issued by an agency accredited under ISO Guide 65, as a Type I, Class 2 adhesive in accordance with Acceptance Criteria AC05, will have exhibited acceptable performance under the above procedure.

NOTE 4—Compatibility of the adhesive with the vinyl siding and insulation used in the insulated vinyl siding is evaluated separately, under 5.2.4.

4.4 *Insulated Vinyl Siding:*

4.4.1 Insulated vinyl siding shall not contain elemental lead (Pb) or compounds of that material other than traces incidental to raw materials or the manufacturing process. This limitation applies to both PVC substrate and to any cap or film material, as well as the insulation material. Compliance with this requirement shall be demonstrated by one of the methods in 6.16.

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5. Physical Requirements

5.1 *Requirements Applicable to Vinyl Siding*—The provisions of 5.1.1 – 5.1.8 apply only to the vinyl siding, exclusive of any insulation material. Where necessary to perform testing, the insulation material shall be removed.

5.1.1 *Length and Width*—The nominal length and width of the vinyl siding shall be as agreed upon between the purchaser and the seller. The actual length shall not be less than ¼ in. (6.4 mm) of the nominal length and the actual width shall be within ±1/16 in. (1.6 mm) of the nominal width when measured in accordance with 6.3 and 6.4.

5.1.2 *Thickness*—These requirements pertain only to measurements of the portions of the vinyl siding that are exposed after installation of the panel, measured in accordance with the procedure in 6.5. The average thickness of each specimen shall be no less than 0.035 in. No individual measurement shall be thinner than 0.003 in. below the nominal thickness. The process average thickness as defined in 3.1.6 shall be no thinner than 0.001 in. below the nominal thickness.

5.1.3 *Camber*—A full length of vinyl siding (typically 10 or 12 ft (3.05 or 3.61 m)) shall not have a camber greater than ⅛ in. (3.2 mm) when measured in accordance with 6.6.

5.1.4 *Heat Shrinkage*—The average heat shrinkage shall not exceed 3.0 % when determined by the method described in 6.7.

5.1.5 *Impact Resistance*—The vinyl siding shall have a minimum impact strength of 60 in.•lbf (6.78 J) when tested in accordance with 6.8.

5.1.6 *Gloss*—The gloss of smooth and embossed vinyl siding shall be uniform across the exposed surface. The average of all readings for a panel determined in 6.11.2.5 shall not differ from the manufacturer's specified gloss value more than the permitted variation in Table 1, and each individual reading shall not vary more than 10 points from the average. Gloss of smooth and embossed vinyl siding shall be tested in accordance with 6.11.

5.1.7 *Uniformity of Color*—The color specified shall be uniform on the exposed surface of the vinyl siding panels, except in the case of variegated colors. When tested in accordance with 6.13, the total color change, ΔE, between a production specimen and the appropriate reference specimen or agreed-upon color coordinates shall not vary by more than 1.5, and the chromatic coordinates thereof shall not change by more than $\pm\Delta a_H = 1.0$ and $\pm\Delta b_H = 1.0$.

5.1.8 *Weathering*—The vinyl siding shall maintain a uniform color and be free of any visual surface or structural changes such as peeling, chipping, cracking, flaking, and pitting when tested in accordance with 6.10.

5.1.9 *Coefficient of Linear Expansion*—The vinyl siding shall have a coefficient of linear expansion not greater than 4.5 by 10^{-5} in./in./°F (8.1 by 10^{-5} mm/mm/°C) when tested in accordance with 6.9.

TABLE 1 Gloss Values

Manufacturer's Specified Gloss Value	Permitted difference from Manufacturer's Specified Gloss Value
Less than or equal to 35	±8
Greater than 35	±10

5.2 *Requirements Applicable to Insulated Vinyl Siding*—The provisions of 5.2.1–5.2.5 apply to insulated vinyl siding, including the integral foam insulation material. Testing shall be conducted on both the vinyl siding and the insulating material, or with the insulating material in place, as described in the referenced test method.

5.2.1 *Thermal Distortion*—The insulated vinyl siding shall be free of bulges, waves, and ripples, and an overlap shall not open more than ¼ in. (6 mm) when tested to a minimum temperature of 150°F (66°C) in accordance with the procedure in 6.12.

5.2.2 *Wind Load Resistance*—The siding shall withstand a minimum static test pressure and a standard wind load design pressure rating shall be determined.

5.2.2.1 *Minimum Test Pressure*—Insulated vinyl siding shall be able to withstand a minimum test pressure of 22.5 lbf/ft^2 (1077 Pa) when tested in accordance with 6.14. The average maximum sustained static pressure determined in 6.14 shall be equal to or greater than this value. If the manufacturer of insulated vinyl siding provides documentation to support compensation for pressure equalization, the test pressure shall be determined from Annex A1 using the documented pressure equalization factor.

NOTE 5—The static test pressure of 22.5 lbf/ft^2 (1077 Pa) for insulated siding was established to withstand structural loading conditions that occur in wind exposures of approximately 110 mph (177 km/h) (V_{ASD}) for mean roof heights of 30 ft (9.1 m) and less in exposure category B, and corresponds to 30.0 lbf/ft^2 (1436 Pa) negative design pressure, to match the default wind design conditions of Table R703.3(1) in the 2015 International Residential Code. Provision is made for compensation for pressure equalization specific to the product if supporting documentation is provided, using procedures in Annex A1.

NOTE 6—Refer to Annex A1 for an explanation as to how the negative design pressure was established, and for applications where the effective negative design pressure as specified in ASCE 7-10 is different from 30.0 lbf/ft^2 (1436 Pa) (for example, wind-zone areas greater than about 110 mph (177 km/h) (V_{ASD}) (225 km/h (V_{ULT})) or mean roof height above 30 ft (9.1 m), or exposures other than exposure category B).

(1) The design-pressure values can be negative (suction loads) or positive. The negative values are the largest in magnitude and are the values used in this specification.

NOTE 7—In that the insulated vinyl siding is being tested as a weather-resistant exterior product applied to an existing exterior structural wall, forces (negative) working to pull the insulated vinyl siding off the wall, fasteners, or disengage locks will be the most important criteria for testing. Positive wind forces test the integrity of the total wall sections, and do not provide a measure of the performance of the insulated vinyl siding.

5.2.2.2 *Standard Wind Load Design Pressure Rating*—The standard wind load design pressure rating shall be determined from the results of testing in accordance with 6.14, using the procedures described in A1.3.

NOTE 8—The standard design pressure rating is valid for applications where the siding is installed over sheathing and its fastening that are capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location. For applications over other sheathing, a different design pressure rating is applicable, and is determined in accordance with A1.3. Determination of a rating other than the standard design pressure rating is not required by this section.

5.2.2.3 *Alternative Design Pressure Ratings*—Design pressure ratings other than the standard wind load design pressure

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rating, for use with different sheathing materials or using different installation or fastening, are permitted to be determined in accordance with testing under 6.14, using the procedures in Annex A1.

5.2.3 *Nail Slot Allowance for Thermal Expansion*—For vinyl siding panels utilizing nail slots to allow for thermal expansion and contraction, the nail slot shall be sized to allow for the expected range of expansion and contraction over a range of 100°F. Compliance with this requirement shall be demonstrated either by the test method in 6.15 or by sizing of the nail slots according to the specifications in the following sections. The instrument used shall be capable of measuring to the nearest 0.01 in. The manufacturing tolerance shall not exceed -0.030 inches.

5.2.3.1 For panels shorter than 6 ft (1829 mm) in length, the minimum nail slot width shall be ⅜ in. (11.4 mm).

5.2.3.2 For panels 6 ft (1829 mm) in length or longer the minimum nail slot width shall be determined according to the following formula. The minimum width shall be the width resulting from application of the formula, rounded to the next lower quarter-inch. Regardless of the results of the calculation, the minimum nail slot width for panels 6 feet or longer shall be 1 in. (25.4 mm).

$$WS = P_c \times (\alpha \times 100°F \times L) + T_c \quad (1)$$

where:

WS = Minimum width of nail slot, in.
P_c = Center-pinning coefficient: 1 if manufacturer's instructions require panel to be center-pinned; 1.5 if center-pinning is not required
α = Coefficient of linear thermal expansion, 4.5×10^{-5} in./in./°F or actual known coefficient for vinyl siding used, as determined by 6.9
L = Length of panel, inches
T_c = Centering tolerance: 0.25 in.

5.2.4 *Compatibility of Adhesives*—When subjected to cyclical conditioning and tested in accordance with 6.17, samples composed of the vinyl siding and insulation bonded with the adhesive, if any, used in the insulated vinyl siding shall not exhibit a decrease in average ultimate tensile strength greater than 20 %, compared to samples not subjected to cyclical conditioning. This requirement is not applicable to insulated vinyl siding that does not contain any adhesive.

5.2.5 *Thermal Insulation Value*—The thermal insulation value (R-value) of the insulated vinyl siding shall be not less than R-2.0 when measured in accordance with 6.18.

5.2.6 *Flame Spread*—Insulated vinyl siding shall have a Flame Spread Index not greater than 200 when tested underin accordance with 6.19.

6. Test Methods

6.1 *General*—The inspection and test procedures contained in this section are used to determine the conformance of products to the requirements of this specification.

NOTE 9—Each producer who represents its products as conforming to this specification typically uses statistically based sampling plans that are appropriate for each manufacturing process to verify on-going compliance. Specifications for quality control programs are beyond the scope of this Standard Specification. Additional sampling and testing of the product, as agreed upon between the purchaser and the manufacturer, are not precluded by this section.

6.2 *Conditioning and Test Conditions*—Condition the test specimen in accordance with Procedure A of Practice D618 and test under those conditions, unless otherwise specified herein.

6.3 *Length*—Lay the specimen on a flat surface and measure with a steel tape that has been verified as accurate to within ±1⁄16 in. (1.6 mm) against a calibrated standard. Measure the length of a vinyl siding panel to the nearest 1⁄16 in. (1.6 mm) at the center, the butt edge, and the bottom of the top lock. The average of the three measurements is the actual length.

6.4 *Width*—Interlock two specimens, each at least 26 in. (660 mm) long, in the normal mode for installation. Lay the two specimens on a flat surface. Measure to the nearest 1⁄16 in. (1.6 mm), the distance between the lowest butt edge of the top specimen and the lowest butt edge of the bottom specimen. Commencing approximately one in. (25 mm) from one end of the specimens, make five measurements at 6-in. (152-mm) intervals, making sure that the measurement is made perpendicular to the butt edge. Average the measurements. The average constitutes the exposed width of vinyl siding.

6.5 *Thickness*—Thickness shall be measured in accordance with Test Method A of Test Method D5947. The micrometer shall be calibrated in accordance with Section 8 of Test Method D5947. The thickness of the vinyl siding shall be measured at a minimum of five locations equally spaced across the entire portion of the vinyl siding that will be exposed after installation. All measurements shall be taken to the nearest 0.001 in. Calculate and report the average of these measurements. Also report the thinnest individual measurement.

6.6 *Camber*—Place a full length of vinyl siding (typically 10 or 12 ft (3.05 or 3.61 m)) on a flat surface alongside a straightedge at least as long as the vinyl siding specimen. Measure the maximum space between the edge of the vinyl siding specimen and the straightedge for each edge to the nearest 1⁄16 in. (1.6 mm).

6.7 *Heat Shrinkage:*

6.7.1 *Apparatus:*

6.7.1.1 *Scriber,* similar to that described in Test Method D1042, with the exception that the needle points shall be separated by 10 ± 0.01 in. (254 ± 0.254 mm).

6.7.1.2 *Test Media,* a controlled-temperature water bath of 5 gal (10 L) or more, equipped with an efficient stirrer that will maintain uniform temperature throughout. Heater and temperature-control devices must maintain the water at 160 ± 1°F (71 ± 0.5°C). Use a wire rack to raise and lower specimens into the water bath. As an alternative to the use of a water bath, heat the specimens for 30 min in a uniformly heated forced-air oven maintained at a temperature of 160 ± 1°F (71 ± 0.5°C).

6.7.1.3 Make measurements with any device capable of measuring the distance between two scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2 *Procedure:*

6.7.2.1 Cut three specimens from the vinyl siding panel, each 1 in. (25.4 mm) wide by 12 in. (305 mm) long. Cut one

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specimen from the center and one from each of the extreme edges of the flat surface. The long axis shall be parallel to the machine direction.

6.7.2.2 Condition specimens at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 10 % relative humidity for at least 24 hours.

6.7.2.3 Make a slight mark with the scribe on each specimen so that a reference point will be clearly visible.

6.7.2.4 Place specimens in the test medium.

6.7.2.5 Remove specimens after 30 min and place on a flat surface until cool.

6.7.2.6 Repeat conditioning in accordance with 6.7.2.2.

6.7.2.7 Make a second mark with the scribe on each specimen, using the same center.

6.7.2.8 Measure the distance, D, between the scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2.9 Calculate the percent shrinkage as (D/10) × 100.

6.7.2.10 Report the average shrinkage of the three specimens tested.

6.8 *Impact Resistance*—Test impact resistance of vinyl siding in accordance with Test Method D4226, Procedure A, impactor head configuration H.25. 4 in.-lb increments (0.5 in. height increments with 8 lb falling weight) shall be used. Minimum sample dimensions shall be 1.5 by 1.5 in. Samples shall be tested with the normally exposed surface facing up. Insulated vinyl siding shall be tested with any insulation material removed. Conditioning time for quality-control tests shall be at least one hour.

6.8.1 For purposes of evaluating failure of the specimen under subsection 3.2.1 of Test Method D4226, a ductile tear of less than 0.2 in. (5 mm) in length shall not be considered a failure. Any brittle break of any dimensions is considered a failure.

6.9 *Coefficient of Linear Expansion*—Conduct this test in accordance with Test Method D696, separately for samples of the vinyl siding and samples of the insulation.

6.9.1 *Alternative Specimen Preparation for Vinyl Siding Samples*—Specimens prepared from strips cut from extruded vinyl siding are permitted to be used in testing under Test Method D696. Where such specimens are used, they shall be cut with the long dimension parallel to the long axis of the vinyl siding panel. Guides shall be used in accordance with Test Method D696 to prevent bending or twisting of the specimen in the dilatometer.

6.10 *Weatherability:*

6.10.1 A minimum of three samples shall be exposed at each of at least three test sites. Test sites shall be located in a northern temperate climate, represented by Cleveland, Ohio or Louisville, Kentucky; a hot, humid climate represented by Miami, Florida; and a hot, dry climate represented by Phoenix, Arizona. The samples shall be exposed for a minimum of 24 months.

6.10.2 Samples shall consist of a flat section of vinyl siding with minimum dimensions of 2 by 3¾ in. (25 by 95 mm).

6.10.3 Samples shall be representative of the product to be evaluated. Samples shall be taken either from commercial products or from laboratory samples. Laboratory samples shall be produced in the same manner as the commercial products to be evaluated.

NOTE 10—Production of laboratory samples in the same manner includes use of the same method of forming the product. For example, if the commercial product is extruded, the laboratory specimen shall be extruded; if the commercial product is injection molded, the laboratory specimen shall be injection molded, and so forth.

6.10.4 Select a minimum of four specimens per sample per test site to allow for three test specimens and one file specimen for each sample evaluated.

6.10.5 Mark each specimen permanently to ensure retention of identity during and after exposure testing.

NOTE 11—Use of a vibrating engraver leaves a permanent mark that satisfies this criterion.

6.10.6 All exposures shall be conducted at an angle of 45° South, plywood-backed, in accordance with Practice D1435 and G147.

6.10.7 After a minimum of 24 months of exposure, remove the samples and inspect each exposed test specimen for appearance and surface condition. Record observations and inspection date in a permanent record.

6.11 *Gloss:*

6.11.1 *Apparatus*—Measure gloss using a 75° geometry glossmeter that meets the requirements of the Apparatus section of Test Method D2457.

6.11.2 *Procedure:*

6.11.2.1 Gloss measurements shall be made in accordance with the procedure in Section 9 of Test Method D2457, unless otherwise specified herein.

6.11.2.2 Measure gloss on one piece of vinyl siding on at least three widely separated sections across the width of the exposed surface of the panel. At least one reading shall be taken on each face of the panel. Use a new surface area for each reading to avoid scratches caused by instrument contact. The area tested must be flat. If a flat area on the exposed surface cannot be found due to the style or depth of embossing of the panel being tested, then a non-exposed area of the panel shall be chosen in its place. Such locations shall be representative of the gloss of the area that will be exposed after installation.

6.11.2.3 Measure gloss parallel to the direction of embossing. When the embossing pattern is not apparent, measure the gloss in the direction of extrusion.

6.11.2.4 Each reading shall be within the appropriate limit specified in 5.1.6.

6.11.2.5 The average of all readings shall be used to represent the gloss of the sample.

6.12 *Thermal Distortion:*

6.12.1 *Test Specimen/Apparatus:*

6.12.1.1 The test specimen shall consist of three courses of insulated vinyl siding, a minimum of 6 ft (1.83 m) in length, mounted on a flat, rigid frame in accordance with the manufacturer's installation instructions.

(1) Horizontal Siding—The middle course shall consist of two lengths of insulated vinyl siding, both with a factory-fabricated end, one section overlapping the other section. The

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end of the overlapping section shall be located not less than 3 in. (76 mm) and not more than 6 in. (152 mm) from the center of the course. Unless specified otherwise by the manufacturer's installation instructions, the insulation of the two lengths of insulated vinyl siding shall be butted firmly together.

(2) Vertical Siding—The middle course shall consist of a single, uninterrupted insulated vinyl siding panel, without overlap.

6.12.1.2 A thermocouple or other heat-sensing element shall be located at the horizontal midpoint of the back side of the middle course of insulated vinyl siding. The heat-sensing element shall be in contact with the back of the vinyl cladding. Any insulation or backing material removed to facilitate placement of the heat sensing element shall be replaced.

6.12.1.3 Radiant-heat rod, 600 W for each linear foot (0.31 m), mounted parallel to the middle course and approximately 32 in. (810 mm) away from the surface of the insulated vinyl siding.

6.12.1.4 Temperature-control device, used to regulate the temperature of the radiant-heat rod, shall be able to maintain the conditions specified in 6.12.2.1.

6.12.1.5 Gap measurement device. A cylindrical pin gauge, ¼ ± 0.005 in. (6 ± 0.127 mm) in diameter is used to evaluate the size of any gap in the overlapped sections of horizontal insulated vinyl siding during the heating period. The pin gauge is attached to a rod such that the gauge can be inserted into a gap while held parallel to the plane of the insulated vinyl siding. The rod shall be sufficiently long to permit insertion of the gauge from beyond the edge to the test frame, not interfere with the exposure of the sample to radiant heat, and otherwise not interfere with conduct of the test.

6.12.2 *Procedure:*

6.12.2.1 Heat the test panel (middle course of insulated vinyl siding) at a rate of 3.0 to 6.0°F/min (1.7 to 3.3°C/min) until a minimum temperature of 150°F (66°C) is achieved as measured by the heat-sensing element on the midpoint of the backside of the middle course. For temperatures equal to or greater than 130°F (54°C), the rate of heating is permitted to be not less than 2.0°F/min (1.1°C/min), provided that the average heating rate from the ambient temperature to 150°F (66°C) is within 3.0 to 6.0°F/min (1.7 to 3.3°C/min). When a temperature of 150°F (66°C) is attained, shut off the heat source.

6.12.2.2 During this heating period, observe the middle course of the insulated vinyl siding for surface distortion and observe for any opening or gap at the end of the overlapped section. If the overlap appears to have opened to approximately ¼ in. (6 mm), attempt to insert the gap measurement device into the opening. If the device can be inserted into the opening to any depth at any location along the overlap, the opening shall be considered to be at least ¼ in. (6 mm).

6.12.2.3 *Failure is defined as:*

(1) the appearance of bulges, waves, or ripples on any surface of the middle course of the insulated vinyl siding; or

(2) occurrence of a gap or opening ¼ in. (6 mm) or greater at any point along the end of the overlapped section, as determined by use of the gap measurement device, at any time before a temperature of 150°F (66°C) is reached.

6.13 *Color Uniformity*—Calculate the difference between the L_H, a_H, and b_H color coordinates for a production specimen to those of either the appropriate reference specimen or the agreed upon color coordinates for that specific color product in accordance with Test Method D2244. Calculate the total difference ΔE between the production specimen and the reference specimen in accordance with Test Method D2244.

6.14 *Wind Load Resistance*—Conduct the test on wind load resistance of finished insulated vinyl siding in accordance with Test Method D5206. The average maximum sustained static test pressure determined from this testing is used in 5.2.3. For purposes of determining compliance with the minimum test pressure and standard design pressure requirements in 5.2.3, the test structure shall be constructed with vertical studs 16 inches on center. The siding shall be tested with insulation attached to the vinyl siding. The siding in the test installation shall be installed over wood sheathing with a nominal thickness of 7/16 to ½ inch, and fastened as follows:

6.14.1 *Fastener Type*—Roofing nail, smooth shank, 0.120 in. (⅛ in. nominal; 3.2 mm) shank diameter, 5/16 in. (7.9 mm) head diameter, length as necessary to penetrate into sheathing and stud a total of 1 ¼ in. (32 mm). For vertical siding, length as necessary to penetrate the thickness of the sheathing plus ¼ in. (6.4 mm).

6.14.2 *Fastener Spacing*—Every 16 in. (406 mm) into center of stud for horizontal siding. For vertical siding, every 12 inches into sheathing only.

6.14.3 Fasteners shall not be driven tightly against the siding. Allow approximately 1/32 in. (0.8 mm) clearance between the fastener head and siding surface.

NOTE 12—The installation details described 6.14 conform to the minimum requirements of the 2015 International Residential Code and the VSI Vinyl Siding Installation Manual.

6.15 *Nail Slot Allowance for Thermal Expansion*—As an alternative to conformance with the nail slot width specification in 5.2.3.1 or 5.2.3.2, provision for thermal expansion and contraction shall be demonstrated through the following test procedure.

6.15.1 *Samples*—At least three samples of each profile in which the insulated vinyl siding is produced shall be provided. The length of each sample shall be at least 50 % of the longest length in which the profile is produced, and not shorter than 12 ft (3658 mm).

6.15.2 *Test Chamber*—The test chamber shall consist of an environmentally controlled room or compartment capable of providing an air temperature range of at least 0 to 100°F (-18 to 38°C) without exposure of the panel to radiant energy from heating or cooling elements. Air temperature shall be controlled such that a rate of temperature change of 2°F (1.11°C) per minute can be achieved over the full temperature range, and the minimum and maximum temperatures can be maintained for at least 15 minutes. Means for circulating air to provide a uniform air temperature throughout the chamber shall be provided. A vertical wall shall be provided for mounting of samples. The wall shall be insulated such that, with no panels mounted, the inner surface of the wall does not deviate more than 10°F (5.5°C) from the air temperature at the high and low temperature extremes after a holding period of

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five minutes. The test chamber shall be of sufficient size to accommodate the longest panel to be tested, including expected thermal expansion of the panel. Means shall be provided to measure the actual temperature of the surface of each panel at a minimum of three evenly-spaced locations along the length of the panel.

6.15.3 *Length Measurement*—A means for measuring the length of each sample throughout the temperature range shall be provided. The method utilized for length measurement shall not be influenced by the temperature of the chamber and shall have a minimum resolution of no greater than 0.0625 in. (1.59 mm).

6.15.4 *Procedure*—Install the sample panels on the wall inside the test chamber, following the manufacturer's instructions for fastener type, spacing, location and tightness. At ambient temperature measure and record the length of each panel and the temperature of the panel, averaged from a minimum of three locations along the length of the panel.

6.15.4.1 *Test Cycle*—Test cycles shall be performed by raising the air temperature to 100 ± 5°F (38 ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding the air temperature at 100°F (38 ± 2.75°C) for 15 minutes, lowering the air temperature to 0 ± 5°F (-18 ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding at 0°F (-18 ± 2.75°C) for 15 minutes, and returning to ambient temperature at an average rate of 2°F per minute.

6.15.4.2 *Conditioning*—Close the test chamber and perform at least two conditioning cycles using the procedure in 6.15.4.1. No interruption is required between conditioning cycles.

6.15.4.3 *Test*—Following completion of the conditioning cycles, conduct three test cycles using the procedure in 6.15.4.1. It is acceptable for the test cycles to follow immediately upon completion of the final conditioning cycle, and no interruption is required between test cycles. After a minimum holding period of 15 minutes at the high and low extremes of each test cycle, measure and record the length of each panel and the temperature of the panel, averaged from a minimum of three locations along the length of the panel.

6.15.5 *Normalization*—From among the length measurements recorded for all three cycles, identify the shortest and longest length of each panel, and the average panel temperature at the time that length was recorded. Determine the maximum difference in length, ΔL, and the maximum difference in temperature, ΔT, by subtracting the smaller from the larger. Normalize the change in length to the full length of the panel over a 100°F (38°C) temperature range using the following formula:

$$E_t = \Delta L \times (100/\Delta T) \times (L_f/L_t) \quad (2)$$

where:

E_t = Total thermal expansion and contraction of a full length panel over a range of 100°F (38°C)
ΔL = maximum change in length of the tested panel,
ΔT = maximum change in temperature of the tested panel,
L_f = longest length in which the panel is produced, and
L_t = actual length of the panel as tested.

6.15.6 *Acceptable Performance*—When tested according to this procedure, the result of $(E_t \times 2) + 0.25$ in. for each of the three samples for each profile shall not be greater than the width of the nail slot. If the manufacturer's installation instructions require the panel to be center-pinned, the result of $E_t + 0.25$ in. for each of the three samples for each profile shall not be greater than the width of the nail slot.

6.16 *Lead Content:*

6.16.1 Testing for lead content shall be conducted on insulated vinyl siding using a rhodizinate-type lead swab test kit conforming to Practice E1753. Testing shall be performed in accordance with the test kit manufacturer's instructions. The insulated vinyl siding shall be deemed to comply with 4.4.1 if the test shows a negative or not-detected result; that is, the test does not indicate the presence of lead. The test shall be conducted separately on the substrate and on any cap or film material, and on the insulation material.

6.16.2 As an alternative to the method in 6.16.1, and as a means of resolving any ambiguous results from that method, an analytical method capable of detecting lead at least as low as 0.02 percent by sample weight shall be employed. Under this alternative, neither the substrate nor any cap or film shall contain a concentration of lead in excess of 0.02 percent by weight.

6.17 *Compatibility of Adhesives:*

6.17.1 *Sample Preparation*—Combine a flat, 2 by 2 in. section of vinyl siding with a 2 by 2 by 0.75 in. sample of insulation, using the adhesive used in the insulated vinyl siding. The top and bottom surfaces of the insulation are to be parallel. The application rate, thickness, and distribution of the adhesive are to be consistent with its application in the insulated vinyl siding. Prepare a total of at least ten such samples.

6.17.2 *Cyclical Conditioning*—Subject half of the samples to the following conditioning. In an appropriate environmental conditioning chamber, starting at room temperature, increase the temperature of air surrounding the sample to 150°F (66°C) and hold for 15 minutes. Over a period of time not greater than 15 minutes, decrease the surrounding air temperature to -10°F (-23°C), and hold for 15 minutes. Return the surrounding air temperature to 150°F (66°C) over a period of time not greater than 15 minutes. This cycle is repeated for a total of 30 cycles.

6.17.2.1 *Tensile Testing*—Condition and test all of the samples in accordance with Test Method C297/C297M Any of the failure modes listed in Test Method C297/C297M (other than failure at the bond to the loading blocks) shall be counted in calculating the average ultimate tensile strength. Separately determine the average ultimate tensile strength for the samples subjected to cyclical conditioning, and for those not subjected to such conditioning.

6.18 *Thermal Insulation Value*—The thermal insulation value for the insulated vinyl siding shall be determined in accordance with Test Method C1363. Test conditions, test sample selection, configuration and installation, and procedure shall be as specified in the following sections.

6.18.1 *Wind Direction and Velocity*—Testing of the base wall and insulated vinyl siding samples shall be with the

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exterior wind direction perpendicular to the plane of the test wall. The calibration procedure in Section 6 of Test Method C1199 shall be used to establish standard room and weather side surface heat transfer coefficients.

6.18.2 *Test Temperatures*—Testing shall be performed at an exterior temperature of 50°F and an interior temperature of 100°F.

6.18.3 *Base Wall*—The base wall for attachment of the insulated vinyl siding shall provide for overall test sample dimensions of 96 ± 6 in. (2438 ± 152 mm) in both the vertical and horizontal axis. The construction of the wall shall be sufficient to hold the test installation without flexing under the imposed wind. The weather side surface of the base wall shall include a solid surface composed of uniform sheet material capable of securely holding standard roofing nails or the fasteners specified by the manufacturer for installation of the insulated vinyl siding under test. The wall shall be fully sealed to prevent movement of air between the chambers.

NOTE 13—The precise materials and construction of the base wall are not specified because its thermal characteristics will be directly measured to establish baseline conditions from which the performance of the insulated vinyl siding alone can be distinguished. A standard framed wall composed of nominal 2 by 4 in. studs on 16 in. (406 mm) centers, covered by nominal ½ in. plywood or oriented strand board (OSB) has been found to be suitable for most test applications.

6.18.4 *Sample Selection*—reserved for any requirements needed for specifying the sample to be used, how many replicates, etc. (if needed).

6.18.5 *Test Installation*—The area covered by the insulated vinyl siding shall be 96 ± 6 in. (2438 ± 152 mm) in both the vertical and horizontal axis. The test installation shall be composed of the number of insulated vinyl siding panels needed to cover the test installation area, and any siding accessories normally used for installation of that insulated vinyl siding.

6.18.5.1 *Overlaps*—The test installation shall include both courses that cover the full width of the test wall with a single panel, and courses composed of two or more adjacent, overlapping panels. The number of courses containing overlapped panels shall be as specified below.

(1) Panels shorter than full width of the test wall—Where the insulated vinyl siding is commercially available in panels shorter in length than the full width of the testing installation, each course shall contain adjacent, overlapped panels. For panels equal to or longer than one-half the test installation width, each course shall contain two panels, with one joint between them. For shorter panels, the number of panels and joints per course is determined by the length of the panels and the overlapping of panels specified in the manufacturer's installation instructions.

(2) Vertical Siding—The test installation for vertical insulated vinyl siding shall contain no overlap joints.

(3) Horizontal Siding—The number of courses with overlap joints for horizontal insulated vinyl siding shall be based on the vertical coverage of the profile, in accordance with Table 1 or the following formula. For test walls with a insulated vinyl siding installation height other than 96 in (2438 mm), or for insulated vinyl siding profiles not listed in Table 2, the number of courses with overlap joints shall be determined according to the following formula:

$$L = 0.375\left(\frac{H}{V}\right) \quad (3)$$

where:

L = Number of courses with overlap joints in test installation; rounded to the nearest integer
H = Height of test installation, inches
V = Vertical coverage of one panel, inches

(4) The specified number of courses with overlaps joints shall be evenly distributed vertically across the test installation. Adjacent courses shall not contain overlap joints.

6.18.5.2 The bottom edge of the insulated vinyl siding shall be secured with a starter strip or equivalent trim specified by the manufacturer. The sides and top edge of the insulated vinyl siding shall be bound by J-channels or equivalent trim specified by the manufacturer.

6.18.5.3 The insulated vinyl siding and trim shall be installed in the order in which they are installed in the field, in accordance with the manufacturer's installation instructions. Fastening of the insulated vinyl siding and trim to the wall shall be as specified in the manufacturer's installation instructions.

6.18.5.4 *Sealing of Test Installation*—No part of the test installation, including insulated vinyl siding panels, joints, overlaps and perimeter, shall be sealed other than by the means integral to manufacturer-supplied siding panels or trim. Any actions specified in the manufacturer's installation instructions to secure or enable an integral sealing means shall be carried out.

6.18.6 *Procedure*—Conduct a test of the base wall alone, with no insulated vinyl siding installed, in accordance with Test Method C1363. Determine the R-value of the base wall. Install the insulated vinyl siding and conduct a test under the same conditions, and determine the R-value of the base wall-insulated vinyl siding assembly. Determine the R-value of the insulated vinyl siding by subtracting the R-value of the base wall alone from that of the base wall-insulated vinyl siding assembly. Report the R-value of the insulated vinyl siding, rounded to the nearest tenth.

6.18.6.1 Reuse of the R-value determined for the base wall is permitted for subsequent tests of insulated vinyl siding. The

TABLE 2 Courses with Overlaps Joints

Siding Type	Vertical Coverage (in.)	Number of Courses Including Overlaps
Single 6.5	6.5	6
Single 7	7	5
Double 4	8	5
Single 8	8	5
Double 4.5	9	4
Triple 3	9	4
Double 5	10	4
Quad 2.5	10	4
Double 6	12	3
Triple 4	12	3
Double 6.5	13	3
Double 7	14	3
Quad 4.5	18	2
Triple 6	18	2

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R-value of the base wall shall be reestablished by testing if the test configuration is changed, the base wall has been removed and reinstalled, ambient temperature or humidity has changed or fluctuated significantly, or any other event has occurred that is likely to affect the R-value of the base wall.

6.19 *Flame Spread*—Conduct the test on flame spread of finished insulated vinyl siding in accordance with Test Method E84. The test specimen shall either be self-supporting by its own structural characteristics or held in place by added supports along the test specimen surface, or secured from the back side.

7. Packaging and Package Marking

7.1 The insulated vinyl siding shall be packed in such a manner as to provide reasonable protection against damage in ordinary handling, transportation, and storage.

7.2 Provisions of Practice D3892 shall apply to this specification.

7.3 To aid identification of insulated vinyl siding conforming to all requirements of this specification, producers and distributors shall include a statement of compliance in conjunction with their name and address on product labels, invoices, sales literature, and the like. The following statement is suggested when sufficient space is available: "This insulated vinyl siding conforms to all the requirements established in ASTM Specification D7793 developed cooperatively with the industry and published by ASTM. Full responsibility for the conformance of this product to the specification is assumed by (name and address of producer or distributor)."

7.4 The following abbreviated statement is suggested when available space on labels is insufficient for the full statement: "Conforms to ASTM Specification D7793 (name and address of producer or distributor)."

7.5 The package shall be marked or labeled with the R-value determined in 6.18.

NOTE 14—Marking or labeling done in compliance with 16 CFR Part 460 will normally satisfy this requirement. That and other government regulations may require additional information and statements which are not required by this standard.

7.6 The standard wind load design pressure rating determined in accordance with 5.2.3.2 shall be stated on the product or on the product package by one of the means in 7.6.1 or 7.6.2.

7.6.1 The package shall be marked or labeled with the standard wind load design pressure rating. The marking shall be in the format "Standard Wind Load Design Pressure Rating: ##.# psf (ASD)".

7.6.2 The standard design pressure rating shall be included on a line imprint or other marking on the front (outward-facing) surface of all siding panels. It is not required that the marking be visible after installation, provided that the marking can be revealed and read by detaching the lower edge lock of an adjacent course, without removal of any fasteners. The standard design pressure marking shall be stated at least once per panel. The marking shall be in the format "Std Design Pressure Rating: ##.# psf (ASD)".

7.6.3 At the option of the manufacturer, additional marking or labeling of the package or product with alternative wind load design pressure ratings determined in accordance with 5.2.2.3 for use with alternative sheathings, wall configurations or fastening methods is permitted. The marking shall use the format specified in 7.6, shall indicate the type of sheathing or wall configuration for which it is applicable, and shall refer to the manufacturer's instructions for more information and any installation requirements.

8. Keywords

8.1 insulated siding; insulated vinyl siding; plastic building products; plastic weatherability; recycled plastic; rigid PVC siding; specification; vinyl siding

ANNEX

(Mandatory Information)

A1. WIND LOAD RESISTANCE TEST DESIGN FACTORS

A1.1 Wind Load Criteria

A1.1.1 ASCE 7-10 is the basis for determining the design pressures used in this specification. Design wind loads are determined on an ASD basis in this specification.

NOTE A1.1—In previous editions of ASCE 7, wind loads were determined using wind speed maps based on a 50-year return period. In ASCE 7-10, maps based on a 700-year return period are used which, for any given location, produce a wind speed approximately 30 % greater than that of the previous maps. This larger magnitude (higher return period) wind speed, referred to as the ultimate wind speed, (V_{ULT}), is used directly (with a load factor of 1.0) to determine nominal wind loads on a Strength Design (LRFD) or "ultimate" wind load basis. When Allowable Stress Design (ASD) is used, ASCE 7-10 provides for these ultimate wind loads, determined from the ultimate wind speed map velocities, to be multiplied by a load factor of 0.6. Alternatively, the adjustment can be made directly to the wind velocity, which is the approach taken in this method (see A1.1.2). This procedure produces results consistent with past ASD wind loads.

A1.1.2 It is necessary to determine whether the wind velocity to be used is based on the maps in ASCE 7-10 or on older maps designed for direct application of ASD. Wind velocity, V, based on ASD is used in this method. Wind speeds determined using the maps in ASCE 7-10, referred to as V_{ULT}, are converted to ASD wind speeds, V_{ASD}, by multiplying by the square root of 0.6. Wind speeds based on maps using an ASD basis do not require conversion (see A1.3) Thus:

$$V = V_{ASD} = V_{ULT} \times \sqrt{0.6} \qquad \text{(A1.1)}$$

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The V determined in this section is used in the following calculations.

A1.1.3 The velocity pressures, q, used in this specification have been computed using the following equation:

$$q = 0.00256\,K_z K_d V^2 I(lb/sq.\,ft) = 0.613\,K_z K_d V^2 I(N/m^2) \quad (A1.2)$$

where:

V = wind velocity, mph (km/h). The basic wind speed corresponds to a 3-s gust speed at 33 ft (10.1 m) above ground in exposure category C, as described in ASCE 7-10. A velocity of $V = V_{ASD}$ = 110 mph (177 km/h) was used in this specification. (See Note A1.2 and Note A1.3.)

I = "importance factor" as described in editions of ASCE 7 prior to ASCE 7-10. A value of 1.0 is used. This factor is not used where the wind speed has been determined from a map in ASCE 7-10. (See Note A1.4.)

K_z = "velocity pressure coefficient" as described in ASCE 7-10. A "K_z" of 0.70 is used in the wind pressure calculations, which is the value from ASCE 7-10 for a mean roof height of 30 ft (9.1 m) above ground level and Exposure Category B.

K_d = "wind directionality factor" as described in ASCE 7-10. A "K_d" of 0.85 is used.

A1.1.4 Thus for the given velocity and factors, the velocity pressure, q = 18.43 lbf/ft^2 (882 Pa).

NOTE A1.2—As explained in Note A1.1, the wind velocity used in this method is converted from the V_{ULT} given by wind speed maps in ASCE 7-10 to V_{ASD} using the equation in A1.1.2. A V_{ULT} wind speed of approximately 140 mph from the maps is equivalent to a V_{ASD} of 110 mph, which is the velocity V used in this specification.

NOTE A1.3—In ASCE 7-10 the default wind speeds are given for exposure category C, and a table is provided to adjust this wind speed for other exposure categories. Since most insulated vinyl siding is installed on buildings located in exposure category B, the velocity pressure coefficient, K_z is included in the equation to make this adjustment.

NOTE A1.4—Editions of ASCE 7 prior to ASCE 7-10 included an importance factor to represent the relative significance of the building and the consequences of its loss. Because most insulated vinyl siding is installed on residential and light commercial buildings, the importance factor was set at 1.0 by default. ASCE 7-10 has removed the importance factor from the velocity pressure equation, and instead provides a different wind speed map for each of the building importance categories (referred to as risk categories in ASCE 7-10). Thus the importance factor will already have been incorporated into the wind speed determined from the appropriate map, and the importance factor is not used for determining velocity pressure using wind speeds from ASCE 7-10 maps.

A1.1.5 ASCE 7-10 recommends various internal and external pressure coefficients, which include gust response factors. These coefficients vary with the effective area of the cladding component, the location of the cladding component relative to building corners, and the configuration of the building (open versus enclosed). The internal and external pressure coefficients are taken from Table 26.11-1 and Figure 30.4-1 of ASCE 7-10. The effective area is taken as 10 square feet (the area of one piece of siding), an enclosed building is assumed, and factors for the building corners are used. The pressure coefficients are as follows:

$$Internal\ Pressure\ Coefficient = \pm 0.18 \quad (A1.3)$$

$$External\ Pressure\ Coefficient = +1.00\ and\ -1.40$$

A1.1.6 The design pressure is calculated by multiplying the velocity pressures by the algebraic sum of the internal and external pressure coefficients.

A1.2 Design Pressure

NOTE A1.5—Because the wind velocity has already been adjusted from an ultimate basis to an ASD basis at the beginning of these calculations, the design pressure determined in this step is an ASD load. This correlates to the design pressure requirements stated in tables in the 2015 International Residential Code and other codes which have also been adjusted to an ASD basis. However, the required design pressures in some other codes and design standards have not been adjusted to an ASD basis. Where required design pressures are based on ultimate wind loads determined from ASCE 7-10 wind speeds, those loads must be multiplied by 0.60 to match the design pressure determined from this equation. A1.2

$$Positive\ Design\ Pressure = (18.43)\,(1.00+0.18) = 21.74\ psf \quad (A1.4)$$

$$Negative\ Design\ Pressure = (18.43)(-1.40-0.18) = -29.12\ psf$$

A1.2.1 The negative values (suction loads) are the largest in magnitude and are the design values used in this specification. Research conducted by various organizations[5,6] has shown that a certain amount of pressure equalization occurs through residential siding products installed with sheathing under high dynamic pressures. In light of this pressure equalization, the design pressure in the ASCE 7-10 wind load standards is reduced by a factor of 0.5 for insulated vinyl siding.

A1.2.2 Therefore, the required test pressures are calculated as follows:

$$P_t = D_P \times PEF \times 1.5 \quad (A1.5)$$

where:

P_t = test pressure, lbf/ft^2 (Pa),

D_P = design pressure, lbf/ft^2 (Pa),

PEF = pressure equalization factor, insulated vinyl siding, 0.5, and

1.5 = safety factor.

A1.2.2.1 If documentation in support of the use of compensation for pressure equalization other than 0.5 is provided, use the calculation in A1.2.2, substituting the appropriate pressure equalization factor.

A1.2.3 Using the above equations, in a 110 mph (177 km/h) (V_{ASD}) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, the required minimum uniform load test pressure for insulated vinyl siding is 21.84 lbf/ft^2 (1046 Pa).

A1.2.3.1 For compliance with 5.2.2, the referenced design pressure has been rounded to -30.0 lbf/ft^2 (1436 Pa) to match the standard design conditions specified by the 2015 International Residential Code. When tested under Test Method D5206, the siding must attain an average maximum sustained static test pressure equal to or greater than the corresponding minimum test pressure of 22.5 lb/ft^2 (1077 Pa).

[5] Vinyl Siding Pressure Equalization Factor, Architectural Testing, Inc. Report No. 01-40776.01, September 2002.

[6] Morrison, M.J., Cope A.D. "Wind Performance and Evaluation Methods of Multi-Layered Wall Assemblies." *Structures Congress*, 2735-2748, Portland, OR, 2015.

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A1.2.4 For applications where the effective design pressure is greater than -30.0 lbf/ft^2 (1436 Pa) (for example, wind zone areas greater than 110 mph (177 km/h) (V_{ASD}), mean roof height over 30 ft (9.1 m), or exposure conditions other than Exposure B), refer to ASCE 7-10 for the effective design pressure. To be shown to be suitable for the application, when tested under Test Method D5206 the siding must attain an average maximum sustained static test pressure equal to or greater than the minimum test pressure determined by the formula in A1.2.2, using the design pressure, D_P, determined for the application using the procedure in A1.1.2 through A1.2.

A1.2.5 These loading conditions apply only to siding installed without an air space directly over sheathing of a type and fastening method that is capable of independently resisting both positive and negative wind design pressures at the building location. Examples of such sheathing include oriented strand board (OSB) and plywood fastened to resist the design wind pressures. For applications where the siding is installed over open studding, without sheathing, rapid pressure equalization does not occur and pressure equalization factor (PEF) is set to 1.0. In these applications, the load the siding will see is equal to the total design pressure. The static test pressure required for products used under these conditions is as follows:

$$P_t = D_P \times PEF \times 1.5 \quad \text{(A1.6)}$$

where:

P_t = static test pressure, lbf/ft^2 (Pa),
D_P = design pressure, lbf/ft^2 (Pa), and
PEF = pressure equalization factor, 1.0, and
1.5 = safety factor.

A1.2.5.1 Therefore in a 110 mph (177 km/h) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, siding installed without sheathing would require a uniform load test pressure of 43.72 lbf/ft^2 (2093 Pa).

NOTE A1.6—Building codes and insulated vinyl siding installation instructions require insulated vinyl siding to be installed over sheathing, so calculation of minimum test pressure for siding installed without sheathing is essentially moot. However, the calculation has been retained for completeness and comparison with other installation conditions.

A1.2.6 When siding is installed over sheathing that is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, a greater percentage of the total wind pressure is transferred to the siding and its fasteners. This has the effect of partially or completely countering the effect of the pressure equalization factor. In these cases a value between 0.5 and 1.0 is used for the pressure equalization factor (PEF).

A1.2.6.1 In addition, in cases where failure of the siding would result in failure of the exterior wall covering assembly (that is, siding and sheathing) a safety factor of greater than 1.5 is indicated.

A1.2.6.2 If the adjusted PEF for a given combination of siding and sheathing is known, and an appropriate safety factor is used, a minimum test pressure can be determined using the equation in A1.2.1. However, it is normally more appropriate to make an adjustment for alternative sheathings when determining the design pressure rating, as discussed in A1.3.

NOTE A1.7—Where the sheathing is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, the layer of siding over the sheathing, and its fastening through the sheathing, act to reinforce the sheathing such that the whole wall covering (siding-sheathing) assembly is capable of resisting such wind pressures. Because the siding is tested by itself (not as part of a siding-sheathing assembly) in Test Method D5206, the adjustment of test pressure (before the test) or of the design pressure (after the test) ensures that the wind load resistance of the assembly as a whole is reflected in the rating of the siding.

NOTE A1.8—In some high wind hazard regions, such as south Florida, the exterior wall covering assembly may also be required to meet wind-borne debris impact resistance criteria which would affect the choice of sheathing material to be used together with siding. Such considerations are beyond the scope of this standard.

A1.3 Wind Design Pressure Rating (Maximum Allowable Pressure)

A1.3.1 A design pressure rating is the maximum wind pressure that a particular siding product is rated to be able to withstand. It is used in building design and building codes to determine the acceptability of a siding product for use under the design wind conditions for a specific application. To be acceptable, a siding's design pressure rating must be equal to or greater than the design pressure for the specific building at the specific location. The design pressure rating is determined from the average maximum sustained static test pressure for a siding product produced by testing under Test Method D5206, the pressure equalization factor, and a safety factor.

A1.3.2 *Standard Design Pressure Rating*—The standard design pressure rating is used for applications where the siding is installed over a sheathing type and fastening method that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location.

A1.3.2.1 The standard design pressure rating assumes that the siding is fastened to the building in the standard manner, with the minimum fastener type, size, spacing, and penetration depth prescribed in Chapter 7 of the International Residential Code and the VSI Vinyl Siding Installation Manual. The installation of the siding for testing under Test Method D5206 must be consistent with these minimum fastening requirements. However, this does not prevent additional testing, using different fastening, to support design pressure ratings for other applications, such as special high wind installations.

A1.3.2.2 The pressure equalization factor and safety factor are the same as those used to determine the test pressure in A1.2.1, using the following equation:

$$D_{Rstd} = \frac{P_m}{(PEF \times SF)} \quad \text{(A1.7)}$$

where:

D_{Rstd} = standard design pressure rating, lbf/ft^2 (Pa),
P_m = average maximum sustained static test pressure, lbf/ft^2 (Pa),
PEF = pressure equalization factor, 0.5, and
SF = safety factor, 1.5.

A1.3.3 *Alternative Design Pressure Ratings*—Design pressure ratings for applications other than the standard conditions described above can be developed. Common circumstances

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where this is done include the use of alternative fastening methods in order to achieve a higher design pressure rating, and cases where the sheathing is not capable of independently resisting wind pressures under design conditions, which necessitates a reduction in the siding's design pressure rating.

A1.3.3.1 *Alternative Fastening*—Where an alternative fastening method is specified by the manufacturer, the siding is permitted to be tested under Test Method D5206 using the specified fastening. The resulting average maximum sustained static test pressure is used in the above equation to determine the alternative design pressure rating. In order for this alternative rating to be realized, the siding must be installed using the alternative method, and the rating must be clearly tied to installation requirements in manufacturer's literature and instructions.

A1.3.3.2 *Alternative Sheathing*—An adjusted design pressure rating for use of the siding over sheathings not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, as discussed in A1.2.6, can be calculated using the above equation if the appropriate PEF and safety factor are specified.

A1.3.3.3 Alternative PEF and safety factor values have been documented (see 2009 and 2012 International Residential Code, section R703.11.2) for one type of sheathing, foam plastic insulating sheathing complying with ANSI/SBCA FS 100. Two wall assembly cases are considered: 1) where the interior surface of the wall is covered with gypsum wall board or equivalent; and 2) where the interior surface of the wall is not covered with gypsum wall board or equivalent. In both cases the siding is installed directly over foam sheathing, which is then attached directly to framing, without intervening sheathing. The PEF and safety factor for each case are as follows:

Case	PEF	Safety Factor
Case 1	0.7	2.0
Case 2	1.0	2.0

A1.3.3.4 Adjustment of the standard design pressure rating is not necessary when foam plastic insulating sheathing is installed directly over sheathing that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, or where the sheathing is fastened in a way that allows it to independently resist the design wind pressure. For such cases the standard design pressure rating is applied.

A1.4 Design Wind Speeds

A1.4.1 The wind velocity maps in ASCE 7-10 provide one source of design wind speeds for particular geographic regions. The velocities on these maps are stated in terms of "ultimate," 700-year return interval speeds. To be used in the procedure in this Annex, those velocities need to be converted to the ASD equivalent in accordance with A1.1.2, and the resulting velocity V used in the equation in A1.1.3. The 2012 and 2015 International Building Code and 2015 International Residential Code also contain maps based on ultimate wind speeds.

A1.4.2 Other maps are available that do not require conversion of wind velocities. Examples include the wind map in the 2012 International Residential Code, on which the velocities have already been converted from those on the ASCE 7-10 maps. Maps from previous editions of ASCE 7 used ASD velocities and do not require conversion. However, only editions since 1995 used the 3-second gust basis that is used in this Annex. The 1998, 2002, and 2005 editions of ASCE 7 continued the use of 3-second gust wind basis, but with improved hazard modeling of hurricane wind speeds first made in the 1998 edition. These previous editions also do not have the benefit of further improved hurricane wind modeling that was incorporated into the maps used in ASCE 7-10.

APPENDIX

(Nonmandatory Information)

X1. VINYL SIDING, BACKED SIDING, AND INSULATED VINYL SIDING

X1.1 Relationships among types of vinyl siding

X1.1.1 Conventional vinyl siding is covered by ASTM D3679, Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding. D3679 includes provisions for the materials and performance of vinyl siding, including minimum PVC composition and percentage of recycled material, dimensional requirements, impact resistance, resistance to surface distortion and deterioration, thermal expansion, windload resistance, etc.

X1.1.2 Backed vinyl siding is vinyl siding that includes an integral foam plastic backing material, and is covered by Specification D7445. That specification includes many of the same requirements as are found in D3679, which are applied to the vinyl siding "skin" of the product. Additional requirements, which apply to the foam backing itself, or to the full product including both siding and foam, are also included in Specification D7445

X1.1.3 Insulated vinyl siding, which is the subject of this standard specification, may be thought of as backed vinyl siding that is able to meet enhanced requirements. Chief among those is the requirement that insulated vinyl siding demonstrate a minimum thermal resistance, or R-value. While the foam backing of backed vinyl siding may, or may not, impart some R-value, it is not required to demonstrate that. To be considered "insulated vinyl siding" the product must demonstrate that it delivers the minimum R-value.

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X1.1.4 As with backed vinyl siding, insulated vinyl siding is composed of a vinyl siding "skin" and foam plastic insulation. The vinyl siding portion must meet specific requirements for vinyl siding, which parallel with those in D3679. As with backed vinyl siding, insulated vinyl siding is subjected to additional requirements that apply to the foam or to the full product including siding and foam. In some cases the minimum specification or performance level is higher for insulated vinyl siding compared to backed vinyl siding. This is consistent with the intent that insulated vinyl siding be understood as offering enhanced performance and tangible benefits over the more basic backed vinyl siding.

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SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D7793 - 17) that may impact the use of this standard. (December 1, 2020)

(1) Revised 1.1.

(2) Added 5.2.6 and 6.19.

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Designation: D7445 – 24

Standard Specification for

Rigid Poly(Vinyl Chloride) (PVC) Siding with Foam Plastic Backing (Backed Vinyl Siding)[11]

An American National Standard

This standard is issued under the fixed designation D7445; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope *

1.1 This specification establishes requirements for vinyl siding with integral foam plastic backing, where the siding is manufactured from rigid PVC compound. Performance requirements and test methods addressed by this standard include materials properties and dimensions, warp, shrinkage, impact strength, expansion, appearance, flame spread, and wind load resistance. Methods of indicating compliance with this specification are also provided.

NOTE 1—Backed vinyl siding is composed of two major components: the siding and the backing. It is intended that the siding portion comply with Specification D3679. Applicable portions of Specification D3679 are included in this specification. Additional requirements that pertain only to the backing as a separate material, or to the combination of siding and backing as a whole, are also included.

1.2 Backed vinyl siding shall be tested with the backing material in place or removed, as specified in the applicable requirement or test method.

1.3 The use of PVC recycled plastic in this product shall be in accordance with the requirements in Section 4.

1.4 Siding produced to this specification shall be installed in accordance with Practice D4756. Reference shall also be made to the manufacturer's installation instructions for the specific product to be installed.

NOTE 2—Information with regard to siding maintenance shall be obtained from the manufacturer.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 3—There is no known ISO equivalent to this standard.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[22]

D618 Practice for Conditioning Plastics for Testing

D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between –30°C and 30°C with a Vitreous Silica Dilatometer

D883 Terminology Relating to Plastics

[1] This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.24 on Plastic Building Products.

Current edition approved X 1, 2024. Published X 2024. Originally approved in 1979. Last previous edition approved in 2018 as D7445 – 18. DOI: 10.1520/D7445-24.

*A Summary of Changes section appears at the end of this standard.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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D1042 Test Method for Linear Dimensional Changes of Plastics Caused by Exposure to Heat and Moisture

D1435 Practice for Outdoor Weathering of Plastics

D1600 Terminology for Abbreviated Terms Relating to Plastics (Withdrawn 2024)[3]

D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

D2457 Test Method for Specular Gloss of Plastic Films and Solid Plastics

D3679 Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding

D3892 Practice for Packaging/Packing of Plastics

D4226 Test Methods for Impact Resistance of Rigid Poly(Vinyl Chloride) (PVC) Building Products

D4756 Practice for Installation of Rigid Poly(Vinyl Chloride) (PVC) Siding and Soffit (Withdrawn 2023)[3]

D5206 Test Method for Windload Resistance of Rigid Plastic Siding

D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens

D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)[3]

D7793 Specification for Insulated Vinyl Siding

E84 Test Method for Surface Burning Characteristics of Building Materials

E631 Terminology of Building Constructions

E1753 Practice for Use of Qualitative Chemical Spot Test Kits for Detection of Lead in Dry Paint Films

G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

2.2 *ASCE Standard:*[4]

ASCE 7-10 Minimum Design loads for Buildings and Other Structures

2.3 *International Code Council:*[5]

International Building Code

International Residential Code

2.4 *Vinyl Siding Institute, Inc.:*[6]

VSI Vinyl Siding Installation Manual (2015)

2.5 *Structural Building Components Association:*[7]

ANSI/SBCA FS 100-2012 Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies

3. Terminology

3.1 Definitions are in accordance with Terminologies D883, E631, and D1600, unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *backed vinyl siding*—a vinyl cladding product sold with manufacturer-installed foam plastic backing material as an integral part of the cladding product. The vinyl cladding portion of backed vinyl siding meets the definition of vinyl siding. Backed vinyl siding is intended to be installed only with the integral backing.

3.2.2 *backing material; foam plastic backing*—a layer or layers of plastic that has been intentionally expanded to produce a reduced-density plastic containing voids consisting of open or closed cells distributed throughout the plastic.

3.2.3 *nominal*—the value that a manufacturer consistently uses to represent a specific property or dimension of a vinyl

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.

[5] Available from International Code Council (ICC), 500 New Jersey Ave., NW, 6th Floor, Washington, DC 20001, http://www.iccsafe.org.

[6] National Housing Center, 1201 15th Street NW, Suite 220, Washington, DC 20005, http://www.vinylsiding.org

[7] 6300 Enterprise Lane, Madison, WI 53719, http://www.sbcindustry.com

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siding product in public claims including, but not limited to, product literature, advertisements, quotations, and certificates of conformance.

3.2.4 *process average thickness*—the rolling, arithmetic mean of average specimen thicknesses measured according to 6.5 for a specific product during all productions runs for the most recent six month period.

3.2.5 *wind load design pressure rating*—the maximum wind pressure that a backed vinyl siding product is rated to withstand, based on testing under Test Method D5206.

3.2.5.1 *standard wind load design pressure rating*—the wind load design pressure rating for a siding product when installed 1) over a sheathing material designed and attached such that it is capable of resisting 100 % of positive and negative wind pressures occurring under design conditions at the building location; and 2) with the standard fastening method specified in building codes, general installation instructions, and the siding manufacturer's instructions.

3.2.5.2 *alternative wind load design pressure rating*—the wind load design pressure rating for a siding product when installed over a sheathing not designed and attached such that it is capable of resisting 100 % of positive and negative wind pressures occurring under design conditions at the building location, or when the siding is not fastened in the standard way; as specified by the manufacturer.

3.2.5.3 *Discussion*—The standard test conditions, configuration, and fastening method used in this specification are specified in 6.14, while alternative sheathing and installation conditions are specified by the manufacturer and must be reflected in the product's installation instructions. Alternative ratings apply only when the specified sheathing and fastening conditions are used. See Annex A1 for information on differences between the standard wind load design pressure rating and alternative wind load design pressure ratings, and how to determine standard and alternative design pressure ratings.

3.2.6 *temperate northern climate*—in weather testing, a North American metropolitan area testing site located within 73 to 100°W longitude and 37 to 45°N latitude.

3.2.7 *vinyl siding*—a shaped material, made principally from rigid poly(vinyl chloride) (PVC), that is used to clad exterior walls of buildings; in this standard, vinyl siding refers to the rigid profile to which the backing material is attached.

3.2.7.1 *Discussion*—Any exception to a homogeneous rigid PVC compound is present in a coextruded or laminated capstock.

4. Materials and Manufacture

4.1 The vinyl siding, exclusive of backing material, shall be made of one or more layers of poly(vinyl chloride) (PVC) compound. Any layers of materials other than poly (vinyl chloride) (PVC) compound shall be kept to less than 20 % by volume. This limitation does not apply to the backing material.

4.2 Where rigid PVC recycled plastic as defined in Guide D7209 is used, the siding containing the PVC recycled plastic shall meet all of the requirements of 3,Terminology; 4, Materials and Manufacture; and 5, Physical Requirements.

4.3 The poly(vinyl chloride) siding material, exclusive of backing material, when tested in accordance with Test Method D635, shall not exceed an average extent of burn of 4 in. (100 mm), with an average time of burn not to exceed 10 s. A minimum sample thickness of 0.035 in. (0.9 mm) is required. **Warning—**The flammability testing data, conclusions, and recommendations of Test Method D635 relate solely to the measurement and description of properties for classification of the poly(vinyl chloride) siding material in response to flame under controlled laboratory conditions and shall not be used for the description or appraisal of the fire hazard of vinyl siding under actual fire conditions.

4.4 The foam plastic backing shall have a Flame Spread Index not greater than 75 and a Smoke Developed Index not greater than 450 when tested separately under method E84.

4.5 The PVC compound when extruded into siding shall maintain uniform color and be free of any visual surface or structural changes, such as peeling, chipping, cracking, flaking, or pitting.

4.6 The PVC compound shall be compounded so as to provide the heat stability and weather exposure stability required for the siding market application.

4.7 Backed vinyl siding shall not contain elemental lead (Pb) or compounds of that material other than traces incidental to raw materials or the manufacturing process. This limitation applies to both PVC substrate and to any cap or film material, as well as the backing material. Compliance with this requirement shall be demonstrated by one of the methods in 6.16.

5. Physical Requirements

5.1 *Requirements Applicable to Vinyl Siding*—The provisions of 5.1.1 – 5.1.8 apply only to the vinyl siding, exclusive of any backing material. Where necessary to perform testing, the backing material shall be removed.

5.1.1 *Length and Width*—The nominal length and width of the siding shall be as agreed upon between the purchaser and the seller. The actual length shall not be less than $^{1}/_{4}$ in. (6.4 mm) of the nominal length and the actual width shall be within ± $^{1}/_{16}$ in. (1.6 mm) of the nominal width when measured in accordance with 6.3 and 6.4.

5.1.2 *Thickness*—These requirements pertain only to measurements of the portions of the siding that are exposed after

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installation of the panel, measured in accordance with the procedure in 6.5. The average thickness of each specimen shall be no less than 0.035 in. No individual measurement shall be thinner than 0.003 in. below the nominal thickness. The process average thickness as defined in 3.2.4 shall be no thinner than 0.001 in. below the nominal thickness.

5.1.3 *Camber*—A full length of siding (typically 10 or 12 ft (3.05 or 3.61 m)) shall not have a camber greater than $^{1}/_{8}$ in. (3.2 mm) when measured in accordance with 6.6.

5.1.4 *Heat Shrinkage*—The average heat shrinkage shall not exceed 3.0 % when determined by the method described in 6.7.

5.1.5 *Impact Resistance*—Siding shall have a minimum impact strength of 60 in.·lbf (6.78 J) when tested in accordance with 6.8.

5.1.6 *Coefficient of Linear Expansion*—The siding shall have a coefficient of linear expansion not greater than 4.5 by 10^{-5}in./in./°F (8.1 by 10^{-5} mm/mm/°C) when tested in accordance with 6.9.

5.1.7 *Gloss*—The gloss of smooth and embossed vinyl siding shall be uniform across the exposed surface. The average of all readings for a panel determined in 6.11.2.5 shall not differ from the manufacturer's specified gloss value more than the permitted variation in Table 1, and each individual reading shall not vary more than 10 points from the average. Gloss of smooth and embossed vinyl siding shall be tested in accordance with 6.11.

TABLE 1 Gloss Values

Manufacturer's Specified Gloss Value	Permitted Difference from Manufacturer's Specified Gloss Value
Less than or equal to 35	±8
Greater than 35	±10

5.1.8 *Uniformity of Color*—The color specified shall be uniform on the exposed surface of the vinyl siding panels, except on the case of variegated colors. When tested in accordance with 6.13, the total color change, ΔE, between a production specimen and the appropriate reference specimen or agreed-upon color coordinates shall not vary by more than 1.5, and the chromatic coordinates thereof shall not change by more than $\pm\Delta a_H = 1.0$ and $\pm\Delta b_H = 1.0$.

5.1.9 *Weathering:*

5.1.9.1 The vinyl siding shall maintain a uniform color and be free of any visual surface or structural changes such as peeling, chipping, cracking, flaking, and pitting when tested in accordance with 6.10.

NOTE 4—Weathering-conformance-testing requirements are to reflect performance of a "typical" extrusion siding profile representing a specific color of PVC compound and a specific extrusion technology. In no case is there an implied requirement for testing all the various shaped and sized siding profiles produced in this color. The lengthy outdoor weatherability testing for new products may be performed concurrently with market development and sales of siding to existing markets. Completion of weatherability testing prior to marketing of the product is not required.

5.2 *Requirements Applicable to Backed Vinyl Siding*—The provisions of 5.2.1 – 5.2.3 apply to backed vinyl siding, including the integral foam backing material. Testing shall be conducted with the backing material in place, as described in the referenced test method.

5.2.1 *Surface Distortion*—The *backed vinyl* siding shall be free of bulges, waves, and ripples when tested to a minimum temperature of 150°F (66°C) in accordance with the procedure in 6.12. This distortion is called "oil-canning."

5.2.2 *Wind Load Resistance*—The siding shall withstand a minimum static test pressure and a standard wind load design pressure rating shall be determined.

5.2.2.1 *Minimum Test Pressure*—Backed siding shall be able to withstand a minimum test pressure of 22.5 lbf/ft^2 (1077 Pa) when tested in accordance with 6.14. The average maximum sustained static test pressure determined in 6.14 shall be equal to or greater than this value. If the manufacturer of backed siding provides documentation to support compensation for pressure equalization, the test pressure shall be determined from Annex A1 using the documented pressure equalization factor.

NOTE 5—The static test pressure of 22.5 lbf/ft^2 (1077 Pa) for backed siding was established to withstand structural loading conditions that occur in wind exposures of approximately 110 mph (177 km/h) (V_{ASD}) for mean roof heights of 30 ft (9.1 m) and less in exposure category B, and corresponds to 30.0 lbf/ft^2 (1436 Pa) negative design pressure, to match the default wind design conditions of Table R703.3(1) in the 2015 International Residential Code. Provision is made for compensation for pressure equalization specific to the product if supporting documentation is provided, using procedures in Annex A1.

NOTE 6—Refer to Annex A1 for an explanation as to how the negative design pressure was established, and for applications where the effective negative design pressure as specified in ASCE 7-10 is different from 30.0 lbf/ft^2 (1436 Pa) (for example, wind-zone areas greater than about 110 mph (177 km/h) (V_{ASD}) (225 km/h (V_{ULT})) or mean roof height above 30 ft (9.1 m), or exposures other than exposure category B).

(1) The design-pressure values can be negative (suction loads) or positive. The negative values are the largest in

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magnitude and are the values used in this specification.

NOTE 7—In that the siding is being tested as a weather-resistant exterior product applied to an existing exterior structural wall, forces (negative) working to pull the siding off the wall, fasteners, or disengage locks will be the most important criteria for testing. Positive wind forces test the integrity of the total wall sections, and do not provide a measure of the performance of the siding.

5.2.2.2 *Standard Wind Load Design Pressure Rating*—The standard wind load design pressure rating shall be determined from the results of testing in accordance with 6.14, using the procedures described in A1.3.

NOTE 8—The standard design pressure rating is valid for applications where the siding is installed over sheathing and its fastening that are capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location. For applications over other sheathing, a different design pressure rating is applicable, and is determined in accordance with A1.3. Determination of a rating other than the standard design pressure rating is not required by this section.

5.2.2.3 *Alternative Design Pressure Ratings*—Design pressure ratings other than the standard wind load design pressure rating, for use with different sheathing materials or using different installation or fastening, are permitted to be determined in accordance with testing under 6.14, using the procedures in Annex A1.

5.2.3 *Nail Slot Allowance for Thermal Expansion*—For siding panels utilizing nail slots to allow for thermal expansion and contraction, the nail slot shall be sized to allow for the expected range of expansion and contraction over a range of 100°F. Compliance with this requirement shall be demonstrated either by the test method in 6.15 or by sizing of the nail slots according to the specifications in the following sections. The instrument used shall be capable of measuring to the nearest 0.01 in. The manufacturing tolerance shall not exceed -0.030 in.

5.2.3.1 For panels shorter than 6 ft (1829 mm) in length, the minimum nail slot width shall be $^{3}/_{8}$ in. (11.4 mm).

5.2.3.2 For panels 6 ft (1829 mm) in length or longer the minimum nail slot width shall be determined according to the following formula. The minimum width shall be the width resulting from application of the formula, rounded to the next lower quarter-inch. Regardless of the results of the calculation, the minimum nail slot width for panels 6 feet or longer shall be 1 in (25.4 mm).

$$WS = P_c \times (\alpha \times 100\,°F \times L) + T_c \qquad (1)$$

WS = minimum width of nail slot, in.,

P_c = center-pinning coefficient: 1 if manufacturer's instructions require panel to be center-pinned; 1.5 if center-pinning is not required,

α = coefficient of linear thermal expansion, 4.5×10^{-5} in./in./°F or actual known coefficient for material used, as determined by 6.9,

L = length of panel, inches, and

T_c = centering tolerance: 0.25 in.

5.2.4 *Flame Spread*—Backed vinyl siding shall have a Flame Spread Index not greater than 200 when tested in accordance with 6.17.

6. Test Methods

6.1 *General*—The inspection and test procedures contained in this section are used to determine the conformance of products to the requirements of this specification. Each producer who represents its products as conforming to this specification shall be permitted to use statistically based sampling plans that are appropriate for each manufacturing process, but shall keep the essential records necessary to document, with a high degree of assurance, his claim that all of the requirements of this specification have been met. Additional sampling and testing of the product, as agreed upon between the purchaser and the manufacturer, are not precluded by this section.

6.2 *Conditioning and Test Conditions*—Condition the test specimen in accordance with Procedure A of Practice D618 and test under those conditions, unless otherwise specified herein.

6.3 *Length*—Lay the specimen on a flat surface and measure with a steel tape. Measure the length of a siding panel to the nearest $^{1}/_{16}$ in. (1.6 mm) at the center, the butt edge, and the bottom of the top lock. The average of the three measurements is the actual length.

6.4 *Width*—Interlock two long specimens, each at least 26 in. (600 mm) long, in the normal mode for installation. Lay the two specimens on a flat surface. Measure to the nearest $^{1}/_{16}$ in. (1.6 mm), the distance between the lowest butt edge of the top specimen and the lowest butt edge of the bottom specimen. Commencing approximately 1 in. (25 mm) from one end of the

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specimens, make five measurements at 6 in. (152 mm) intervals, making sure that the measurement is made perpendicular to the butt edge. Average the measurements. The average constitutes the exposed width of siding.

6.5 Thickness shall be measured in accordance with Test Method A of Test Method D5947. The micrometer shall be calibrated in accordance with Section 8 of Test Method D5947. The thickness of the siding shall be measured at a minimum of 5 locations equally spaced across the entire portion of the siding that will be exposed after installation. All measurements shall be taken to the nearest 0.001 in. Calculate and report the average of these measurements. Also report the thinnest individual measurement.

6.6 *Camber*—Place a full length of siding (typically 10 or 12 ft (3.05 or 3.61 m)) on a flat surface alongside a straightedge at least as long as the siding specimen. Measure the maximum space between edge of the siding specimen and the straightedge for each edge to the nearest $^{1}/_{16}$ in. (1.6 mm).

6.7 *Heat Shrinkage:*

6.7.1 *Apparatus:*

6.7.1.1 *Scriber,*similar to that described in Test Method D1042, with the exception that the needle points shall be separated by 10 ± 0.01 in. (254 ± 0.254 mm).

6.7.1.2 *Test Media,*a controlled-temperature water bath of 5 gal (10 L) or more, equipped with an efficient stirrer that will maintain uniform temperature throughout. Heater and temperature-control devices must maintain the water at 160 ± 1°F (71 ± 0.5°C). Use a wire rack to raise and lower specimens into the water bath. As an alternative to the use of a water bath, the specimens may be heated for 30 min in a uniformly heated forced-air oven maintained at a temperature of 160 ± 1°F (71 ± 0.5°C).

6.7.1.3 Make measurements with any device capable of measuring the distance between two scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2 *Procedure:*

6.7.2.1 Cut three specimens from the siding panel, each 1 in. (25.4 mm) wide by 12 in. (305 mm) long. Cut one specimen from the center and one from each of the extreme edges of the flat surface. The long axis shall be parallel to the machine direction.

6.7.2.2 Condition specimens at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity for at least 24 h.

6.7.2.3 Make a slight mark with the scribe on each specimen so that a reference point will be clearly visible.

6.7.2.4 Place specimens in the test medium.

6.7.2.5 Remove specimens after 30 min and place on a flat surface until cool.

6.7.2.6 Repeat conditioning in accordance with 6.7.2.2.

6.7.2.7 Make a second mark with the scribe on each specimen, using the same center.

6.7.2.8 Measure the distance, *D*, between the scribe marks to the nearest 0.01 in. (0.254 mm).

6.7.2.9 Calculate the percent shrinkage as $(D/10) \times 100$.

6.7.2.10 Report the average shrinkage of the three specimens tested.

6.8 *Impact Resistance*—Test impact resistance of siding in accordance with Test Method D4226, Procedure A, impactor head configuration H.25. 4 in.-lb increments (0.5 in. height increments with 8 lb falling weight) shall be used. Minimum sample dimensions shall be 1.5 by 1.5 in. Samples shall be tested with the normally exposed surface facing up. Backed siding shall be tested with any backing material removed. Conditioning time for quality-control tests shall be at least 1 h.

6.8.1 For purposes of evaluating failure of the specimen under section 3.2.1 of Test Method D4226, a ductile tear of less than 0.2 in. (5 mm) in length shall not be considered a failure. Any brittle break of any dimensions is considered a failure.

6.9 *Coefficient of Linear Expansion*—Conduct this test in accordance with Test Method D696.

6.10 *Weatherability:*

6.10.1 A minimum of three samples shall be exposed at each of at least three test sites. Test sites shall be located in a northern temperate climate, represented by Cleveland, Ohio or Louisville, Kentucky; a hot, humid climate represented by Miami, Florida; and a hot, dry climate represented by Phoenix, Arizona. The samples shall be exposed for a minimum of 24 months.

6.10.2 Samples shall consist of a flat section of siding with minimum dimensions of 2 in. by 3 $^{3}/_{4}$ in. (25 mm by 95 mm).

6.10.3 Samples shall be representative of the product to be evaluated.

NOTE 9—Samples prepared in the laboratory in the same manner as commercial samples are permitted to be used as an alternative to a commercial part. If the commercial product is extruded, the laboratory specimen must be extruded; if the commercial product is injection molded, the laboratory specimen must be injection molded, and so forth.

6.10.4 Select a minimum of 4 specimens per sample per test site to allow for 3 test specimens and 1 file specimen for each sample evaluated.

6.10.5 Mark each specimen permanently to ensure retention of identity during and after exposure testing.

NOTE 10—Use of a vibratool leaves a permanent mark that satisfies this criterion.

6.10.6 All exposures shall be conducted at an angle of 45° South, plywood backed, in accordance with Practice D1435 and

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6.10.7 After a minimum of 24 months of exposure, remove the samples and inspect each exposed test specimen for appearance and surface condition. Record observations and inspection date in a permanent record.

6.11 *Gloss:*

6.11.1 *Apparatus*—Measure gloss using a 75° geometry glossmeter that meets the requirements of the Apparatus section of Test Method D2457.

6.11.2 *Procedure:*

6.11.2.1 Gloss measurements shall be made in accordance with the procedure in Section 9 of Test Method D2457, unless otherwise specified herein.

6.11.2.2 Measure gloss on one piece of siding on at least three widely separated sections across the width of the exposed surface of the panel. At least one reading shall be taken on each face of the panel. Use new surface area for each reading to avoid scratches caused by instrument contact. The area tested must be flat. If a flat area on the exposed surface cannot be found due to the style or depth of embossing of the panel being tested, then a non-exposed area of the panel shall be chosen in its place. Such locations shall be representative of the gloss of the area that will be exposed after installation.

6.11.2.3 Measure gloss parallel to the direction of embossing. When the embossing pattern is not apparent, measure the gloss in the direction of extrusion.

6.11.2.4 Each reading shall be within the appropriate limit specified in 5.1.7.

6.11.2.5 The average reading of all readings shall be used to represent the gloss of the sample.

6.12 *Surface Distortion:*

6.12.1 *Test Specimen/Apparatus:*

6.12.1.1 The test specimen shall consist of three courses of backed vinyl siding, a minimum of 6 ft (1.83 m) in length, mounted on a flat rigid frame in accordance with the manufacturer's recommended installation instructions.

(1) Horizontal Siding—The middle course shall consist of two lengths of backed vinyl siding, both with a factory-fabricated end, one section overlapping the other section. The end of the overlapping section shall be located not less than 3 in. (76 mm) and not more than 6 in. (152 mm) from the center of the course. Unless specified otherwise by the manufacturer's installation instructions, the insulation of the two lengths of backed vinyl siding shall be butted firmly together.

(2) Vertical Siding—The middle course shall consist of a single, uninterrupted backed vinyl siding panel, without overlap.

6.12.1.2 A thermocouple or other heat-sensing element shall be located at the horizontal midpoint of the backside of the middle course of backed vinyl siding. The heat-sensing element shall be in contact with the back of the vinyl cladding. Any backing material removed to facilitate placement of the heat sensing element shall be replaced.

6.12.1.3 *Radiant-Heat Rod,*600 W for each linear foot (0.31 m), mounted parallel to the middle course and approximately 32 in. (810 mm) away from the surface of the backed vinyl siding.

6.12.1.4 *Temperature-Control Device,*used to regulate the temperature of the radiant-heat rod, shall be able to maintain the conditions specified in 6.12.2.1.

6.12.1.5 *Gap Measurement Device*—A cylindrical pin gauge, $^{1}/_{4}$ ±0.005 in. (6±0.127 mm) in diameter is used to evaluate the size of any gap in the overlapped sections of horizontal backed vinyl siding during the heating period. The pin gauge is attached to a rod such that the gauge can be inserted into a gap while held parallel to the plane of the backed vinyl siding. The rod shall be sufficiently long to permit insertion of the gauge from beyond the edge to the test frame, not interfere with the exposure of the sample to radiant heat, and otherwise not interfere with conduct of the test.

6.12.2 *Procedure:*

6.12.2.1 Heat the test panel (middle course of backed vinyl siding) at a rate of 3.0 to 6.0°F/min (1.7 to 3.3°C/min) until a minimum temperature of 150°F (66°C) is achieved as measured by the heat-sensing element on the midpoint of the backside of the middle course. For temperatures equal to or greater than 130°F (54°C), the rate of heating is permitted to be not less than 2.0°F/min (1.1°C/min), provided that the average heating rate from the ambient temperature to 150°F (66°C) is within 3.0 to 6.0°F/min (1.7 to 3.3°C/min). When a temperature of 150°F (66°C) is attained, shut off the heat source.

6.12.2.2 During this heating period, observe the middle course of the backed vinyl siding for surface distortion and observe for any opening or gap at the end of the overlapped section. If the overlap appears to have opened to approximately $^{1}/_{4}$ in. (6 mm), attempt to insert the gap measurement device into the opening. If the device can be inserted in to the opening to any depth at any location along the overlap, the opening shall be considered to be at least $^{1}/_{4}$ in. (6 mm).

6.12.2.3 Failure is defined as:

(1) the appearance of bulges, waves, or ripples on any surface of the middle course of the backed vinyl siding;

(2) occurrence of a gap or opening $^{1}/_{4}$ in. (6 mm) or greater at any point along the end of the overlapped section, as determined by use of the gap measurement device, at any time or before a temperature of 150°F (66°C) is reached.

6.13 *Color Uniformity*—Calculate the difference between the L_H, a_H, and b_H color coordinates for a production specimen to

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those of either the appropriate reference specimen or the agreed upon color coordinates for that specific color product in accordance with Test Method D2244. Calculate the total difference *ΔE* between the production specimen and the reference specimen in accordance with Test Method D2244.

6.14 *Wind Load Resistance*—Conduct the test on wind load resistance of finished siding in accordance with Test Method D5206. The average maximum sustained static test pressure determined from this testing is used in 5.2.2. For purposes of determining compliance with the minimum test pressure and standard design pressure requirements in 5.2.2, the test structure shall be constructed with vertical studs 16 in. on center. The siding shall be tested with the foam plastic backing attached to the vinyl siding. The siding in the test installation shall be installed over wood sheathing with a nominal thickness of $^{7}/_{16}$ to $^{1}/_{2}$ in., and fastened as follows:

6.14.1 *Fastener type*—Roofing nail, smooth shank, 0.120 in. ($^{1}/_{8}$ in. nominal; 3.2 mm) shank diameter, $^{5}/_{16}$ in. (7.9 mm) head diameter, length as necessary to penetrate into sheathing and stud a total of 1 $^{1}/_{4}$ in. (32 mm). For vertical siding, length as necessary to penetrate the thickness of the sheathing plus $^{1}/_{4}$ in. (6.4 mm).

6.14.2 *Fastener Spacing*—Every 16 in. (406 mm) into center of stud for horizontal siding. For vertical siding, every 12 in. into sheathing only.

6.14.3 Fasteners shall not be driven tightly against the siding. Allow approximately $^{1}/_{32}$ in. (0.8 mm) clearance between the fastener head and siding surface.

NOTE 11—The installation details described 6.14 conform to the minimum requirements of the 2015 International Residential Code and the VSI Vinyl Siding Installation Manual.

6.15 *Nail Slot Allowance for Thermal Expansion*—As an alternative to conformance with the nail slot width specification in 5.2.3.1 or 5.2.3.2, provision for thermal expansion and contraction shall be demonstrated through the following test procedure.

6.15.1 *Samples*—At least 3 samples of each profile in which the siding is produced shall be provided. The length of each sample shall be at least 50 % of the longest length in which the profile is produced, and not shorter than 12 ft (3658 mm).

6.15.2 *Test Chamber*—The test chamber shall consist of an environmentally controlled room or compartment capable of providing an air temperature range of at least 0°F to 100°F (-18°C to 38°C) without exposure of the panel to radiant energy from heating or cooling elements. Air temperature shall be controlled such that a rate of temperature change of 2°F (1.11°C) per minute can be achieved over the full temperature range, and the minimum and maximum temperatures can be maintained for at least 15 minutes. Means for circulating air to provide a uniform air temperature throughout the chamber shall be provided. A vertical wall shall be provided for mounting of samples. The wall shall be insulated such that, with no panels mounted, the inner surface of the wall does not deviate more than 10°F (5.5°C) from the air temperature at the high and low temperature extremes after a holding period of 5 minutes. The test chamber shall be of sufficient size to accommodate the longest panel to be tested, including expected thermal expansion of the panel. Means shall be provided to measure the actual temperature of the surface of each panel at a minimum of 3 evenly-spaced locations along the length of the panel.

6.15.3 *Length Measurement*—A means for measuring the length of each sample throughout the temperature range shall be provided. The method utilized for length measurement shall not be influenced by the temperature of the chamber and shall have a minimum resolution of no greater than 0.0625 in. (1.59 mm).

6.15.4 *Procedure*—Install the sample panels on the wall inside the test chamber, following the manufacturer's instructions for fastener type, spacing, location and tightness. At ambient temperature measure and record the length of each panel and the temperature of the panel, averaged from a minimum of 3 locations along the length of the panel.

6.15.4.1 *Test Cycle*—Test cycles shall be performed by raising the air temperature to 100°F ± 5°F (38°C ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding the air temperature at 100°F (38°C ± 2.75°C) for 15 minutes, lowering the air temperature to 0°F ± 5°F (-18°C ± 2.75°C) at an average rate of 2°F (1.11°C) per minute, holding at 0 °F (-18°C ± 2.75°C) for 15 minutes, and returning to ambient temperature at an average rate of 2 °F per minute.

6.15.4.2 *Conditioning*—Close the test chamber and perform at least 2 conditioning cycles using the procedure in 6.15.1. No interruption is required between conditioning cycles.

6.15.4.3 *Test*—Following completion of the conditioning cycles, conduct 3 test cycles using the procedure in 6.15.4.1. It is acceptable for the test cycles to follow immediately upon completion of the final conditioning cycle, and no interruption is required between test cycles. After a minimum holding period of 15 minutes at the high and low extremes of each test cycle, measure and record the length of each panel and the temperature of the panel, averaged from a minimum of 3 locations along the length of the panel.

6.15.5 *Normalization*—From among the length measurements recorded for all three cycles, identify the shortest and longest length of each panel, and the average panel temperature at the time that length was recorded. Determine the maximum difference in length, ΔL, and the maximum difference in temperature, ΔT, by subtracting the smaller from the larger. Normalize the change in length to the full length of the panel over a 100 °F (38 °C) temperature range using the following formula:

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$$E_t = \Delta L \times (100/\Delta T) \times (L_f/L_t) \quad (2)$$

E_t = total thermal expansion and contraction of a full length panel over a range of 100°F (38°C),

ΔL = maximum change in length of the tested panel,

ΔT = maximum change in temperature of the tested panel,

L_f = longest length in which the panel is produced, and

L_t = actual length of the panel as tested.

6.15.6 *Acceptable Performance*—When tested according to this procedure, the result of ($E_t \times 2$) + 0.25 in. for each of the 3 samples for each profile shall not be greater than the width of the nail slot. If the manufacturer's installation instructions require the panel to be center-pinned, the result of E_t + 0.25 in. for each of the 3 samples for each profile shall not be greater than the width of the nail slot.

6.16 *Lead Content:*

6.16.1 Testing for lead content shall be conducted on backed vinyl siding using a rhodizinate-type lead swab test kit conforming to Practice E1753. Testing shall be performed in accordance with the test kit manufacturer's instructions. The backed vinyl siding shall be deemed to comply with 4.7 if the test shows a negative or not-detected result; that is, the test does not indicate the presence of lead. The test shall be conducted separately on the substrate and on any cap or film material.

6.16.2 As an alternative to the method in 6.16.1, and as a means of resolving any ambiguous results from that method, an analytical method capable of detecting lead at least as low as 0.02 percent by sample weight shall be employed. Under this alternative, neither the substrate nor any cap or film shall contain a concentration of lead in excess of 0.02 percent by weight.

6.17 *Flame Spread*—Conduct the test on flame spread of finished backed vinyl siding in accordance with Test Method E84. The test specimen shall either be self-supporting by its own structural characteristics or held in place by added supports along the test specimen surface, or secured from the back side.

7. Packaging and Package Marking

7.1 The siding shall be packed in such a manner as to provide reasonable protection against damage in ordinary handling, transportation, and storage.

7.2 Provisions of Practice D3892 shall apply to this specification.

7.3 To aid identification of siding conforming to all requirements of this specification, producers and distributors shall include a statement of compliance in conjunction with their name and address on product labels, invoices, sales literature, and the like. The following statement is suggested when sufficient space is available:

This PVC siding conforms to all the requirements established in ASTM Specification D7445, developed cooperatively with the industry and published by ASTM.

Full responsibility for the conformance of this product to the specification is assumed by (name and address of producer or distributor).

7.4 The following abbreviated statement is suggested when available space on labels is insufficient for the full statement: Conforms to ASTM Specification D7445 (name and address of producer or distributor).

7.5 The standard wind load design pressure rating determined in accordance with 5.2.2.2 shall be stated on the product or on the product package by one of the means in 7.5.1 or 7.5.2.

7.5.1 The package shall be marked or labeled with the standard wind load design pressure rating. The marking shall be in the format "Standard Wind Load Design Pressure Rating: ##.# psf (ASD)".

7.5.2 The standard design pressure rating shall be included on a line imprint or other marking on the front (outward-facing) surface of all siding panels. It is not required that the marking be visible after installation, provided that the marking can be revealed and read by detaching the lower edge lock of an adjacent course, without removal of any fasteners. The standard design pressure marking shall be stated at least once per panel. The marking shall be in the format "Std Design Pressure Rating: ##.# psf (ASD)".

7.5.3 At the option of the manufacturer, additional marking or labeling of the package or product with alternative wind load design pressure ratings determined in accordance with 5.2.2.3 for use with alternative sheathings, wall configurations or fastening methods is permitted. The marking shall use the format specified in 7.5, shall indicate the type of sheathing or wall configuration for which it is applicable, and shall refer to the manufacturer's instructions for more information and any installation requirements.

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8. Keywords

8.1 plastic building products; plastic weatherability; recycled plastic; rigid PVC siding; specification

ANNEX

(Mandatory Information)

A1. WIND LOAD RESISTANCE TEST DESIGN FACTORS

A1.1 *Wind Load Criteria:*

A1.1.1 ASCE 7-10 is the basis for determining the design pressures used in this specification. Design wind loads are determined on an ASD basis in this specification.

NOTE A1.1—In previous editions of ASCE 7, wind loads were determined using wind speed maps based on a 50-year return period. In ASCE 7-10, maps based on a 700-year return period are used which, for any given location, produce a wind speed approximately 30 % greater than that of the previous maps. This larger magnitude (higher return period) wind speed, referred to as the ultimate wind speed, (V_{ULT}), is used directly (with a load factor of 1.0) to determine nominal wind loads on a Strength Design (LRFD) or "ultimate" wind load basis. When Allowable Stress Design (ASD) is used, ASCE 7-10 provides for these ultimate wind loads, determined from the ultimate wind speed map velocities, to be multiplied by a load factor of 0.6. Alternatively, the adjustment can be made directly to the wind velocity, which is the approach taken in this method (see A1.1.2). This procedure produces results consistent with past ASD wind loads.

A1.1.2 It is necessary to determine whether the wind velocity to be used is based on the maps in ASCE 7-10 or on older maps designed for direct application of ASD. Wind velocity, V, based on ASD is used in this method. Wind speeds determined using the maps in ASCE7-10, referred to as V_{ULT}, are converted to ASD wind speeds, V_{ASD}, by multiplying by the square root of 0.6. Wind speeds based on maps using an ASD basis do not require conversion (see A1.3). Thus:

$$V = V_{ASD} = V_{ULT} \times \sqrt{0.6} \qquad \text{(A1.1)}$$

The V determined in this section is used in the following calculations.

A1.1.3 The velocity pressures, q, used in this specification have been computed using the following equation:

$$q = 0.00256\, K_z K_d V^2 I\,(\,lb/sq\,ft\,) = 0.613\, K_z\, K_d\, V^2 I\,(N/m^2) \qquad \text{(A1.2)}$$

V = wind velocity, mph (km/h). The basic wind speed corresponds to a 3-s gust speed at 33 ft (10.1 m) above ground in exposure category C, as described in ASCE 7-10. A velocity of $V = V_{ASD}$ = 110 mph (177 km/h) was used in this specification. (See Note A1.2and Note A1.3.)

I = "importance factor" as described in editions of ASCE 7 prior to ASCE 7-10. A value of 1.0 is used. This factor is not used where the wind speed has been determined from a map in ASCE 7-10. (See Note A1.4.)

K_z = "velocity pressure coefficient" as described in ASCE 7-10. A "K_z" of 0.70 was used in the wind pressure calculations, which is the value from ASCE 7-10 for a mean roof height of 30 ft (9.1 m) above ground level and Exposure Category B.

K_d = "wind directionality factor" as described in ASCE 7-10. A "K_d" of 0.85 is used.

A1.1.4 Thus, for the given velocity and factors, the velocity pressure = 18.43 lbf/ft^2 (882 Pa).

NOTE A1.2—As explained in Note A1.1, the wind velocity used in this method is converted from the V_{ULT} given by wind speed maps in ASCE 7-10 to V_{ASD} using the equation in A1.1.2. A V_{ULT} wind speed of approximately 140 mph from the maps is equivalent to a V_{ASD} of 110 mph, which is the velocity V used in this specification.

NOTE A1.3—In ASCE 7-10 the default wind speeds are given for exposure category C, and a table is provided to adjust this wind speed for other exposure categories. Since most backed vinyl siding is installed on buildings located in exposure category B, the velocity pressure coefficient, K_z is included in the equation to make this adjustment.

NOTE A1.4—Editions of ASCE 7 prior to ASCE 7-10 included an importance factor to represent the relative significance of the building and the consequences of its loss. Because most backed vinyl siding is installed on residential and light commercial buildings, the importance factor was set at 1.0 by default. ASCE 7-10 has removed the importance factor from the velocity pressure equation, and instead provides a

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different wind speed map for each of the building importance categories (referred to as risk categories in ASCE 7-10). Thus the importance factor will already have been incorporated into the wind speed determined from the appropriate map, and the importance factor is not used for determining velocity pressure using wind speeds from ASCE 7-10 maps.

A1.1.5 ASCE 7-10 recommends various internal and external pressure coefficients, which include gust response factors. These coefficients vary with the effective area of the cladding component, the location of the cladding component relative to building corners, and the configuration of the building (open versus enclosed). The internal and external pressure coefficients are taken from Table 26.11-1 and Figure 30.4-1 of ASCE 7-10. The effective area is taken as 10 square ft (the area of one piece of siding), an enclosed building is assumed, and factors for the building corners are used. The pressure coefficients are as follows:

$$\textit{Internal Pressure Coefficient} = \pm 0.18 \qquad \text{(A1.3)}$$

$$\textit{External Pressure Coefficient} = +1.00 \textit{ and } -1.40$$

The design pressure is calculated by multiplying the velocity pressures by the algebraic sum of the internal and external pressure coefficients.

A1.2 *Design Pressure:*

NOTE A1.5—Because the wind velocity has already been adjusted from an ultimate basis to an ASD basis at the beginning of these calculations, the design pressure determined in this step is an ASD load. This correlates to the design pressure requirements stated in tables in the 2015 International Residential Code and other codes which have also been adjusted to an ASD basis. However, the required design pressures in some other codes and design standards have not been adjusted to an ASD basis. Where required design pressures are based on ultimate wind loads determined from ASCE 7-10 wind speeds, those loads must be multiplied by 0.60 to match the design pressure determined from this equation.

$$\textit{Positive Design Pressure} = (18.43)(1.00+0.18) = 21.74\ \textit{psf} \qquad \text{(A1.4)}$$

$$\textit{Negative Design Pressure} = (18.43)\,(-1.40-0.18) = -29.12\ \textit{psf}$$

A1.2.1 The negative values (suction loads) are the largest in magnitude and are the design values used in this specification. Research conducted by various organizations[8,8] [99] has shown that a certain amount of pressure equalization occurs through residential siding products installed with sheathing under high dynamic pressures. In light of this pressure equalization, the design pressure in the ASCE 7-10 wind load standards is reduced by a factor of 0.5 for backed siding.

A1.2.2 Therefore, the required test pressures are calculated as follows:

$$P_t = D_P \times PEF \times 1.5 \qquad \text{(A1.5)}$$

where:

P_t = test pressure, lbf/ft^2 (Pa),

D_P = design pressure, lbf/ft^2 (Pa),

PEF = pressure equalization factor, backed siding, 0.5, and

1.5 = safety factor.

A1.2.2.1 If documentation in support of the use of compensation for pressure equalization other than 0.5 is provided, use the calculation in A1.2.2, substituting the appropriate pressure equalization factor.

A1.2.3 Using the above equations, in a 110 mph (177 km/h) (V_{ASD}) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, the required minimum uniform load test pressure for backed siding is 21.84 lbf/ft^2 (1046 Pa).

A1.2.3.1 For compliance with 5.2.2, the referenced design pressure has been rounded to -30.0 lbf/ft^2 (1436 Pa) to match

[8] Vinyl Siding Pressure Equalization Factor, Architectural Testing, Inc. Report No. 01–40776.01, September 2002.

[9] Morrison M.J., Cope A.D. "Wind Performance and Evaluation Methods of Multi-Layered Wall Assemblies." Structures Congress, 2735-2748, Portland, OR, 2015.

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the standard design conditions specified by the 2015 International Residential Code. When tested under Test Method D5206, the siding must attain an average maximum sustained static test pressure equal to or greater than the corresponding minimum test pressure of 22.5 lb/ft^2 (1077 Pa).

A1.2.4 For applications where the effective design pressure is greater than -30.0 lbf/ft^2 (1436 Pa) (for example, wind zone areas greater than 110 mph (177 km/h) (V_{ASD}), mean roof height over 30 ft (9.1 m), or exposure conditions other than Exposure B), refer to ASCE 7-10 for the effective design pressure. To be shown to be suitable for the application, when tested under Test Method D5206 the siding must attain an average maximum sustained static test pressure equal to or greater than the minimum test pressure determined by the formula in A1.2.2, using the design pressure, D_P, determined for the application using the procedure in A1.1.2 through A1.2.

A1.2.5 These loading conditions apply only to siding installed without an air space directly over sheathing of a type and fastening method that is capable of independently resisting both positive and negative wind design pressures at the building location. Examples of such sheathing include oriented strand board (OSB) and plywood fastened to resist the design wind pressures. For applications where the siding is installed over open studding, without sheathing, rapid pressure equalization does not occur. In these applications, the load the siding will see is equal to the total design pressure and the pressure equalization factor (PEF) is set to 1.0. The static test pressure required for products used under these conditions is as follows:

$$P_t = D_P \times PEF \times 1.5 \qquad \text{(A1.6)}$$

where:

P_t = static test pressure, lbf/ft^2 (Pa),

D_P = design pressure, lbf/ft^2 (Pa),

PEF = pressure equalization factor, 1.0, and

1.5 = safety factor.

A1.2.5.1 Therefore in a 110 mph (177 km/h) wind zone area specifying a design pressure of -29.12 lbf/ft^2 (1394 Pa) for a building 30 ft (9.1 m) in height or less, siding installed without sheathing would require a uniform load test pressure of 43.72 lbf/ft^2 (2093 Pa).

NOTE A1.6—Building codes and backed vinyl siding installation instructions require backed vinyl siding to be installed over sheathing, so calculation of minimum test pressure for siding installed without sheathing is essentially moot. However, the calculation has been retained for completeness and comparison with other installation conditions.

A1.2.6 When siding is installed over sheathing that is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, a greater percentage of the total wind pressure is transferred to the siding and its fasteners. This has the effect of partially or completely countering the effect of the pressure equalization factor. In these cases a value between 0.5 and 1.0 is used for the pressure equalization factor (PEF).

A1.2.6.1 In addition, in cases where failure of the siding would result in failure of the exterior wall covering assembly (that is, siding and sheathing) a safety factor of greater than 1.5 is indicated.

A1.2.6.2 If the adjusted PEF for a given combination of siding and sheathing is known, and an appropriate safety factor is used, a minimum test pressure can be determined using the equation in A1.2.1. However, it is normally more appropriate to make an adjustment for alternative sheathings when determining the design pressure rating, as discussed in A1.3.

NOTE A1.7—Where the sheathing is not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, the layer of siding over the sheathing, and its fastening through the sheathing, act to reinforce the sheathing such that the whole wall covering (siding-sheathing) assembly is capable of resisting such wind pressures. Because siding is tested by itself (not as part of a siding-sheathing assembly) in Test Method D5206, the adjustment of test pressure (before the test) or of the design pressure (after the test) ensures that the wind load resistance of the assembly as a whole is reflected in the rating of the siding.

NOTE A1.8—In some high wind hazard regions, such as south Florida, the exterior wall covering assembly may also be required to meet wind-borne debris impact resistance criteria which would affect the choice of sheathing material to be used together with siding. Such considerations are beyond the scope of this standard.

A1.3 *Wind Design Pressure Rating (Maximum Allowable Pressure):*

A1.3.1 A design pressure rating is the maximum wind pressure that a particular backed vinyl siding product is rated to be able to withstand. It is used in building design and building codes to determine the acceptability of a siding product for use under the design wind conditions for a specific application. To be acceptable, a siding's design pressure rating must be equal to or greater than the design pressure for the specific building at the specific location. The design pressure rating is determined from the average maximum sustained static test pressure for a siding product produced by testing under Test Method D5206,

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the pressure equalization factor, and a safety factor.

A1.3.2 *Standard Design Pressure Rating*—The standard design pressure rating is used for applications where the siding is installed over a sheathing type and fastening method that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location.

A1.3.2.1 The standard design pressure rating assumes that the siding is fastened to the building in the standard manner, with the minimum fastener type, size, spacing, and penetration depth prescribed in Chapter 7 of the International Residential Code and the VSI Vinyl Siding Installation Manual. The installation of the siding for testing under Test Method D5206 must be consistent with these minimum fastening requirements. However, this does not prevent additional testing, using different fastening, to support design pressure ratings for other applications, such as special high wind installations.

A1.3.2.2 The pressure equalization factor and safety factor are the same as those used to determine the test pressure in A1.2.1, using the following equation:

$$D_{Rstd} = \frac{P_m}{(PEF \times SF)} \qquad (0)$$

where:

D_{Rstd} = standard design pressure rating, lbf/ft^2 (Pa),

P_m = average maximum sustained static test pressure, lbf/ft^2 (Pa),

PEF = pressure equalization factor, 0.5, and

SF = safety factor, 1.5.

A1.3.3 *Alternative Design Pressure Ratings*—Design pressure ratings for applications other than the standard conditions described above can be developed. Common circumstances where this is done include the use of alternative fastening methods in order to achieve a higher design pressure rating, and cases where the sheathing is not capable of independently resisting wind pressures under design conditions, which necessitates a reduction in the siding's design pressure rating.

A1.3.3.1 *Alternative Fastening*—Where an alternative fastening method is specified by the manufacturer, the siding is permitted to be tested under Test Method D5206 using the specified fastening. The resulting average maximum sustained static test pressure is used in the above equation to determine the alternative design pressure rating. In order for this alternative rating to be realized, the siding must be installed using the alternative method, and the rating must be clearly tied to installation requirements in manufacturer's literature and instructions.

A1.3.3.2 *Alternative Sheathing*—An adjusted design pressure rating for use of the siding over sheathings not capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, as discussed in A1.2.6, can be calculated using the above equation if the appropriate PEF and safety factor are specified.

A1.3.3.3 Alternative PEF and safety factor values have been documented (see 2009 and 2012 International Residential Code, section R703.11.2) for one type of sheathing, foam plastic insulating sheathing complying with ANSI/SBCA FS 100. Two wall assembly cases are considered: 1) where the interior surface of the wall is covered with gypsum wall board or equivalent; and 2) where the interior surface of the wall is not covered with gypsum wall board or equivalent. In both cases the siding is installed directly over foam sheathing, which is then attached directly to framing, without intervening sheathing. The PEF and safety factor for each case are as follows:

Case	PEF	Safety Factor
Case 1	0.7	2.0
Case 2	1.0	2.0

A1.3.3.4 Adjustment of the standard design pressure rating is not necessary when foam plastic insulating sheathing is installed directly over sheathing that is capable of independently resisting both positive and negative wind pressures occurring under design conditions at the building location, or where the sheathing is fastened in a way that allows it to independently resist the design wind pressure. For such cases the standard design pressure rating is applied.

A1.4 *Design Wind Speeds:*

A1.4.1 The wind velocity maps in ASCE 7-10 provide one source of design wind pressures for particular geographic regions. The velocities on these maps are stated in terms of "ultimate", 700-year return interval speeds. To be used in the procedure in this Annex, those velocities need to be converted to the ASD equivalent in accordance with A1.1.2, and the resulting velocity V used in the equation in A1.1.3. The 2012 and 2015 International Building Code and 2015 International Residential Code also contain maps based on ultimate wind speeds.

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A1.4.2 Other maps are available that do not require conversion of wind velocities. Examples include the wind map in the 2012 International Residential Code, on which the velocities have already been converted from those on the ASCE 7-10 maps. Maps from previous editions of ASCE 7 used ASD velocities and do not require conversion. However, only editions since 1995 used the 3-second gust basis that is used in this annex. The 1998, 2002, and 2005 editions of ASCE 7 continued the use of 3-second gust wind basis, but with improved hazard modeling of hurricane wind speeds first made in the 1998 edition. These previous editions also do not have the benefit of further improved hurricane hazard modeling that was incorporated into the maps used in ASCE 7-10.

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SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D7445–18) that may impact the use of this standard. (X 1, 2024)

(1) Revised 1.1.
(2) Added 5.2.4 and 6.17.

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TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Residential

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S12128

Date Submitted	02/14/2025	**Section**	202	**Proponent**	Jennifer Bridge
Chapter	2	**Affects HVHZ**	No	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

12109

Summary of Modification

Proposed revision to the definition of wind-borne debris region

Rationale

Simulation shows that the risk of wind-borne debris damage exists whether an Exposure D condition is due to the proximity to open water on the coast or to a lake with at least 5000 ft of fetch in the upwind direction. Simulation also shows that the risk of wind-borne debris damage due to a 130 mph wind speed where an Exposure D condition exists upwind of the decreases below the risk for an Exposure B condition for a 140 mph wind speed at a distance of approximately 3000 ft from the water line.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
None

Impact to building and property owners relative to cost of compliance with code
Increased cost for required wind-borne debris opening protection in areas 3000 ft from where an Exposure D condition exists upwind of the waterline (including inland lakes). Reduced cost associated with property damage when protective coverings mitigate wind-borne debris damage.

Impact to industry relative to the cost of compliance with code
None

Impact to small business relative to the cost of compliance with code
None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Impacts the safety and welfare of the public during hurricane events.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Strengthens the code as it applies to the protection of buildings from wind-borne debris damage.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No products specified in proposed modification.

Does not degrade the effectiveness of the code

Does not reduce requirements for wind-borne debris protection.

Alternate Language

2nd Comment Period

S12128-A1

Proponent T Stafford **Submitted** 8/24/2025 12:07:07 PM **Attachments** Yes

Rationale:

This comment reflects a compromise between the original proposal and the current Wind-borne Debris Region (WBDR) in the FBC. Even with the reduced applicability of the WBDR adjacent to Exposure D conditions (3000 ft vs 1 mile specified in ASCE 7-22) in the original proposal, the practical limitations of enforcement and understanding the specific location of the WBDR remain where wind speeds are between 130 mph and 140 mph. Additionally, the original proposal as written would reduce the WBDR from current requirements in coastal areas of the 130 mph to 140 mph range by changing the applicability from 1 mile to 3000 feet. The coastal areas are the most likely to be affected by wind-borne debris from hurricanes. If approved, this comment would change the WBDR to apply in all areas where the wind speed is 130 mph. It would maintain current areas where protection is required (V = 140 mph; and within one mile of the coastal mean high water line where V = 130). However, in regions where the wind speed is between 130 mph and 140 mph “and” located more than 1 mile from the coastal mean high water line, buildings would be permitted to be designed as partially enclosed in accordance with ASCE 7 as an alternative to protecting glazed openings. See attached figure for a visual representation for Risk Category II. This proposal would represent a significant improvement in the wind resistance of buildings in this region with little added cost. It provides the option for homeowners and building owners to protect glazed openings or design the building as partially enclosed. Designing a building as partially enclosed will result in minimal cost increase but will increase the design pressures on every part of the building – roof-to-wall connections, windows, siding, roof decking, most roof coverings, etc. We believe this to be a better path forward.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

No impact to local entities relative to enforcement of the code. This proposed modification will make enforcement of the WBDR criteria in this region significantly easier than the original proposal.

Impact to building and property owners relative to cost of compliance with code

This proposed modification would result in a slight increase in cost of compliance with the code for building and property owners.

Impact to industry relative to the cost of compliance with code

No impact to industry relative to the cost of compliance with the code.

Impact to small business relative to the cost of compliance with code

None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposed modification is directly connected to the health, safety, and welfare of the general public by expanding the Wind-borne Debris Region in the code but providing cost effective options for compliance with the code in the expanded areas.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification strengthens the code by expanding the Wind-borne Debris Region but provides cost effective options for compliance with the code in the expanded areas.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

This proposed modification does not degrade the effectiveness of the code.

S12128-A1Text Modification

Further modify the original proposal as follows:

WIND-BORNE DEBRIS REGION. Areas within hurricane-prone regions located ~~in accordance with one of the following:~~ where the ultimate design wind speed, V_{ult}, is 130 mph (58 m/s) or greater.

~~1. Within 3,000 ft (0.94 km) of the mean high-water line where an Exposure D condition exists upwind at the waterline and the ultimate design wind speed, V_{ult}, is 130 mph (58 m/s) or greater; or~~

~~2. In areas where the ultimate design wind speed, V_{ult}, is 140 mph (63.6 m/s) or greater; or Hawaii.~~

R301.2.1.2 Protection of openings. Exterior glazed openings in buildings located in windborne debris regions shall be protected from windborne debris. Glazed opening protection for windborne debris shall meet the requirements of the Large Missile Test of ASTM E1996 and ASTM E1886 as modified in Section 301.2.1.2.1, TAS 201, 202 and 203, or AAMA 506, as applicable. Garage door glazed opening protection for windborne debris shall meet the requirements of an approved impact-resisting standard or ANSI/DASMA 115.

1. Openings in sunrooms, balconies or enclosed porches constructed under existing roofs or decks are not required to be protected provided the spaces are separated from the building interior by a wall and all openings in the separating wall are protected in accordance with this section. Such space shall be permitted to be designed as either partially enclosed or enclosed structures.

2. Storage sheds that are not designed for human habitation and that have a floor area of 720 square feet (67 m^2) or less are not required to comply with the mandatory wind-borne debris impact standard of this code.

3. Buildings located more than 1 mile from the coastal mean high water line where the ultimate design wind speed, V_{ult}, is less than 140 mph (63.6 m/s) are permitted to be designed as partially enclosed in accordance with ASCE 7 in lieu of protecting exterior glazed openings from wind-borne debris.

Exception: (*no change*)

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Mod12128_A1_TextOfModification.pdf

S12128Text Modification

WIND-BORNE DEBRIS REGION. Areas within hurricane-prone regions located in accordance with one of the following:

~~1. Within 1 mile (1.61 km) of the coastal mean high water line where the ultimate design wind speed, V_{ult}, is 130 mph (58 m/s) or greater; or~~

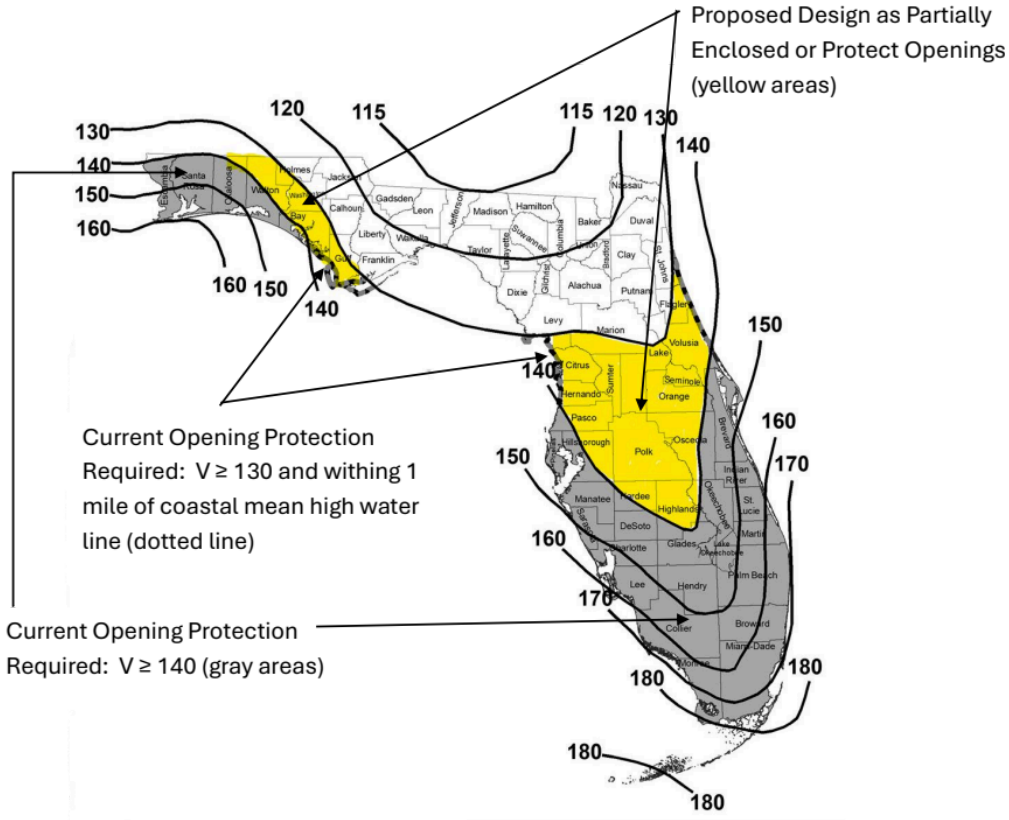
1. Within 3,000 ft (0.94 km) of the mean high-water line where an Exposure D condition exists upwind at the waterline and the ultimate design wind speed, V_{ult}, is 130 mph (58 m/s) or greater; or

2. In areas where the ultimate design wind speed, V_{ult}, is 140 mph (63.6 m/s) or greater; or Hawaii.

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Mod12128_TextOfModification.pdf

S12128-A1Rationale



Mod_12128_A1_Rationale_WBDR DWG.pdf Page: 1

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Residential

30

SP11963

Date Submitted	02/13/2025	**Section**	322.1.10	**Proponent**	Rebecca Quinn obo FL Div Emerg Mgnt
Chapter	3	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

11962

Summary of Modification

Certain documentation is required to be submitted for residential construction in flood hazard areas to document the elevation to which Lowest Floors are elevated. The proposal specifies use of the FEMA Elevation Certificate that is specifically designed for those purposes.

Rationale

Certain documentation is required to be submitted for residential construction in flood hazard areas to document the elevation to which Lowest Floors are elevated. The proposal specifies use of the FEMA Elevation Certificate that is specifically designed for those purposes. More than half of Florida NFIP communities participate in the NFIP Community Rating System (244 out of 469). A basic requirement for all CRS Communities is use of the FEMA Elevation Certificate. NFIP Elevation Certificate: FEMA Form FF-206-FY-22-152 (3/22) - fema_form-ff-206-fy-22-152.pdf

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Lessens burden caused when permittees use other forms of certification.
Impact to building and property owners relative to cost of compliance with code
None, because owners must submit the documentation in some form.
Impact to industry relative to the cost of compliance with code
The change does not affect the technical requirements of the code.
Impact to small business relative to the cost of compliance with code
The change does not affect the technical requirements of the code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Yes, provide information needed for final inspection.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The change does not affect the technical requirements of the code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The change does not affect the technical requirements of the code.

Does not degrade the effectiveness of the code

No; improves effectiveness because the FEMA Forms are designed to collect the information necessary to help determine compliance.

Alternate Language

2nd Comment Period

RP11963-A1

Proponent Rebecca Quinn obo FL Div Emerg Mgnt **Submitted** 8/7/2025 8:02:47 AM **Attachments** No

Rationale:

Where a FEMA form is specified we added “or equivalent.” The value of the form is the completeness of the requested information, which is still valuable even if provided in a substantially equivalent format.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Lessens burden because whether the FEMA form or equivalent is used, the information necessary is provided

Impact to building and property owners relative to cost of compliance with code

None, because owners must submit the documentation in some form.

Impact to industry relative to the cost of compliance with code

The change does not affect the technical requirements of the code.

Impact to small business relative to the cost of compliance with code

The change does not affect the technical requirements of the code.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Improves compliance and ensures records are complete whether the FEMA forms or equivalents are used. We note that sec. 42.0366, F.S., requires surveyors to submit Elevation Certificates to FDEM (certificates are posted online and accessible to the public).

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

The change does not affect the technical requirements of the code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

The change does not affect the technical requirements of the code.

Does not degrade the effectiveness of the code

No; improves effectiveness because whether the FEMA Forms or equivalent are used, the are designed to collect the information necessary to help determine compliance is provided..

SP11963-A1Text Modification

R322.1.10 As-built elevation documentation. A licensed professional surveyor and mapper or registered design professional shall prepare and seal the FEMA Elevation Certificate or equivalent to document the as-built ~~documentation of the~~ elevations specified in Section R322.2 or R322.3.

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Mod11963_A1_TextOfModification.pdf

SP11963Text Modification

R322.1.10 As-built elevation documentation. A licensed professional surveyor and mapper or registered design professional shall prepare and seal the FEMA Elevation Certificate to document the as-built ~~documentation of the~~ elevations specified in Section R322.2 or R322.3.

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Mod11963_TextOfModification.pdf

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Residential

31

SP11984

Date Submitted	02/11/2025	**Section**	322.1.6	**Proponent**	Dallas Thiesen
Chapter	3	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language Yes**

Related Modifications

Summary of Modification

Updates requirements for pool and spa equipment installed in special flood hazard zones.

Rationale

Swimming pool and spa equipment is designed for outdoor use and is generally weather resistant. Pool and spa equipment is not designed to work at a substantially different elevation than the pool or spa that it is serving, requiring pool and spa equipment to be installed above grade can cause loss of prime, can damage to the equipment, and can shorten the service life of the equipment. Pool and spa equipment is also expressly excluded from flood insurance coverage under the National Flood Insurance Program (NFIP) and there is no duty to mitigate or minimize damage to such equipment.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

This will save consumers the unnecessary cost of elevating swimming pool and spa equipment and by extending the service life of the equipment.

Impact to industry relative to the cost of compliance with code

This will save industry the unnecessary cost of elevating swimming pool and spa equipment and by extending the service life of the equipment.

Impact to small business relative to the cost of compliance with code

This will save industry the unnecessary cost of elevating swimming pool and spa equipment and by extending the service life of the equipment.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Simplifies enforcement by eliminating potential confusion.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Simplifies enforcement by eliminating potential confusion.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposal does not specify a product or material.

Does not degrade the effectiveness of the code

Simplifies enforcement by eliminating potential confusion.

Alternate Language

2nd Comment Period

SP11984-A1

Proponent Rebecca Quinn obo FL Div Emerg Mgnt **Submitted** 8/7/2025 10:14:57 AM **Attachments** No

Rationale:
Rather than completely remove any requirement (original proposal), this modification clarifies the requirements for pool equipment installed in Special Flood Hazard Areas to add that elevation to the extent practical should maintain functionality and safe conditions. This change is based on the original intent when “to the extent practical” requirement was proposed by FEMA, referring to guidance that advises full elevation to the BFE, but if that height “would result in problems with pump function and performance, equipment is to be elevated as high as possible while allowing safe functioning.” The objective of regulating development in flood hazard areas is to minimize the impact of flooding on the activity, and the impact of the activity on flooding. Partial elevation achieves some damage reduction during frequent, low-level flooding. Whether something is or isn’t insurable under NFIP flood insurance policies has no bearing on what is regulated (see NFIP definition for “development,” which is broad, including any man-made change).

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Adds clarity for determining practicality of elevation.

Impact to building and property owners relative to cost of compliance with code
no change from original requirement

Impact to industry relative to the cost of compliance with code
Adds functionality and safety to determining practicality.

Impact to small business relative to the cost of compliance with code
This will save industry the unnecessary cost of elevating swimming pool and spa equipment and by extending the service life of the equipment.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Clarifies that safe conditions is part of determining practicality of elevation.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Adds clarify.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities
Does not require any different equipment.

Does not degrade the effectiveness of the code
Improves interpretation and enforceability.

1st Comment Period History

SP11984-G1

Proponent Michael Weinbaum Submitted 4/9/2025 9:06:22 PM Attachments No

Comment:

Martin Aquatic Design and Engineering supports this code change.

SP11984-A1Text Modification

R322.1.6 Protection of mechanical, plumbing and electrical systems. Electrical systems, equipment and components; heating, ventilating, air conditioning; plumbing appliances and plumbing fixtures; duct systems; and other service equipment shall be located at or above the elevation required in Section R322.2 or R322.3. Replacement of exterior equipment and exterior appliances damaged by flood shall meet the requirements of this section. If replaced as part of a substantial improvement, electrical systems, equipment and components; heating, ventilating, air conditioning and plumbing appliances and plumbing fixtures; duct systems; and other service equipment shall meet the requirements of this section. Systems, fixtures, and equipment and components shall not be mounted on or penetrate through walls intended to break away under flood loads.

Exception: Locating electrical systems, equipment and components; heating, ventilating, air conditioning; plumbing appliances and plumbing fixtures; duct systems; and other service equipment is permitted below the elevation required in Section R322.2 or R322.3 provided that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the required elevation in accordance with ASCE 24. Equipment for pools, spas and water features shall be permitted below the elevation required in Section R322.2 or R322.3 provided it is elevated to the extent practical while maintaining functionality and safe conditions, ~~and is~~ anchored to prevent floatation and resist flood forces, and ~~is~~ supplied by branch circuits that have ground-fault circuit interrupter protection. Electrical wiring systems are permitted to be located below the required elevation provided that they conform to the provisions of the electrical part of this code for wet locations.

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Mod11984_A1_TextOfModification.pdf

SP11984Text Modification

R322.1.6 Protection of mechanical, plumbing and electrical systems.

Electrical systems, equipment and components; heating, ventilating, air conditioning; plumbing appliances and plumbing fixtures; duct systems; and other service equipment shall be located at or above the elevation required in Section R322.2 or R322.3. Replacement of exterior equipment and exterior appliances damaged by flood shall meet the requirements of this section. If replaced as part of a substantial improvement, electrical systems, equipment and components; heating, ventilating, air conditioning and plumbing appliances and plumbing fixtures; duct systems; and other service equipment shall meet the requirements of this section. Systems, fixtures, and equipment and components shall not be mounted on or penetrate through walls intended to break away under flood loads.

Exception: Locating electrical systems, equipment and components; heating, ventilating, air conditioning; plumbing appliances and plumbing fixtures; duct systems; and other service equipment is permitted below the elevation required in Section R322.2 or R322.3 provided that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the required elevation in accordance with ASCE 24. Equipment for pools, spas and water features shall be permitted below the elevation required in Section R322.2 or R322.3 provided it ~~is elevated to the extent practical,~~ is anchored to prevent flotation and resist flood forces, and is supplied by branch circuits that have ground-fault circuit-interrupter protection. Electrical wiring systems are permitted to be located below the required elevation provided that they conform to the provisions of the electrical part of this code for wet locations.

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Mod11984_TextOfModification.pdf

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Residential

32

S12170

Date Submitted	02/16/2025	**Section**	609.3	**Proponent**	Milad Shabanian
Chapter	6	**Affects HVHZ**	No	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language Yes**

Related Modifications

Revise section R609.3

Summary of Modification

Revise exterior windows and doors provision with focus on water intrusion.

Rationale

See attached document.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
No impact to local entity relative to enforcement of code
Impact to building and property owners relative to cost of compliance with code
No impact to building and property owners relative to cost of compliance with code.
Impact to industry relative to the cost of compliance with code
No impact to building and property owners relative to cost of compliance with code
Impact to small business relative to the cost of compliance with code
No impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
This change provides a reasonable solution improving public safety by providing requirements focusing on water intrusion.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Improves building construction and resistance against water intrusion during wind driven rain condition.
Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

No it does not.

Does not degrade the effectiveness of the code

No it does not.

Alternate Language

2nd Comment Period

S12170-A3

Proponent T Stafford **Submitted** 8/24/2025 12:39:25 PM **Attachments** No

Rationale:

This comment is one of two that are being submitted for consideration by the Structural TAC as alternatives to the original proposal. This comment maintains the deletion of the overhang exception to water intrusion testing for doors but would permit doors with a limited water rating (LW) as specified in AAMA/WDMA/CSA 101/I.S.2/A440. Products with an LW rating are characterized by a water intrusion test that is less than the minimum test pressure required for the indicated Performance Grade (typically at 0 psf). However, LW products are intended to be used in locations where adequate protection from water exposure is provided. The overhang exception in the current FBC will provide some protection of the door from wind driven rain. However, it clearly cannot protect doors from horizontal wind driven rain that occurs during hurricanes. Therefore, this comment deletes the overhang exception and specifically requires doors with an LW rating to be protected from water exposure as specified by the manufacturer or a registered design professional. This comment reflects a compromise from the original proposal. It requires some level of water intrusion testing but at much lower levels than required for doors installed in areas that are not adequately protected from water exposure.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Local entities will be required to ensure that doors with an LW rating are protected from water exposure as required by the manufacturer or a registered design professional.

Impact to building and property owners relative to cost of compliance with code

No impact to building and property owners relative to cost of compliance with code.

Impact to industry relative to the cost of compliance with code

No impact to industry relative to cost of compliance with code.

Impact to small business relative to the cost of compliance with code

No impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This proposed modification will provide improved water intrusion protection for doors.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This proposed modification strengthens the code by providing improved water intrusion protection for doors.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This proposed modification does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities.

Does not degrade the effectiveness of the code

This proposed modification does not degrade the effectiveness of the code.

2nd Comment Period

S12170-A1

Proponent Jennifer Hatfield **Submitted** 8/23/2025 3:06:40 PM **Attachments** No

Rationale:

As discussed at the June TAC meeting, the proponent and industry asked for initial disapproval so we could work together to provide alternatives to deleting the existing language. This comment provides one option of how to address concerns but without removing a critical component of the code that is necessary in some instances when an owner needs to also consider accessibility and safety concerns that would result from a higher threshold. This alternative language will make it clear that door assemblies must have a limited water rating per the standard and must have an overhang installed. It also increases the overhang requirements for better protection from water intrusion.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Impact to small business relative to the cost of compliance with code

No impact to small business relative to the cost of compliance with code

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This alternate language provides a reasonable solution to both better protect the public from water intrusion at the same time taking into account accessibility and safety requirements associated with a higher threshold.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Yes, it strengthens the code.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not.

Does not degrade the effectiveness of the code

It does not.

1st Comment Period History

S12170-G1

Proponent Jessica Ferris Submitted 4/9/2025 2:45:37 PM Attachments No

Comment:

On behalf of World Millwork Alliance (WMA), I urge the non-approval of this proposed code modification. Removing the overhang exception for non-HVHZ areas of the state means that side-hinged exterior doors would no longer have the option of testing and labeling to the ANSI/WMA 100 or ASTM E330 as expressly referenced in Section 609.3. WMA 100 and ASTM E330 are structural performance standards only and do not address water infiltration. And the reason that the comparable section of the IRC does not reference this overhang exception (per proponent's rationale) is because the IRC only addresses design wind loads (structural performance) and does not specify water intrusion testing. Also, this modification is the same as Mod S12169.

1st Comment Period History

S12170-G2

Proponent Jennifer Hatfield Submitted 4/16/2025 3:59:10 PM Attachments No

Comment:

On behalf of the Fenestration & Glazing Industry Alliance (FGIA) we must oppose this proposal as it currently stands, along with its corresponding FBC, Building proposal that would delete the exception to water intrusion testing for exterior doors that have an overhang spanning outward over the door of a specified length. At a minimum, some type of exception provision must be provided in the cases where accessibility requirements must be met. A ½ inch door threshold height required for accessibility has a high risk of water intrusion unless an overhang or other provisions are provided that reduce the water exposure to the door. Further, there are cases where a higher threshold becomes a safety concern due to the trip hazard that comes with it. Many older homeowners may prefer eliminating a trip hazard that could otherwise become a significant risk of falling with the possibility of serious medical conditions resulting from such an incident. In cases where a lower threshold is either required or preferred, requiring an overhang provides some level of protection rather than no protection at all. It is a balance between important water intrusion considerations and safety/accessibility considerations. As noted in the proponents rationale, FGIA looks forward to collaborating with IBHS, the Commission, and other interested parties to determine a solution that may modify the existing language rather than a complete deletion.

S12170-A3Text Modification

Further modify the proposal as follows:

R609.3 Testing and labeling. Exterior windows and sliding doors shall be tested by an approved independent laboratory, and bear a label identifying manufacturer, performance characteristics and approved inspection agency to indicate compliance with AAMA/WDMA/CSA 101/I.S.2/A440 or TAS 202 (HVHZ shall comply with TAS 202 and ASTM E1300). Exterior side-hinged doors shall be tested and labeled as conforming to AAMA/WDMA/CSA 101/I.S.2/A440 or ANSI/WMA 100, or comply with Section R609.5. Exterior windows and doors shall be labeled with a permanent label, marking, or etching providing traceability to the manufacturer and product. The following shall also be required either n a permanent label or on a temporary supplemental label applied by the manufacturer: information identifying the manufacturer, the product model/series number, positive and negative design pressure rating, product maximum size tested, impact-resistance rating if applicable, Florida product approval number or Miami-Dade product approval number applicable test standard(s), and approved product certification agency, testing laboratory, evaluation entity or Miami-Dade product approval.

The labels are limited to one design pressure rating per reference standard. The temporary supplemental label shall remain on the window or door until final approval by the building official.

Exceptions:

1. (*n*o change*)*

2. Door assemblies labeled with a limited water (LW) rating as specified in AAMA/WDMA/CSA 101/I.S.2/A440 shall be protected from water exposure in accordance with the door system manufacturer's applicable instructions or as determined by a *registered design professional*.

3 ~~2~~. (*no change*)

4 ~~3~~. (*no change*)

Page: 1

Mod12170_A3_TextOfModification.pdf

S12170-A1Text Modification

R609.3 Testing and labeling. Exterior windows and sliding doors shall be tested by an approved independent laboratory, and bear a label identifying manufacturer, performance characteristics and approved inspection agency to indicate compliance with AAMA/WDMA/CSA 101/I.S.2/A440 or TAS 202 (HVHZ shall comply with TAS 202 and ASTM E1300). Exterior side-hinged doors shall be tested and labeled as conforming to AAMA/WDMA/CSA 101/I.S.2/A440 or ANSI/WMA 100, or comply with Section R609.5. Exterior windows and doors shall be labeled with a permanent label, marking, or etching providing traceability to the manufacturer and product. The following shall also be required either n a permanent label or on a temporary supplemental label applied by the manufacturer: information identifying the manufacturer, the product model/series number, positive and negative design pressure rating, product maximum size tested, impact-resistance rating if applicable, Florida product approval number or Miami-Dade product approval number applicable test standard(s), and approved product certification agency, testing laboratory, evaluation entity or Miami-Dade product approval.

The labels are limited to one design pressure rating per reference standard. The temporary supplemental label shall remain on the window or door until final approval by the building official.

Exceptions:

1. (*no change*)

2. Door assemblies labeled with a Limited Water (LW) rating as specified in AAMA/WDMA/CSA 101/I.S.2/A440 shall be permitted to be installed where the overhang (OH) ratio is equal to or more than 1 ~~need not be tested for water infiltration~~. The overhang ratio shall be calculated by the following equation:

OH ratio = OH Length/OH Height

Where:

OH length = The minimum horizontal measure of how far a permanent overhang over a door projects outward in each direction of the exterior surface of the ~~from~~ door frame ~~surface~~ (refer to Figure A). For installations with side walls that have height equal to the overhang height on each side of the door and that extend the full length of the overhang that is perpendicular to the door, the overhang length that is parallel to the door need not be considered (refer to Figure B).

OH height = The maximum vertical measure of the distance from the bottom of the door frame ~~sill~~ to the bottom surface of the permanent overhang over the ~~a~~ door (refer to Figures A and B).

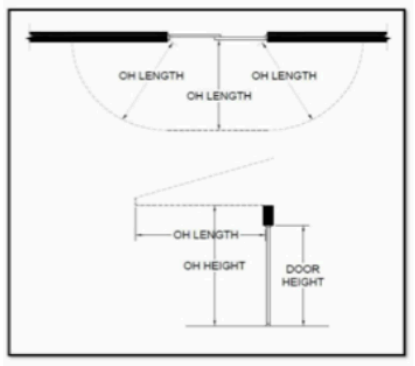


Figure A

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Mod12170_A1_TextOfModification.pdf

S12170-A1Text Modification

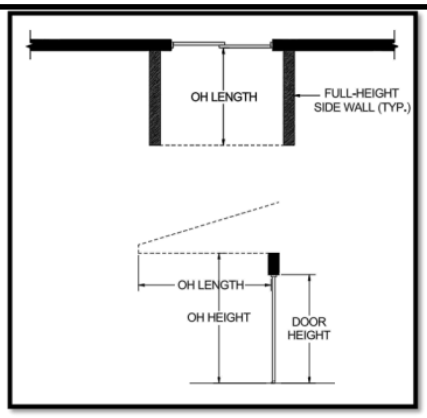


Figure B

3. (*no change*)

4. (*no change*)

Page: 2

Mod12170_A1_TextOfModification.pdf

S12170Text Modification

R609.3 Testing and labeling. Exterior windows and sliding doors shall be tested by an approved independent laboratory, and bear a label identifying manufacturer, performance characteristics and approved inspection agency to indicate compliance with AAMA/WDMA/CSA 101/I.S.2/A440 or TAS 202 (HVHZ shall comply with TAS 202 and ASTM E1300). Exterior side-hinged doors shall be tested and labeled as conforming to AAMA/WDMA/CSA 101/I.S.2/A440 or ANSI/WMA 100, or comply with Section R609.5. Exterior windows and doors shall be labeled with a permanent label, marking, or etching providing traceability to the manufacturer and product. The following shall also be required either n a permanent label or on a temporary supplemental label applied by the manufacturer: information identifying the manufacturer, the product model/series number, positive and negative design pressure rating, product maximum size tested, impact-resistance rating if applicable, Florida product approval number or Miami-Dade product approval number applicable test standard(s), and approved product certification agency, testing laboratory, evaluation entity or Miami-Dade product approval.

The labels are limited to one design pressure rating per reference standard. The temporary supplemental label shall remain on the window or door until final approval by the building official.

Exceptions:

1. (*no* change*)*

~~2. Door assemblies installed where the overhang (OH) ratio is equal to or more than 1 need not be tested for water infiltration. The overhang ratio shall be calculated by the following equation:~~

~~OH ratio = OH Length/OH Height where:~~

~~OH length = The horizontal measure of how far an overhang over a door projects out from door surface.~~

~~OH height = The vertical measure of the distance from the door sill to the bottom of the overhang over a door.~~

2 ~~3~~. (*no change*)

3 ~~4~~. (*no change*)

Page: 1

Mod12170_TextOfModification.pdf

Rationale:

This proposal is submitted on behalf of the Insurance Institute for Business and Home Safety (IBHS), based on observations from post-event investigations and experiments that highlight the need for this change.

This proposal deletes the exception to water intrusion testing for exterior doors that have an overhang spanning outward over the door of a specified length. AAMA/WDMA/CSA 101/I.S.2/A440 and TAS 202 require windows and doors to be tested for water intrusion. This exception to water intrusion testing in AAMA/WDMA/CSA 101/I.S.2/A440 and TAS 202 is unique to the Florida Building Code. It is not contained in either of the referenced standards nor the *International Codes*. An example of the application of the overhang exception is shown in the following illustration which is taken from Figure 3 of the FEMA *Hurricane Ian in Florida Recovery Advisory 3, Reducing Water Intrusion Through Windows and Doors (2023d)*:

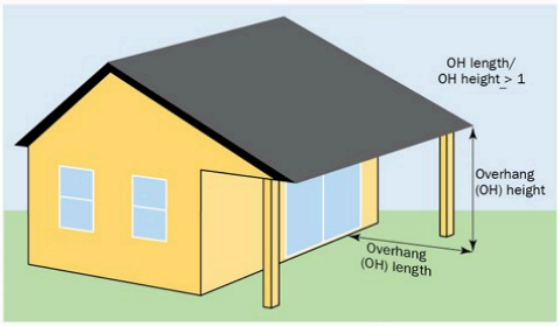


Figure 3: Overhang exception to water penetration testing for doors in the FBCB and FBCR.

This exception originated as a way to comply with the accessibility requirements but still provide some protection from water intrusion due to wind driven rain. A higher threshold or sill riser is often needed to provide the required resistance to water intrusion. However, a higher threshold or sill can in some instances be in conflict with the accessibility requirements for accessible routes. As currently written, this exception provides a blanket exemption to water intrusion testing regardless of whether the door is part of an accessible route or not.

This protection configuration will provide some protection of the door from wind driven rain. However, it clearly cannot protect doors from horizontal wind driven rain that occurs during hurricanes. Interior finishes and contents can be severely damaged by water intrusion through doors.

The FEMA Hurricane Ian in Florida Mitigation Assessment Team (MAT) report documented numerous homeowner reports of water intrusion through doors, particularly sliding glass doors, at nearly all sites visited. (See Section 4.2.3 and Figures 4-9 and 4-10 for examples provided in the FEMA Hurricane Ian in Florida Mitigation Team Assessment Report, FEMA P-2342 (https://www.fema.gov/sites/default/files/documents/fema_rm-hurriance-ian-mat-report-12-2023.pdf). The report notes that at this site, the exterior sliding doors had an overhang length the

exceeded the minimum length required to comply with the exception in the FBC. However, the homeowner reported significant water intrusion due to wind-driven rain through the sliding door.

This water intrusion can result in costly damage to interior contents and furnishings. The observations from the FEMA Hurricane Ian in Florida MAT led to the report recommending the following in Recommendation FL-12a:

The Florida Building Commission should collaborate with the window industry (Window and Door Manufacturers Association [WDMA], Fenestration and Glazing Industry Alliance, and key manufacturers) and other stakeholders to modify or delete the exceptions to water intrusion testing in the FBC. The FBC exempts doors from water intrusion testing required by American Architectural Manufacturers Association (AAMA)/WDMA/Canadian Standards Association (CSA) 101/I.S.2/A440, and TAS 202 for doors installed in certain conditions. While these installations may provide sufficient protection in areas outside hurricane-prone regions, it will not protect doors from the wind driven horizontal rain that commonly occurs during hurricanes. The entire State of Florida is within a hurricane-prone region.

This proposal, if approved, would implement this recommendation by deleting this exception to the required water intrusion testing in the specified referenced standards.

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Residential

33

S11871

Date Submitted	02/07/2025	**Section**	703.11.1	**Proponent**	Fernando Pages
Chapter	7	**Affects HVHZ**	No	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

R703.11.1.1 Fastners R703.11.1.2 Penetration depth R703.11.1.3 Spacing

Summary of Modification

Change replaces the 16" OC stud fastening rule with a prescriptive table allowing tested fastener alternatives based on framing and sheathing. Backed by ASTM D5206 and engineering data, it permits ring shank nails where stud attachment is difficult, ensuring secure, code-compliant installation.

Rationale

This change updates the 16" OC stud fastening requirement with a prescriptive table allowing tested fastener alternatives based on framing and sheathing. Supported by ASTM D5206 and engineering data, it ensures secure installation by requiring ring shank nails where stud attachment is difficult, improving durability and compliance.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Simplify enforcement: We will remove references to installation practices in the code in Table R703.3(1) as the table is redundant and not used in an additional proposal.

Impact to building and property owners relative to cost of compliance with code

Adds about 25% in material costs, and potential additional labor costs. Estimated additional cost for an average 20 square home is between $50-$150.

Impact to industry relative to the cost of compliance with code

This change offers alternatives to installation which will add additional fasteners and ring shank nails vs. smooth shank nails which are more expensive.

Impact to small business relative to the cost of compliance with code

Adds between 25% and 50% in material costs, and potential additional labor costs. Estimated additional cost for an average 20 square home is between $50-$150.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This change will offer options of installation while addressing trends in construction related to energy efficiency and alternative framing concepts.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Strenghtens the code by adding nailing requiremnts to areas where most siding failur occurs: At gable ends.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate against other mateirals or products.

Does not degrade the effectiveness of the code

Does not degrade the code.

Alternate Language

2nd Comment Period

S1871-A2

Proponent Fernando Pages **Submitted** 8/21/2025 3:54:35 PM **Attachments** Yes

Rationale:

This change will offer options of installation attachment on multiple substrates while addressing trends in construction related to energy efficiency and alternative framing concepts. This change updates the 16" OC stud fastening requirement with a prescriptive table allowing tested fastener alternatives based on framing and sheathing. Supported by ASTM D5206 and engineering data, it ensures secure installation by requiring ring shank nails and screws where stud attachment is difficult, improving durability and compliance.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Simplify enforcement: We will remove references to installation practices in the code in Table R703.3(1) as the table is redundant and not used in an additional proposal.

Impact to building and property owners relative to cost of compliance with code

Adds about 25% in fastening material costs, and potential additional labor costs. The estimated additional cost for an average 20 square home is between $50-$150.

Impact to industry relative to the cost of compliance with code

Adds about 25% in fastening material costs, and potential additional labor costs. The estimated additional cost for an average 20 square home is between $50-$150.

Impact to small business relative to the cost of compliance with code

Adds between 25% and 50% in material costs, and potential additional labor costs. Estimated additional cost for an average 20 square home is between $50-$150.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

This change will offer options of installation while addressing trends in construction related to energy efficiency and alternative framing concepts.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Strengthens the code by adding nailing requirements to areas where most siding failure occurs: At gable ends.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

Does not discriminate against other materials or products.

Does not degrade the effectiveness of the code

Does not degrade the code.

S11871-A2Text Modification

See attachments

Page: 1

Mod11871_A2_TextOfModification.pdf

S11871-A2Text Modification

Molimo™
Architectural Product Testing

TEST REPORT

ASTM D 5206-24

REPORT NO.: 30984.01-106-11-R1

RENDERED TO: POLYMERIC EXTERIOR PRODUCTS ASSOCIATION (PEPA)
Alexandria, Virginia

PRODUCT TYPE: Vinyl Siding

SCOPE OF WORK: ASTM D5206 Windload Testing on Double 5 Vinyl Siding

Test Date: 5/20/2025
Report Date: 6/3/2025
Test Record Retention End Date: 5/20/2029

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Page: 1

Mod_11871_A2_Text_Testing to suport new table.pdf

S11871-A2Text Modification

Molimo™ Architectural Product Testing

CLIENT INFORMATION: POLYMERIC EXTERIOR PRODUCTS ASSOCIATION (PEPA)
1800 Diagonal Road, Suite 545
Alexandria, Virginia 22314

TEST LABORATORY: Molimo, LLC
1410 Eden Road
York, Pennsylvania 17402
717-900-6034

PROJECT SUMMARY:

PRODUCT TYPE: Vinyl Siding

SERIES/MODEL: ASTM D5206 Windload Testing on Double 5 Vinyl Siding

PROJECT SUMMARY:

Molimo, LLC was contracted to perform Siding Windload testing on the above referenced product. The results are tested values and were secured by using the designated test method. A summary of the Average Maximum Sustained Negative Pressure achieved for the specimens tested are shown in the table below.

Product	Average Maximum Sustained Negative Pressure
Double 5 Vinyl Siding with Screws Spaced 16" on center	30 psf
Double 5 Vinyl Siding with Screws Spaced 12" on center	38.3 psf

PROJECT DETAILS:

Test Date: 5/20/2025

Test Record Retention End Date: 5/20/2029

Test Location: Molimo, LLC test facility in York, Pennsylvania.

Test Specimen Source: The test specimens were provided by the client. Representative samples of the test specimen will be retained by Molimo for a minimum of four years from the test completion date.

Drawing Reference: The test specimen drawings were supplied by the client. The test specimen construction was verified by Molimo and was found to be representative of the products tested. Test specimen drawings are located in Appendix B of this report.

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WITNESSES:

The following representatives witnessed all or part of the testing.

Name	Company
Sara Krompholz	PEPA
Aaron Faust	Cornerstone Building Brands
Dean Martin	ProVia
Melissa Mueller	Westlake Building Products
Justin L. Bupp	Molimo, LLC
Robert J. Beatty	Molimo, LLC

TEST METHOD:

ASTM D 5206-24 – *Standard Test Method for Windload Resistance of Rigid Plastic Siding*

TEST SPECIMEN DESCRIPTION:

GENERAL DESCRIPTION:

Each specimen consisted of four horizontal courses of siding with a male interlock on the bottom and female interlock on the top. A vinyl starter strip was utilized the length of the bottom plate.

DETAILED SIDING DESCRIPTION:

Material Type	PVC
Nominal Thickness	0.040"
Measured Thickness	0.040"
Nail Hem Type	Single
Nail Hem Thickness	0.040"
Nail Slot Edge Distance	0.240"
Exterior Finish	Wood grain finish

INSTALLATION:

Test Buck Construction: THE test buck measured 5’ wide by 6' high and was constructed of #2 Spruce-Pine-Fir nominal 2x4 lumber. Two studs were located 16" on center (3 spans) and were attached to the top and bottom plates with 3" long drywall screws. A sheet of nominal 7/16" thick OSB, with three 4" diameter holes to allow pressure to transfer to the siding was secured to the wood studs with #8 x 1-5/8" long drywall screws. Silicone was utilized on the backside of the test panel to seal the perimeter. A 2 mil thick plastic film was loosely draped over the interior of the siding to enable attainment of pressure.

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Molimo™ Architectural Product Testing

TEST SPECIMEN DESCRIPTION: (Continued)

Mounting Details: The siding was mounted with #8 x 1" cabinet screws, spaced 16" on center for test specimens #1-4 and 12-1/2" on center for test specimens #5-7, fastened into the sheathing.

TEST RESULTS: The temperature during testing was 19° C (67° F).

ASTM D 5206 SIDING WINDLOAD TEST

***Note**: All loads were negative pressure and were held for thirty seconds. A 5.0 psf pre-load was applied before running the specimens to failure.*

Test Specimen #1: Screws 16" on center

Test Pressure	Test Results
10.0 psf to 35 psf	No Damage
37 psf	Nail hem over-rode the installation fasteners at the 2nd course

Test Specimen #2: Screws 16" on center

Test Pressure	Test Results
10.0 psf to 30 psf	No Damage
35 psf	Nail hem over-rode the installation fasteners at the 1st course

Test Specimen #3: Screws 16" on center

Test Pressure	Test Results
10.0 psf to 25 psf	No Damage
26 psf	Nail hem over-rode the installation fasteners at the 2nd course

Test Specimen #4: Screws 16" on center

Test Pressure	Test Results
10.0 psf to 30 psf	No Damage
32.7 psf	Nail hem over-rode the installation fasteners at the 1st course

Average Maximum Sustained Negative Pressure: 30 psf

Average Ultimate Negative Test Pressure: 32.6 psf

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Molimo™ Architectural Product Testing

TEST RESULTS: (Continued)

Test Specimen #5: Screws 12-1/2" on center

Test Pressure	Test Results
10.0 psf to 45 psf	No Damage
46 psf	Nail hem over-rode the installation fasteners at the 1st course

Test Specimen #6: Screws 12-1/2" on center

Test Pressure	Test Results
10.0 psf to 35 psf	No Damage
38 psf	Nail hem over-rode the installation fasteners at the 1st course

Test Specimen #7: Screws 12-1/2" on center

Test Pressure	Test Results
10.0 psf to 35 psf	No Damage
40 psf	Nail hem over-rode the installation fasteners at the 2nd course

Average Maximum Sustained Negative Pressure: 38.3 psf

Average Ultimate Negative Test Pressure: 41.3 psf

***General Note**: All testing was performed in accordance with the referenced standard.*

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A copy of this report, detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation will be retained by Molimo, LLC for the entire test record retention period. At the end of this retention period, the service life of this report will expire.

Results obtained are tested values and were secured by using the designated test methods. The results in this report are relevant only to the specimen(s) tested. This test report does not constitute certification of this product nor an opinion or endorsement by this laboratory. It is the exclusive property of the client so named herein and relates only to the specimen(s) tested. This report may not be reproduced, except in full, without the written permission of Molimo, LLC.

For MOLIMO, LLC:

Written by:	Authorized by:
Robert J. Beatty	Justin L. Bupp
Project Manager	Manager – Product Testing

RJB:cmc

Attachments (pages): This report is complete only when all attachments listed are included.
Appendix-A: Photos (3)
Appendix B: Drawing (1)

This report was produced from controlled document template MMO-00046, Rev 4, 8/27/2024.

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Molimo™
Architectural Product Testing

Report No.: 30984.01-106-11-R1

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	6/2/2025	All	Original Report Issue
1	6/3/2025	Appendix B	Updated Drawing

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Appendix A

Photos

Photo No. 1-Mounting Screw



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Report No.: 30984.01-106-11-R1

Photo No. 2-Test Buck Setup/Installation



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Photo No. 3- Nail Override



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Report No.: 30984.01-106-11-R1

Appendix B

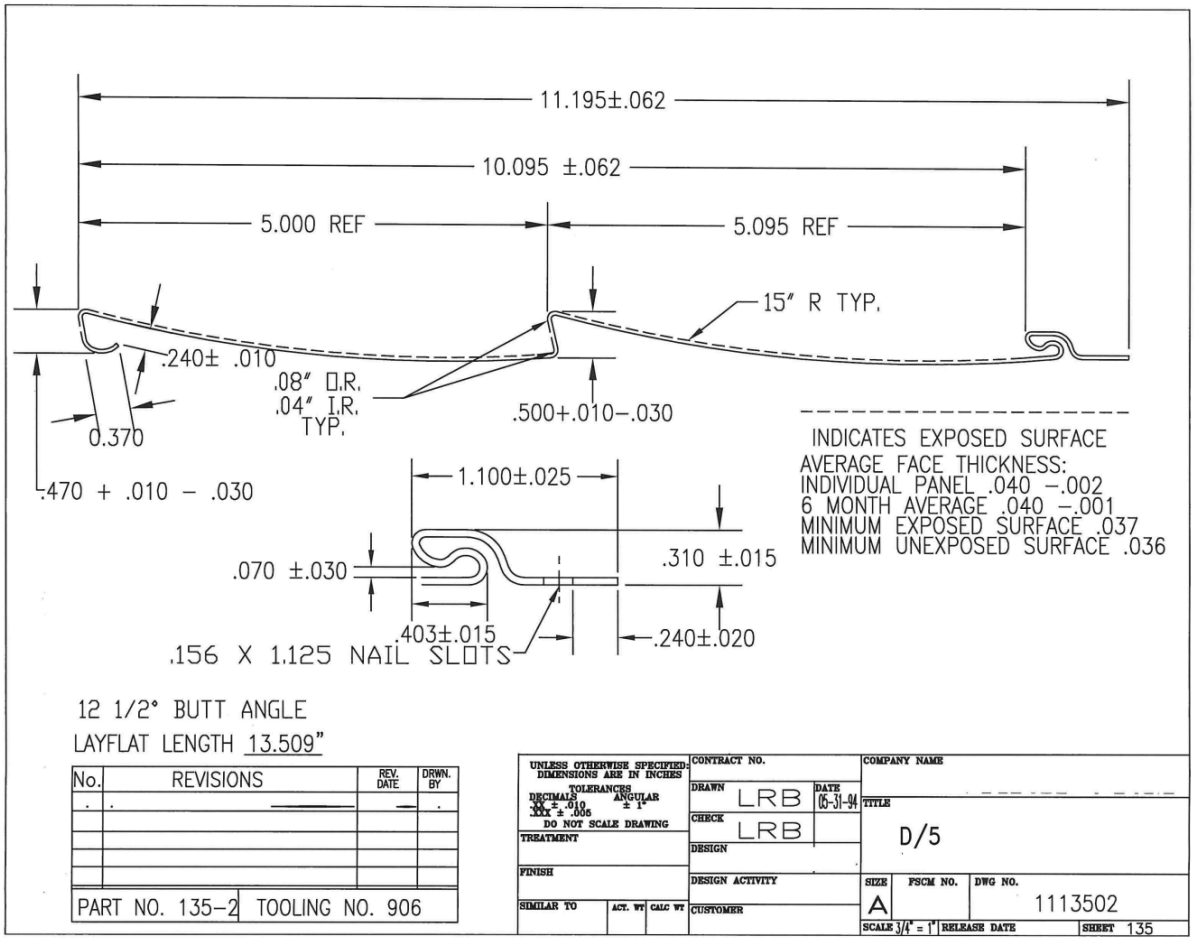
Drawings

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VINYL SIDING INSTITUTE, INC.
WINDLOAD TEST REPORT

SCOPE OF WORK
ASTM D5206 WINDLOAD TESTING ON DOUBLE 5, SIDING AND 0.046" PANEL AND FASCIA

REPORT NUMBER
M5139.01-109-40

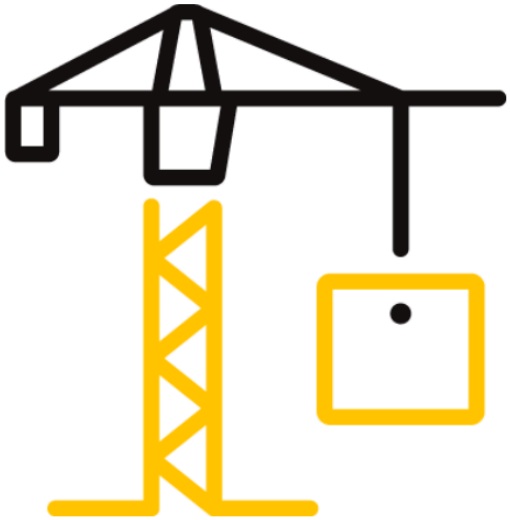
TEST DATE(S)
07/26/21 - 07/27/21

ISSUE DATE 08/20/21
REVISED DATE 09/08/21

RECORD RETENTION END DATE
07/27/25

PAGES
26

DOCUMENT CONTROL NUMBER
ATI 00500 (07/24/17)
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TEST REPORT FOR VINYL SIDING INSTITUTE, INC.
Report No.: M5139.01-109-40
Revision 1: 09/08/21
Date: 08/20/21

REPORT ISSUED TO
VINYL SIDING INSTITUTE, INC.
Vinyl Siding Institute 1800 Diagonal Road, Suite 545
Alexandria, Virginia 22314

SECTION 1
SCOPE

Architectural Testing, Inc. (an Intertek company) dba Intertek Building & Construction (B&C) was contracted by Vinyl Siding Institute, Inc. to perform windload testing in general accordance with ASTM D5206 on their Double 5, siding and 0.046" panel and fascia. Results obtained are tested values and were secured by using the designated test method(s). Testing was conducted at Intertek B&C test facility in York, Pennsylvania.

For INTERTEK B&C:

COMPLETED BY:	Andrew P. Mehalick	**REVIEWED BY:**	Vicki L. McElwain
TITLE:	Technician – Product Testing	**TITLE:**	Supervisor – Product Testing
SIGNATURE:		**SIGNATURE:**	
DATE:	09/08/21	**DATE:**	09/08/21

APM:nls

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SECTION 2
TEST METHOD(S)

The specimens were evaluated in general accordance with the following:

ASTM D5206-19, *Standard Test Method for Windload Resistance of Rigid Plastic Siding*

Test #14 was tested using two different installations with each installation tested once.

SECTION 3
MATERIAL SOURCE

Test specimens were provided by the client. Representative samples of the test specimen(s) will be retained by Intertek B&C for a minimum of four years from the test completion date.

SECTION 4
EQUIPMENT

Tape Measure Verification: 63788
Weather Station: 63316
Control Panels: 005406 and 005644

SECTION 5
LIST OF OFFICIAL OBSERVERS

NAME	COMPANY
Sara Krompholz	Vinyl Siding Institute, Inc.
Matt Dobson	Vinyl Siding Institute, Inc.
Alan Hoying	Cornerstone Building Brands
Neil Sexton	CertainTeed, LLC
Richard E. Hartman, III	Intertek B&C
Vicki L. McElwain	Intertek B&C
Andrew P. Mehalick	Intertek B&C

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TEST REPORT FOR VINYL SIDING INSTITUTE, INC.
Report No.: M5139.01-109-40
Revision 1: 09/08/21
Date: 08/20/21

SECTION 6
DOUBLE 5 SIDING DESCRIPTION

MANUFACTURER	VSI Member
SERIES/MODEL	Double 5
PRODUCT TYPE	Rigid Plastic Siding
MATERIAL TYPE	PVC
NOMINAL THICKNESS	0.046"
MEASURED THICKNESS	0.044"
NAIL HEM TYPE	Double
NAIL HEM THICKNESS	Bottom Hem: 0.042", Top Hem: 0.040"
NAIL SLOT EDGE DISTANCE	0.275"
EXTERIOR FINISH	Wood grain finish

SECTION 7
TEST #1, 1-1/2" ELECTROGALVANIZED ROOFING NAILS SPACED 24" ON CENTER DESCRIPTION

The specimen was installed into a test buck measuring 4' 1-1/2" wide by 6' high constructed of #2 Spruce-Pine-Fir nominal 2x4 lumber. One stud was spaced 24" on center (two spans) and was attached to the top and bottom plates with 3" long drywall screws. A sheet of nominal 1/2" thick OSB, with four 4" diameter holes to allow pressure to transfer to the siding, was secured to the studs with #8 x 1-5/8" drywall screws. Silicone was utilized on the backside of the test panel to seal the perimeter. A 2 mil thick plastic film was loosely draped over the interior of the siding to enable attainment of pressure.

The siding was mounted with 1/8" shank diameter, 7/16" head, 1-1/2" long electrogalvanized roofing nails, spaced 24" on center through the sheathing and into the studs.

Each specimen consisted of four horizontal courses of siding with a male interlock on the bottom and a female interlock on the top. A PVC starter strip was utilized the length of the bottom plate.

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TEST REPORT FOR VINYL SIDING INSTITUTE, INC.
Report No.: M5139.01-109-40
Revision 1: 09/08/21
Date: 08/20/21

SECTION 8
TEST #1, 1-1/2" ELECTROGALVANIZED ROOFING NAILS SPACED 24" ON CENTER TEST RESULTS

The temperature range during testing was 28°C - 29°C (83°F - 85°F). The results are tabulated as follows:

General Note: *All loads were negative pressure and were held for thirty seconds. A 5.0 psf pre-load was applied before running specimens to failure.*

Test Specimen #1:

PRESSURE	RESULTS
10.0 psf to 25.0 psf	No damage
30.0 psf	Nail hem over-rode the installation fasteners at the second course. Held test load for 15 seconds.

Test Specimen #2:

PRESSURE	RESULTS
10.0 psf to 30.0 psf	No damage
35.0 psf	Nail hem over-rode the installation fasteners at the third course. Held test load for 25 seconds.

Test Specimen #3:

PRESSURE	RESULTS
10.0 psf to 25.0 psf	No damage
30.0 psf	Nail hem over-rode the installation fasteners at the third course. Held test load for 20 seconds.

SECTION 9
CONCLUSION

The specimen(s) tested successfully achieved an Average Maximum Sustained Negative Pressure of 26.7 psf and an Average Ultimate Negative Test Pressure of 31.7 psf.

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TEST REPORT FOR VINYL SIDING INSTITUTE, INC.
Report No.: M5139.01-109-40
Revision 1: 09/08/21
Date: 08/20/21

SECTION 10

TEST #3, 1-1/2" " ELECTROGALVANIZED ROOFING NAILS SPACED 12" ON CENTER DESCRIPTION

The specimen was installed into a test buck measuring 4' 1-1/2" wide by 6' high constructed of #2 Spruce-Pine-Fir nominal 2x4 lumber. One stud was spaced 24" on center (two spans) and was attached to the top and bottom plates with 3" long drywall screws. A sheet of nominal 1/2" thick OSB, with four 4" diameter holes to allow pressure to transfer to the siding, was secured to the studs with #8 x 1-5/8" drywall screws. Silicone was utilized on the backside of the test panel to seal the perimeter. A 2 mil thick plastic film was loosely draped over the interior of the siding to enable attainment of pressure.

The siding was mounted with 1/8" shank diameter, 7/16" head, 1-1/2" long electrogalvanized roofing nails, spaced 12" on center. Half of the nails were into the sheathing only, the other half were through the sheathing and into the studs.

Each specimen consisted of four horizontal courses of siding with a male interlock on the bottom and a female interlock on the top. A PVC starter strip was utilized the length of the bottom plate.

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SECTION 11
TEST #3, 1-1/2" ELECTROGALVANIZED ROOFING NAILS SPACED 12" ON CENTER TEST RESULTS

The temperature during testing was 31°C - 32°C (87°F - 89°F). The results are tabulated as follows:

General Note: *All loads were negative pressure and were held for thirty seconds. A 5.0 psf pre-load was applied before running specimens to failure.*

Test Specimen #4:

PRESSURE	RESULTS
10.0 psf to 45.0 psf	No damage
50.0 psf	Installation fasteners pulled out of the test buck at the second course. Held test load for two seconds.

Test Specimen #5:

PRESSURE	RESULTS
10.0 psf to 40.0 psf	No damage
45.0 psf	Nail hem over-rode the installation fasteners at the second course. Held test load for seven seconds.

Test Specimen #6:

PRESSURE	RESULTS
10.0 psf to 40.0 psf	No damage
45.0 psf	Nail hem over-rode the installation fasteners at the second course. Held test load for one second.

SECTION 12
CONCLUSION

The specimen(s) tested successfully achieved an Average Maximum Sustained Negative Pressure of 41.7 psf and an Average Ultimate Negative Test Pressure of 46.7 psf.

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SECTION 13

TEST #4, 1-1/2" ELECTROGALVANIZED ROOFING NAILS SPACED 12" ON CENTER INTO SHEATHING DESCRIPTION

The specimen was installed into a test buck measuring 4' 1-1/2" wide by 6' high constructed of #2 Spruce-Pine-Fir nominal 2x4 lumber. Two studs were spaced 16" on center (three spans) and were attached to the top and bottom plates with 3" long drywall screws. A sheet of nominal 1/2" thick OSB, with five 4" diameter holes to allow pressure to transfer to the siding, was secured to the studs with #8 x 1-5/8" drywall screws. Silicone was utilized on the backside of the test panel to seal the perimeter. A 2 mil thick plastic film was loosely draped over the interior of the siding to enable attainment of pressure.

The siding was mounted with 1/8" shank diameter, 7/16" head, 1-1/2" long electrogalvanized roofing nails, spaced 12" on center into the sheathing only.

Each specimen consisted of four horizontal courses of siding with a male interlock on the bottom and a female interlock on the top. A PVC starter strip was utilized the length of the bottom plate.

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SECTION 14

TEST #4, 1-1/2" ELECTROGALVANIZED ROOFING NAILS SPACED 12" ON CENTER INTO SHEATHING TEST RESULTS

The temperature range during testing was 28°C - 29°C (83°F - 85°F). The results are tabulated as follows:

General Note: *All loads were negative pressure and were held for thirty seconds. A 5.0 psf pre-load was applied before running specimens to failure.*

Test Specimen #7:

PRESSURE	RESULTS
10.0 psf to 35.0 psf	No damage
40.0 psf	Installation fasteners pulled out of the test buck at the second course. Held test load for five seconds.

Test Specimen #8:

PRESSURE	RESULTS
10.0 psf to 40.0 psf	No damage
45.0 psf	Installation fasteners pulled out of the test buck at the first course. Held test load for three seconds.

Test Specimen #9:

PRESSURE	RESULTS
10.0 psf to 45.0 psf	No damage
50.0 psf	Installation fasteners pulled out of the test buck at the first course. Held test load for 23 seconds.

SECTION 15

CONCLUSION

The specimen(s) tested successfully achieved an Average Maximum Sustained Negative Pressure of 40.0 psf and an Average Ultimate Negative Test Pressure of 45.0 psf.

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SECTION 16

TEST #6, 1-1/2" RING SHANK NAILS SPACED 12" ON CENTER INTO SHEATHING DESCRIPTION

The specimen was installed into a test buck measuring 4' 1-1/2" wide by 6' high constructed of #2 Spruce-Pine-Fir nominal 2x4 lumber. Two studs were spaced 16" on center (three spans) and were attached to the top and bottom plates with 3" long drywall screws. A sheet of nominal 1/2" thick OSB, with five 4" diameter holes to allow pressure to transfer to the siding, was secured to the studs with #8 x 1-5/8" drywall screws. Silicone was utilized on the backside of the test panel to seal the perimeter. A 2 mil thick plastic film was loosely draped over the interior of the siding to enable attainment of pressure.

The siding was mounted with 1/8" shank diameter, 7/16" head, 1-1/2" long ring shank nails, spaced 12" on center into the sheathing only.

Each specimen consisted of four horizontal courses of siding with a male interlock on the bottom and a female interlock on the top. A PVC starter strip was utilized the length of the bottom plate.

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SECTION 17
TEST #6, 1-1/2" RING SHANK NAILS SPACED 12" ON CENTER INTO SHEATHING TEST RESULTS

The temperature range during testing was 29°C - 30°C (85°F - 86°F). The results are tabulated as follows:

General Note: *All loads were negative pressure and were held for thirty seconds. A 5.0 psf pre-load was applied before running specimens to failure.*

Test Specimen #10:

PRESSURE	RESULTS
10.0 psf to 45.0 psf	No damage
50.0 psf	Nail hem over-rode the installation fasteners at the second course. Held test load for 12 seconds.

Test Specimen #11:

PRESSURE	RESULTS
10.0 psf to 45.0 psf	No damage
50.0 psf	Nail hem over-rode the installation fasteners at the second course. Held test load for 25 seconds.

Test Specimen #12:

PRESSURE	RESULTS
10.0 psf to 45.0 psf	No damage
46.0 psf	Nail hem over-rode the installation fasteners at the second course.

SECTION 18
CONCLUSION

The specimen(s) tested successfully achieved an Average Maximum Sustained Negative Pressure of 45.0 psf and an Average Ultimate Negative Test Pressure of 48.7 psf.

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SECTION 19

TEST #9, 7/16" CROWN STAPLES SPACED 16" ON CENTER DESCRIPTION

The specimen was installed into a test buck measuring 4' 1-1/2" wide by 6' high constructed of #2 Spruce-Pine-Fir nominal 2x4 lumber. Two studs were spaced 16" on center (three spans) and were attached to the top and bottom plates with 3" long drywall screws. A sheet of nominal 1/2" thick OSB, with five 4" diameter holes to allow pressure to transfer to the siding, was secured to the studs with #8 x 1-5/8" drywall screws. Silicone was utilized on the backside of the test panel to seal the perimeter. A 2 mil thick plastic film was loosely draped over the interior of the siding to enable attainment of pressure.

The siding was mounted with 16-gauge, 7/16" crown, 1-1/2" long staples, spaced 16" on center through the sheathing and into the studs.

Each specimen consisted of four horizontal courses of siding with a male interlock on the bottom and a female interlock on the top. A PVC starter strip was utilized the length of the bottom plate.

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SECTION 20
TEST #9, 7/16" CROWN STAPLES SPACED 16" ON CENTER TEST RESULTS

The temperature range during testing was 28°C - 32°C (82°F - 89°F). The results are tabulated as follows:

General Note: *All loads were negative pressure and were held for thirty seconds. A 5.0 psf pre-load was applied before running specimens to failure.*

Test Specimen #13:

PRESSURE	RESULTS
10.0 psf to 60.0 psf	No damage
65.0 psf	Nail hem tore at the third course. Held test load for three seconds.

Test Specimen #14:

PRESSURE	RESULTS
10.0 psf to 60.0 psf	No damage
64.0 psf	Installation fasteners pulled out of the test buck at the fourth course.

Test Specimen #15:

PRESSURE	RESULTS
10.0 psf to 70.0 psf	No damage
75.0 psf	Nail hem tore at the first course. Held test load for one second.

SECTION 21
CONCLUSION

The specimen(s) tested successfully achieved an Average Maximum Sustained Negative Pressure of 63.3 psf and an Average Ultimate Negative Test Pressure of 68.0 psf.

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SECTION 22

TEST #11, 7/16" CROWN STAPLES SPACED 12" ON CENTER INTO SHEATHING DESCRIPTION

The specimen was installed into a test buck measuring 4' 1-1/2" wide by 6' high constructed of #2 Spruce-Pine-Fir nominal 2x4 lumber. Two studs were spaced 16" on center (three spans) and were attached to the top and bottom plates with 3" long drywall screws. A sheet of nominal 1/2" thick OSB, with five 4" diameter holes to allow pressure to transfer to the siding, was secured to the studs with #8 x 1-5/8" drywall screws. Silicone was utilized on the backside of the test panel to seal the perimeter. A 2 mil thick plastic film was loosely draped over the interior of the siding to enable attainment of pressure.

The siding was mounted with 16-gauge, 7/16" crown, 1-1/2" long staples, spaced 12" on center into the sheathing.

Each specimen consisted of four horizontal courses of siding with a male interlock on the bottom and a female interlock on the top. A PVC starter strip was utilized the length of the bottom plate.

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SECTION 23
TEST #11, 7/16" CROWN STAPLES SPACED 12" ON CENTER INTO SHEATHING TEST RESULTS

The temperature during testing was 31°C (87°F). The results are tabulated as follows:

General Note: *All loads were negative pressure and were held for thirty seconds. A 5.0 psf pre-load was applied before running specimens to failure.*

Test Specimen #16:

PRESSURE	RESULTS
10.0 psf to 50.0 psf	No damage
55.0 psf	Installation fasteners pulled out of the test buck at the second course. Held test load for 23 seconds.

Test Specimen #17:

PRESSURE	RESULTS
10.0 psf to 60.0 psf	No damage
65.0 psf	Installation fasteners pulled out of the test buck at the first course. Held test load for four seconds.

Test Specimen #18:

PRESSURE	RESULTS
10.0 psf to 55.0 psf	No damage
57.0 psf	Installation fasteners pulled out of the test buck at the second course.

SECTION 24
CONCLUSION

The specimen(s) tested successfully achieved an Average Maximum Sustained Negative Pressure of 55.0 psf and an Average Ultimate Negative Test Pressure of 59.0 psf.

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SECTION 25
TEST #14, FASCIA WITH DRIP EDGE DESCRIPTION

The specimen was installed into a test buck measuring 6' wide by 8-1/2" high, constructed of #2 Spruce-Pine-Fir nominal 2x4 lumber. Two studs were spaced 24" on center (three spans) and were attached to the roof and soffit sheathing with 3" long drywall screws. Two pieces of 1x4 boards, with three 4" diameter holes to allow pressure to transfer to the specimen, were secured to the studs with #8 x 3" drywall screws. Silicone was utilized to seal the perimeter. A 2 mil thick plastic film was loosely draped over the interior of the specimen to enable attainment of pressure.

The specimen consisted of a 0.017" thick by 72" wide by 1-5/8" tall drip edge with a 2-7/8" installation leg. The drip edge was installed on the roof edge of the buck with 1/8" shank diameter, 7/16" head, 1-1/2" long electrogalvanized roofing nails, spaced 10" on center through the drip edge and into the roof sheathing. A 0.020" thick by 72" wide by 7-3/4" tall fascia with a 1" leg was placed under the drip edge. The fascia was mounted using 1/16" shank diameter, 3/16" head, 1-1/4" long trim nails, spaced 24" on center through the fascia and into the soffit sheathing. The fascia was also face nailed with trim nails spaced 1" below the drip edge and 24" on center into the face sheathing of the buck.

SECTION 26
TEST #14, FASCIA WITH DRIP EDGE TEST RESULTS

The temperature during testing was 32°C (90°F). The results are tabulated as follows:

General Note: *All loads were negative pressure and were held for thirty seconds. A 5.0 psf pre-load was applied before running specimens to failure.*

Test Specimen #19:

PRESSURE	RESULTS
10.0 psf to 60.0 psf	No damage
65.0 psf	Fascia over-rode the installation fasteners at the face. Held test load for 20 seconds.

SECTION 27
CONCLUSION

The specimen(s) tested successfully achieved an Average Maximum Sustained Negative Pressure of 60 psf and an Average Ultimate Negative Test Pressure of 65 psf.

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SECTION 28
TEST #14, FASCIA WITH DRIP EDGE AND SOFFIT DESCRIPTION

The specimen was installed into a test buck measuring 6' wide by 8-1/2" high, constructed of #2 Spruce-Pine-Fir nominal 2x4 lumber. Two studs were spaced 24" on center (three spans) and were attached to the roof and soffit sheathing with 3" long drywall screws. Two pieces of 1x4 boards, with three 4" diameter holes to allow pressure to transfer to the specimen, were secured to the studs with #8 x 3" drywall screws. Silicone was utilized to seal the perimeter. A 2 mil thick plastic film was loosely draped over the interior of the specimen to enable attainment of pressure.

The specimen consisted of a 0.017" thick by 72" wide by 1-5/8" tall drip edge with a 2-7/8" installation leg. The drip edge was installed on the roof edge of the buck with 1/8" shank diameter, 7/16" head, 1-1/2" long electrogalvanized roofing nails, spaced 10" on center through the drip edge and into the roof sheathing. The Double 5 siding was placed on the soffit side of the buck. The soffit was installed on the soffit side of the buck with 1/8" shank diameter, 7/16" head, 1-1/2" long electrogalvanized roofing nails, spaced 12" on center through the nail hem and into the soffit sheathing. A 0.020" thick by 72" wide by 7-3/4" tall fascia with a 1" leg was placed under the drip edge. The fascia was mounted using 1/16" shank diameter, 3/16" head, 1-1/4" long trim nails, spaced 24" on center through the fascia and into the soffit sheathing. The fascia was also face nailed with trim nails spaced 1" below the drip edge and 24" on center into the face sheathing of the buck.

SECTION 29
TEST #14, FASCIA WITH DRIP EDGE AND SOFFIT TEST RESULTS

The temperature during testing was 29°C (85°F). The results are tabulated as follows:

General Note: *All loads were negative pressure and were held for thirty seconds. A 5.0 psf pre-load was applied before running specimens to failure.*

Test Specimen #20:

PRESSURE	RESULTS
10.0 psf to 100.0 psf	No damage
102.0 psf	No failure. Exceeded blower capacity.

SECTION 30
CONCLUSION

The specimen(s) tested successfully achieved an Average Maximum Sustained Negative Pressure of 100.0 psf and an Average Ultimate Negative Test Pressure of 102.0 psf.

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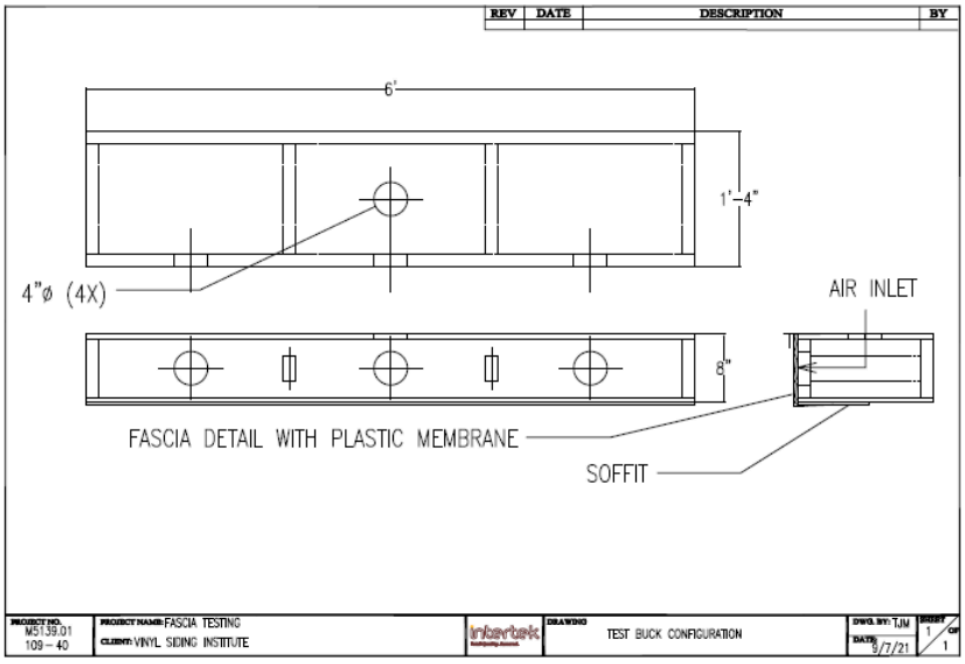
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SECTION 31
SKETCH(ES)



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SECTION 32
PHOTOGRAPHS



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Photo No. 2
Test #4, Prior to Testing

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Photo No. 3
Test #6, Prior to Testing

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Photo No. 4
Test #9, Prior to Testing

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Photo No. 5
Test #11, Prior to Testing

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Photo No. 6
Test #14 without Soffit, Prior to Testing



Photo No. 7
Test #14 with Soffit, Prior to Testing

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SECTION 33
DRAWINGS

The test specimen drawings were not supplied by the client.

SECTION 34
REVISION LOG

REVISION #	DATE	PAGES	REVISION
0	08/20/21	N/A	Original Report Issue
1	09/08/21	19	Added sketch

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VINYL SIDING INSTITUTE TECHNICAL REPORT

Understanding How Polymeric Siding Products Performed in the Storm

This report provides observations and assessments made by the Vinyl Siding Institute (VSI) on the performance of vinyl siding, insulated vinyl siding, and polypropylene siding (known collectively as polymeric siding) and accessories during Hurricane Irma, along with a visual analysis of how polymeric siding and soffit (including aluminum fascia) performed during actual hurricane conditions.

HURRICANE IRMA
August 30 – September 16, 2017
Category 2 in Surveyed Area



VINYL SIDING



POLYPROPYLENE SIDING



INSULATED VINYL SIDING

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AUTHORS

Written and researched by the Vinyl Siding Institute, March 2018.

ABOUT THE VINYL SIDING INSTITUTE

The Vinyl Siding Institute, Inc. (VSI) is the trade association for manufacturers of vinyl and other polymeric siding and suppliers to the industry. One of VSI's goals is to develop material, product, and performance standards in cooperation with standards-making organizations and code bodies. VSI engages in product stewardship and serves as an information resource to remodelers, builders, planners, designers, architects, elected officials, building code officials, distributors, homeowners, and other exterior cladding decision-makers on the facts about vinyl and other polymeric sidings.

VINYL SIDING INSTITUTE



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Executive Summary

Field inspections conducted by VSI staff and consultants during October of 2017, tracing the path of Hurricane Irma along the southwestern coastline of Florida, confirmed that modern polymeric siding products (installed in the last 20 years) performed successfully and as designed during a major storm. Nevertheless, proper installation and proper product specification are critical. Where product failure was observed it was either because of improper installation or improper product selection/specification.

Failure of soffit and fascia is an area that should be studied more closely, and a review of current requirements should be evaluated for their effectiveness. Current I-Code provisions requiring soffit fastening at both the wall and fascia ends may help to contribute to successful product performance, but current codes lack specification for fascia installation. Failure of fascia is an area that has not been studied closely, but should be, as this issue may contribute to the failure of soffit.

KEY OBSERVATIONS:

- In general, modern polymeric siding products performed successfully as designed.
- Modern polymeric siding, designed for high wind/hurricane areas, performed and withstood hurricane force winds where installed properly.
- Modern standards and testing verification, coupled with modern code requirements, have contributed to successful product performance.
- Improper installation methods can lead to product blow-off.
- Improper specification of polymeric siding with products not designed for high-wind areas can be an issue, however steps have been taken by industry to ensure a clear understanding of product design pressure ratings and whether or not it is appropriate for specification in high wind areas.
- Failure of soffit and fascia is an issue that has been partially addressed and continues to be an area that warrants further research for a more complete solution. Current I-Code provisions requiring soffit fastening at wall and fascia may be the solution.
- Building codes generally lack any specification around fascia installation. Failure of fascia is an issue and can also be a contributing factor to the failure of soffit.

Background on Hurricanes and Codes

Along the eastern seaboard of the United States, close to seven hurricanes (tropical cyclones with a wind of force 12 on the Beaufort scale, equal to or exceeding 74 mph) make landfall every four years (or 1.75 per year). About three highly destructive hurricanes hit the U.S. coast every five years (or 0.60 per year). Of the 284 hurricanes to strike the Atlantic and Gulf coast, from Texas to Maine, between 1851 and 2010 (most recent comparative data), Florida was impacted by 114 and Texas by 64. Louisiana, which suffered the costliest hurricane in US history with Hurricane Katrina, was impacted by 57 hurricanes in the same period.[1]

Resilient building materials, such as appropriate polymeric claddings, are required to protect life and property, and assure speedy recovery after future high-wind and hurricane events, which some predict will occur at increased levels of violence and frequency.

In 2002, the state of Florida rolled out new statewide building standards that included beefed-up structural reinforcing, specific testing requirements on the impact resistance of glass and the wind resistance of roof tiles, construction site staging methods to prevent flying debris, and strict wind-resistant nailing standards for exterior cladding. Testing and quality control standards were put in place to prove that manufacturers' materials and recommended installation methods were able to withstand winds of up to 120 mph.

THE SAFFIR-SIMPSON HURRICANE WIND SCALE, MODIFIED FROM SIMPSON (1974).

Scale Number (Category)	Winds Average 1-min (mph)
1	74-95
2	96-110
3	111-130
4	131-155
5	> 155

A major hurricane is a category 3, 4, or 5 hurricanes on the Saffir-Simpson Hurricane Wind Scale

1. The Deadliest, Costliest, and Most Intense United, States Tropical Cyclones From 1851 To 2010 (And Other Frequently Requested Hurricane Facts); Eric S. Blake, Et Al. National Weather Service, National Hurricane Center Miami, Florida, August 2011.

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After Hurricane Irma, it has been generally agreed that testing standards and building code requirements have worked.

Ms. Julie Rochman, chief executive of the Insurance Institute for Business and Home Safety, is quoted in the *Wall Street Journal*, as saying, "It looks like the building codes have proved themselves, that the new construction has done well.[2]"

While International Code Council (ICC) CEO Dominic Sims, in a *Highlands News-Sun*[3] article, said that there's "no doubt" newer codes saved homes during Hurricane Irma. "I don't think there is any doubt that the continued improvements to the Florida building codes system has really helped Florida deal with this storm," Sims stated in the *News-Sun* article.

"More rigorous standards have led to improved resilience of building products, including polymeric siding, which greatly benefits homeowners and the overall real estate market in wind-hazard areas," said Kate Offringa, President and CEO of the Vinyl Siding Institute.

Building codes specify required design pressure for a given location and building characteristics. Building products, including siding, are tested using methods such as ASTM D5206 to develop information on the maximum pressure the product is suitable for. For a product to be properly used, its design pressure rating must be at least as high as the requirements for the location and building. Manufacturers have published this compliance information for many years in their code compliance reports and other product information. Manufacturers will soon also begin publishing this design pressure information on the product or package label to further clearly communicate whether or not the product is suitable for use in high wind areas.



"It looks like the building codes have proved themselves, that the new construction has done well.[2]"

Ms. Julie Rochman
Chief Executive of the Insurance Institute for Business and Home Safety



2. https://www.wsj.com/articles/one-early-lesson-from-irma-hurricane-building-codes-work-1505559600
3. http://yoursun.com/sunnews/sebring/sebringnews/13475714-695/story.html.csp

SOFFIT

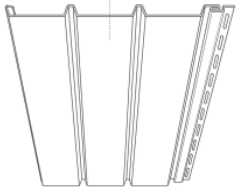
In previous versions of the International Residential Code (IRC), soffit has been required to be "fastened", without providing more detail. The recently published 2018 IRC has added the following requirements (sections R703.3.1 and R703.11.1.4), which should provide for more wind-resistant installations.

- Vinyl soffit must have a design pressure rating appropriate for the location and application, determined by testing
- Vinyl soffit is now required to be fastened at both the fascia and wall ends, and not simply "fastened"

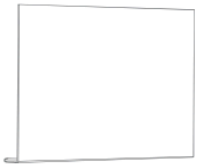
The parameters used to determine the design pressure rating included in ASTM product specifications provide a precise way of determining the wind load resistance of polymeric siding and soffits. Manufacturers have been able to use certain design characteristics of the siding to influence the wind resistance of the siding and target it to different wind severity regions. Factors such as narrower face exposure (distance between rows of fasteners); greater thickness and reinforced or fully doubled nail hems allow for use of the siding in hurricane prone zones.

It is critical that only siding with such wind enhancements be used in high wind areas and that the maximum wind pressure for which the siding or soffit is designed and tested be matched to the requirements of the building and its wind exposure according to the building code.

Vinyl soffit must be fastened at both the fascia and wall ends.



SOFFIT
(Triple 4" Solid)



FASCIA
Installed with or without F-Channel and finish trim to provide a maintenance-free fascia board.

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Field Review of Polymeric Siding Performance During Hurricane Irma

Background on Hurricane Irma

Hurricane Irma originated in Cape Verde, on the southwest coast of Africa, as do many of the storms that impact the Atlantic coast of the United States. The storm broke many records in size, intensity and duration. From a Category 5 hurricane in the open Atlantic, Irma lost energy as it crossed Cuba, before making landfall on Cudjoe Key as Category 4, with winds at 130 mph (215 km/h). Irma then further weakened to Category 3 status prior to another landfall in Florida on Marco Island later the same day. The storm weakened to a Category 2 once inland, but maintained hurricane status as it traveled up the peninsula until becoming a tropical storm north of Tampa.

WIND SPEED MAP



Figure 1
Courtesy Peter Vickery of Applied Research Associates (ARA)

IRMA FACTS

Dates:
August 30 – September 16, 2017

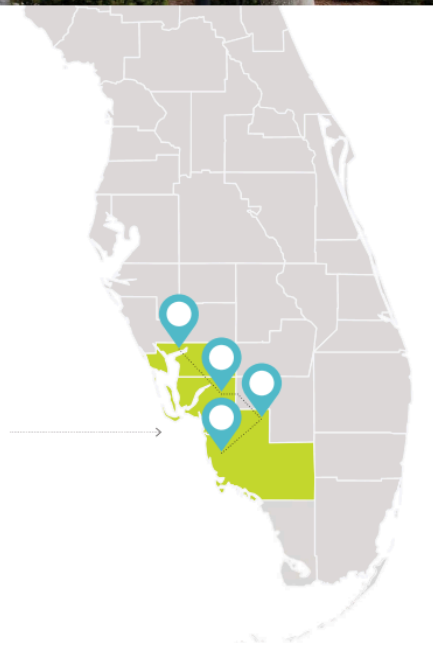
Highest wind speed: 185 mph
Damage: ≥ $64.2 billion (2017 USD);

FIELD SURVEY:

On October 2nd and 3rd of 2017, a field analysis crew from VSI spent two days reviewing the performance of polymeric claddings in the southwestern area of Florida impacted by Hurricane Irma. The observations began in Punta Gorda and moved southeast through Lehigh Acres and Immokalee and ended in the Golden Gate/Bonita Springs areas.

FLORIDA FIELD SURVEY LOCATIONS

- Punta Gorda
- Lehigh Acres
- Immokalee
- Golden Gate/Bonita Springs



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Here are some examples of findings from this field visit.



Gulf Breeze at Punta Gorda:
An apartment complex of 170 units distributed in 30 buildings. Properly specified and correctly installed insulated siding enabled this product to withstand hurricane force winds. This insulated siding had design pressure ratings of 55 psf, certified to withstand winds of up to 151 mph (ASD; Category B, mean roof height 30 ft.).



Gulf Breeze at Punta Gorda:
An apartment complex of 170 units distributed in 30 buildings. Properly specified and correctly installed insulated siding enabled this product to withstand hurricane force winds. This insulated siding had design pressure ratings of 55 psf, certified to withstand winds of up to 151 mph (ASD; Category B, mean roof height 30 ft.).



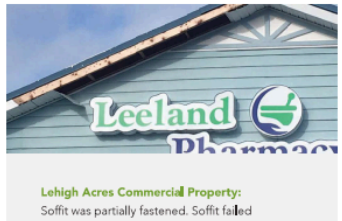
Lehigh Acres:
This home suffered no visible damage to siding, soffit, or fascia.



Orange Grove Park Condominium at Lehigh Acres:
While the storm wreaked havoc in Lehigh Acres, as you can see by the downed palm trees and upturned vegetation, the homes in this 56-unit complex, built in the 1980s, suffered minimal damage.



Orange Grove Park Condominium at Lehigh Acres:
While the storm wreaked havoc in Lehigh Acres, as you can see by the downed palm trees and upturned vegetation, the homes in this 56 unit complex, built in the 1980s, suffered minimal damage.



Lehigh Acres Commercial Property:
Soffit was partially fastened. Soffit failed where fascia was also pulled off.



Jubilation at Immokalee:
Built in 2003, this 89-unit, 10-building multifamily complex endured significant damage to soffits and fascias where improper installation was observed. Despite this damage, wind-driven rain only penetrated one of the 89 units. Considering the storms impact on Immokalee, in whole, the damages to the complex were minimal. Improper installation of both soffits and siding may have failed to limit storm damage.



Jubilation at Immokalee:
Built in 2003, this 89-unit, 10-building multifamily complex endured significant damage to soffits and fascias where improper installation was observed. Despite this damage, wind-driven rain only penetrated one of the 89 units. Considering the storms impact on Immokalee, in whole, the damages to the complex were minimal. Improper installation of both soffits and siding may have failed to limit storm damage.

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Findings from the Field Survey



Camden Cove at Bonita Springs:
The failed soffit was improperly installed. Note there is no connection to wall; the only fastener was at the fascia. Current requirements in the International Residential Code could have possibly limited or prevented this damage because fasteners are now required at both the wall and fascia.



Courtyards at Golden Gate City:
This 56-unit development was built in the early 1980s, but later was resided, time frame unknown. The product installed on these buildings was not rated for high velocity winds and represents a good example of improper specification. The failure of this product was most noticeable in the gable end areas, where design pressures can be higher because of lack of interior sheathing.



Courtyards at Golden Gate City:
This 56 unit development was built in the early 1980s, but was later resided, time frame unknown. The soffit product on these buildings was not fastened, only friction fit.



Golden Gate City:
No visible damage to siding, soffit, or fascia.



Golden Gate City:
No visible damage to siding, soffit, or fascia.



Golden Gate City:
No visible damage to siding, soffit, or fascia.



Golden Gate City:
No visible damage to siding, soffit, or fascia.



Golden Gate City:
No visible damage to siding, soffit, or fascia.

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Findings from the Field Survey



Jubilation at Immokalee:
Built in 2003, this 89-unit, 10-building multifamily complex was sided with a product that was properly specified for use in high velocity wind areas. Its design pressure rating is 50, it is good for 144 mph (ASD, Category B, mean roof height 30 feet).



Jubilation at Immokalee:
Built in 2003, this 89-unit, 10-building multifamily complex suffered significant failure. Installation defects at the first course of siding. The installers did not use a starter strip, but J-channel instead. J-channel does not secure the lower edge of the siding, and should not be used instead of starter strip.



Lehigh Acres:
Here the soffits do not appear to be fastened, and failed.



Lehigh Acres:
This commercial strip mall had only one area of failure, although it is not clear the product was rated for high wind. The installer used J-channel to trim the siding without fastening the siding. This is improper installation.

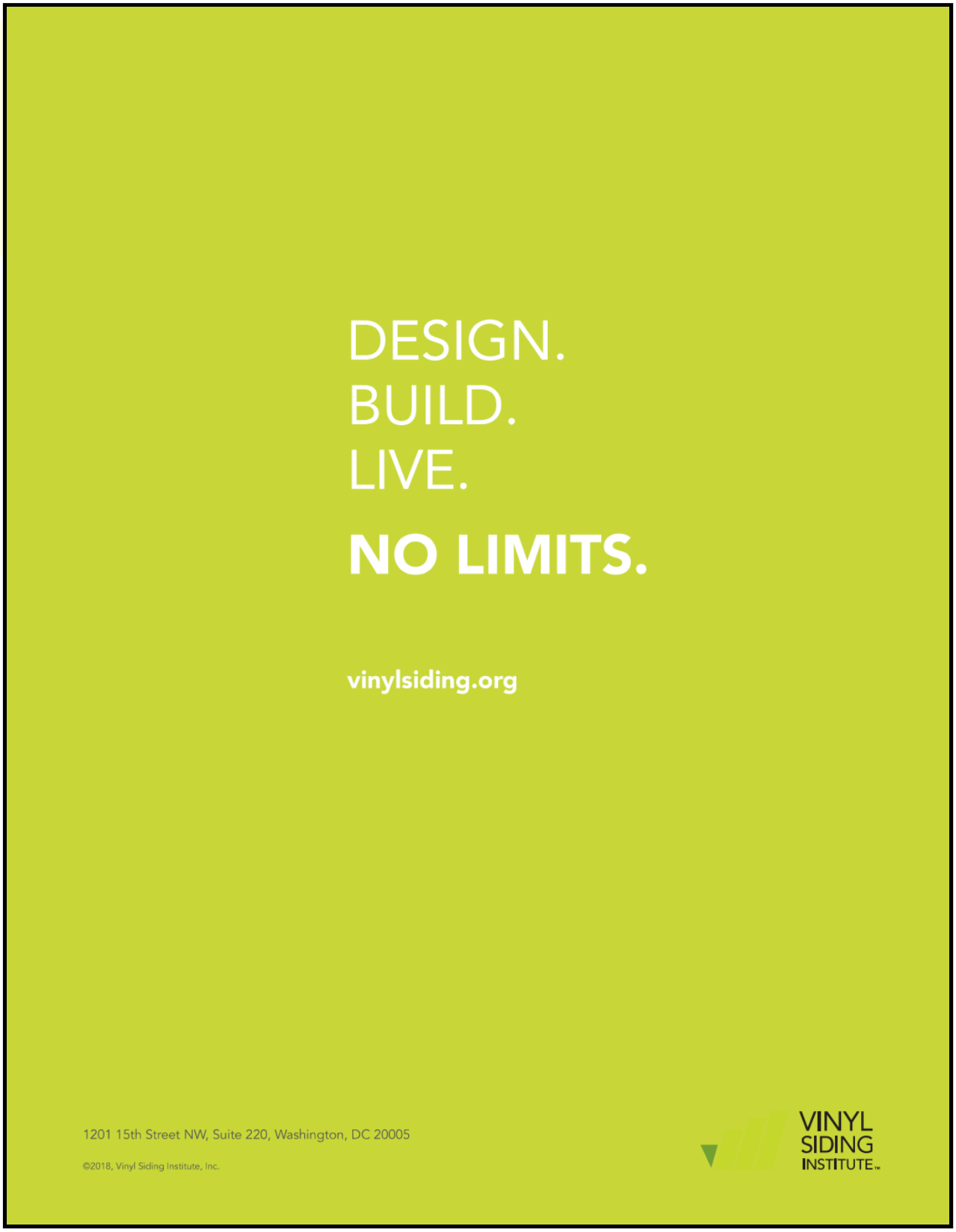
Conclusions and Recommendations

- Properly specified products, installed properly, were observed to have performed as designed and show how resilient polymeric siding and soffit products can be under hurricane conditions.
- Use of siding that is not properly rated for the wind conditions of the location and building type has a greater likelihood of failure during a hurricane. Siding not properly rated for the application continues to be frequently observed as having been blown off after hurricanes. The industry has taken steps to ensure that wind load design pressure rating information is available for every certified siding product. Specifiers, installers and code officials need to work towards the goal of making sure the siding rating matches the requirements for the location and building.
- Installation and performance of the product is extremely important. Improperly installed product can fail and lead to building damage.
- Proper starter strips, matched to the shape of the lock of the siding product, must be used at the lowest course. Failure to secure the lowest edge, such as by simply inserting it into a J-channel, can lead to failure. For example in one major multifamily development, the use of J-channel instead of starter strips appears to have led to failure of the first course of siding throughout the development.
- Failure of soffit, often associated with removal of fascia, continues to be common. More study is needed to identify sources of vulnerability.
- Changes to the building code require fastening of soffit at both the fascia and wall ends. This may be adequate for performance in high wind areas but should be studied more closely. Florida codes should be updated to explicitly require such fastening.
- Design pressure rating and fastening detail for fascia is not currently regulated by the I-Codes or Florida Building Code.
- The failure of fascia can lead to the failure of soffit. Soffit/fascia systems should be studied closely and solutions both through installation information and regulation should be considered.

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Modification # 11871

Code Change Cycle	2026 Triennial Original Modification 01/03/2025 - 02/18/2025
Sub Code	Residential
Chapter & Topic	Chapter 7 - Wall Covering
Section	703.11.1
Related Modifications:	R703.11.1.1 Fasteners
	R703.11.1.2 Penetration depth
	R703.11.1.3 Spacing

Summary of Modification

Change replaces the 16" OC stud fastening rule with a prescriptive table allowing tested fastener alternatives based on framing and sheathing. Backed by ASTM D5206 and engineering data, it permits ring shank nails where stud attachment is difficult, ensuring secure, code-compliant installation.

Add hurricane report

R703.11.1 Installation. [Revise as follows]

Vinyl siding, backed vinyl siding, insulated vinyl siding, and compatible accessories shall be installed in accordance with the manufacturer's instructions. For vinyl siding, backed vinyl siding, and insulated vinyl siding applied under the design wind pressure of 30 PSF or less in accordance with Table R301.2 (2), the prescriptive fastening requirements of Table R703.11.1 shall be permitted. Provisions of Section R703.11.2 shall apply.

[Delete without substitution]

~~**R703.11.1.1 Fasteners.**~~

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~~Unless specified otherwise by the manufacturer's instructions, fasteners for vinyl siding shall be 0.120-inch (3 mm) shank diameter nail with a 0.313-inch (8 mm) head.~~

~~R703.11.1.2 Penetration depth.~~

~~Unless specified otherwise by the manufacturer's installation instructions or in accordance with Table R703.3(1), fasteners shall penetrate into building framing. The total penetration into the sheathing, furring framing or other nailable substrate shall be a minimum 11/4 inches (32 mm).~~

~~R703.11.1.3 Spacing.~~

~~Unless specified otherwise by the manufacturer's installation instructions, the maximum spacing between fasteners for horizontal siding shall be 16 inches (406 mm), and for vertical siding 12 inches (305 mm) both horizontally and vertically. Where specified by the manufacturer's instructions and supported by a test report, alternative fastener spacing is permitted.~~

[Add new table as follows]

Table R703.11.1 Prescriptive Fastener Requirements for *Vinyl Siding, Backed Vinyl Siding*, and *Insulated Vinyl Siding*

Fastener[a]	Substrate[b]	Penetration Depth[c]	Spacing
Smooth shank nail, not less than 0.120" nail diameter shank with 0.313"(5/16") head.	Nailable Substrate	Not less than 1-1/4"	Horizontal siding – Not greater than 16-inches on center
Ring diameter shank nail, not less than 0.120" diameter shank with 0.313"(5/16") head.	min. 7/16" nailable substrate	Through substrate plus a minimum of 1/4" through	Horizontal siding – Not greater than 16-inches on center
Ring diameter shank nail, not less than 0.120" diameter shank with 0.313"(5/16") head.	> 15/32" thick nailable substrate	Through substrate plus a minimum of 1/4" through	Horizontal siding – Not greater than 16-inches on center

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Fastener[a]	Substrate[b]	Penetration Depth[c]	Spacing
Either smooth shank or ring shank (as specified above)	min. 7/16" nailable substrate	Through substrate plus a minimum of 1/4" through	Vertical siding – Not greater than 12-inches on center each way
Ring shank nail, not less than 0.120" diameter shank with 0.313"(5/16") head or screw not less than 0.138 diameter shank with a 0.423" truss or washer head.	min. 3/4" thick wood furring	into furring 3/4	Not greater than 12-inches on center
24” o.c. Framing (For 20 psf or less design wind pressure)[d]			
All fastener types	Nailable substrate	Not less than 1-1/4”	Horizontal siding not greater than 24 inches on center.

a. Fasteners shall comply with ASTM F1667

b. Wood framing and furring shall have a minimum specific gravity of 0.42. Other nailable substrates with equal or greater fastener withdrawal performance shall also be permitted. Where fiberboard, gypsum, foam plastic or other non-nailable substrate is use, fastener must go into studs or other form of nailable substrate.

c. The total thickness of wood structural panel, wood furring, and other nailable substrates shall be satisfying the required penetration depth.

d. For 0.120 inch roofing nail only, 24 inches on center fastener spacing for horizontal siding shall be permitted where the allowable stress design wind pressure is 20 psf or less in accordance with Section 1609. Alternatively, it shall be permitted where the mean roof height of the building is 30 feet (9.1 m) or less and the design wind speed does not exceed 115 mph for Exposure B or 110 mph Exposure C.

Rational

This change updates the 16" OC stud fastening requirement with a prescriptive table allowing tested fastener alternatives based on framing and sheathing. Supported by ASTM D5206 and engineering data, it ensures secure installation by requiring ring shank nails and screws where stud attachment is difficult, improving durability and compliance.

Fiscal

Simplify enforcement: We will remove references to installation practices in the code in Table R703.3(1) as the table is redundant and not used in an additional proposal.

Impact Owner

Adds about 25% in material costs, and potential additional labor costs.

The estimated additional cost for an average 20 square home is between $50-$150.

Industry

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Adds between 25% and 50% in material costs, and potential additional labor costs.

Estimated additional cost for an average 20 square home is between $50-$150.

Requirements

This change will offer options of installation while addressing trends in construction related to energy efficiency and alternative framing concepts.

Strengthens

Strengthens the code by adding nailing requirements to areas where most siding failure occurs: At gable ends.

Discriminate

Does not discriminate against other materials or products.

Degrade

Does not degrade the code.

Corrects referenced standards, removes staples as an attachment method, and clarifies footnotes, per TAC recommendation. Submitting testing results used to arrive at table recommendations.

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R703.11.1 Installation. [Revise as follows]

Vinyl siding, backed vinyl siding, insulated vinyl siding, and compatible accessories shall be installed in accordance with the manufacturer's installation instructions. For vinyl siding and insulated vinyl siding applied in accordance with the wind speed and exposure limits of Table R703.3.2 and rated for minimum wind load design pressure rating of 30 psf or greater in accordance with ASTM D3679 or ASTM D7793, respectively, the prescriptive fastening requirements of Table R703.11.1 shall be permitted as an alternative to the manufacturer's installation instructions.

[Add new text as follows:]

Table R703.11.1 Prescriptive Fastner Requirements for Vinyl and Insulated Vinyl Siding

Fastener[a]	Substrate[b]	Penetration Depth[c]	Spacing
Smooth shank nail, not less than 0.120" nail shank with 0.313(5/16)" head or 16 gage staple with 3/8- to 1/2- inch crown	Nailable substrate	Not less than 1-1/4"	Horizontal siding - not greater tha center
Ring shank nail, not less than 0.120" nail shank with 0.313(5/16)" head	min. 7/16" nailable substrate	Through substrate a minimum of 1/4"	Horizontal siding - not greater tha center
Ring shank nail, not less than 0.120" nail shank with 0.313(5/16)" head	> 15/32" thick nailable subtrate	Through substrate a minimum of 1/4"	Horizontal siding - Not greater th center
Either smooth shank or ring shank (a specified above)	min. 7/16" nailable subtrate	Through substrate a minimum of 1/4"	Vertical siding - Not greater than center each way
Ring shank nail, not less than 0.120" nail shank with 0.313(5/16)" head or screw not less than 0.138 screw shank with a .423" truss or pan head	min. 3/4" thick wood furring	Into furring 3/4"	Horizontal siding - Not greater tha center
24" o.c. framing (For 20 psf or less design wind pressure)[d]			
All fastener types	Nailable substrate	Not less than 1-1/4"	Horizontal siding - Not greater th center

a. Smooth and ring shank roofing nails shall comply with ASTM F1667.

b. Wood framing and furring shall have a minimum specific gravity of 0.42. Other *nailable* substrates with equal or greater faste withdrawal performance shall also be permitted. Where fiberboard, gypsum, foam plastic or other non-nailable substrate is use fasteners must penetrate studs or other form of *nailable substrate*.

c. The total thickness of *wood structural panel*, wood furring, wood framing, and other *nailable substrates* shall satisfying the re penetration depth.

d. 24" o.c. fastener spacing for horizontal siding shall be permitted where design wind pressure is 20 psf or less in accordance Tables R301.2.1(1) and (2) for 10 ft^2 tributary area and wall zone 5. Alternatively, it shall be permitted where the mean roof he building is 30 feet (9.1 m) or less and the design wind speed does not exceed 115 mph for Exposure B or 110 mph Exposure C

[Delete without substitution]

~~**R703.11.1.1 Fasteners.**~~

~~Unless specified otherwise by the manufacturer's instructions, fasteners for vinyl siding shall be 0.120-inch (3 mm) shank diameter nail with a 0.313-inch (8 mm) head.~~

~~**R703.11.1.2 Penetration depth.**~~

~~Unless specified otherwise by the manufacturer's installation instructions or in accordance with Table R703.3(1), fasteners shall penetrate into building framing. The total penetration into the sheathing, furring framing or other nailable substrate shall be a minimum 11/4 inches (32 mm).~~

~~**R703.11.1.3 Spacing.**~~

~~Unless specified otherwise by the manufacturer's installation instructions, the maximum spacing between fasteners for horizontal siding shall be 16 inches (406 mm), and for vertical siding 12 inches (305 mm) both horizontally and vertically. Where specified by the manufacturer's instructions and supported by a test report, alternative fastener spacing is permitted.~~

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TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Residential

34

S11872

Date Submitted	02/07/2025	**Section**	703.11.1.5	**Proponent**	Fernando Pages
Chapter	7	**Affects HVHZ**	No	**Attachments**	No
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Summary of Modification

This change adds to the recently added requirements with vinyl siding and the importance of starter strip and utility trim. Larger openings need additional connection points for the siding over the top, as this increases the performance of the siding system.

Rationale

This change adds to the recently added requirements with vinyl siding and the importance of starter strip and utility trim. Larger openings need additional connection points for the siding over the top, as this increases the performance of the siding system.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Adds requirment to openings larger than 4 ft. that will require inspector to aknowledge.

Impact to building and property owners relative to cost of compliance with code
This change would add about $5 per opening that it impacts. So an average house might have 3-4 applications, resulting in $15–$20 per house addition.

Impact to industry relative to the cost of compliance with code
This change would add about $5 per opening that it impacts.

Impact to small business relative to the cost of compliance with code
This change would add about $5 per opening that it impacts.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Securing trimmed siding with utility trim and snap locks enhances wind resistance, preventing panel loosening or failure in high winds. This ensures the siding system performs as intended, maintaining building envelope integrity and reducing the risk of wind-driven damage.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This modification strengthens the code by requiring utility trim and snap locks for trimmed siding, improving wind performance. It ensures a more secure installation method, aligning with manufacturer guidelines and industry best practices for better durability and system integrity.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This change applies universally to all vinyl siding installations, ensuring consistent performance without restricting specific materials or manufacturers. It aligns with tested industry standards and manufacturer guidelines, supporting proven construction methods without discrimination.

Does not degrade the effectiveness of the code

This modification enhances, rather than degrades, the code by improving wind resistance in vinyl siding installations. It aligns with existing requirements and manufacturer guidelines, ensuring better performance without weakening any existing provisions of the Florida Building Code.

Alternate Language

2nd Comment Period

Proponent Fernando Pages **Submitted** 8/20/2025 12:25:28 PM **Attachments** No

R311872-A1

Rationale:

Corrects confusing language regarding utility channel, per TAC request, and adds same to FBC to harmonize requirements in both codes.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Adds requirements to openings may require inspector to acknowledge correct installation.

Impact to building and property owners relative to cost of compliance with code

This change would add about $5 per opening that it impacts. So, an average house might have 5-10 applications, resulting in $150–$200 per house addition.

Impact to industry relative to the cost of compliance with code

This change would add about $5 per affected opening.

Impact to small business relative to the cost of compliance with code

This change would add about $5 per opening that it impacts.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Securing trimmed siding with utility trim and snap locks enhances wind resistance, preventing panel loosening or failure in high winds. This ensures the siding system performs as intended, maintaining building envelope integrity and reducing the risk of wind-driven damage.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

This modification strengthens the code by requiring utility trim and snap locks for trimmed siding, improving wind performance. It ensures a more secure installation method, aligning with manufacturer guidelines and industry best practices for better durability and system integrity.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

This change applies universally to all vinyl siding installations, ensuring consistent performance without restricting specific materials or manufacturers. It aligns with tested industry standards and manufacturer guidelines, supporting proven construction methods without discrimination.

Does not degrade the effectiveness of the code

This modification enhances, rather than degrades, the code by improving wind resistance in vinyl siding installations. It aligns with existing requirements and manufacturer guidelines, ensuring better performance without weakening any existing provisions of the Florida Building Code.

S11872-A1Text Modification

Text of Modification

R703.11.1.5 Utility trim and Snap Lock. Where horizontal siding has to be cut or trimmed below windows, and at the top of walls, the top edge of the siding shall be secured with utility trim and snap locks or as specified by the manufacturer's installation instructions. See Figures R703.11.1.5(1) and R703.11.1.5(2).

Where siding panels are installed above openings and have been field-trimmed at the bottom edge, the cut panel shall be supported with utility trim and snap locks.

Add to FBC to align with residential

1405.14.2.2 Utility trim

Under windows, at top of walls, ~~utility trim shall be used with snap locks.~~, and where siding panels are installed above openings and have been field-trimmed at the bottom edge, the cut panels shall be supported with utility trim and snap locks.

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Mod11872_A1_TextOfModification.pdf

S11872Text Modification

R703.11.1.5 Utility trim and Snap Lock. Where horizontal siding has to be cut or trimmed below windows and at the top of walls, the top edge of the siding shall be secured with utility trim and snap locks or as specified by the manufacturer's installation instructions. See Figures R703.11.1.5(1) and R703.11.1.5(2).

Where there are openings greater than 4 feet (1219 mm) in width and the bottom of the siding panel has been trimmed, utility trim and snap locks shall be used above the opening. Utility trim shall be applied upside down.

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Mod11872_TextOfModification.pdf

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Residential

35

S11964

Date Submitted	02/15/2025	**Section**	46	**Proponent**	Jennifer Hatfield
Chapter	2712	**Affects HVHZ**	No	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments No **Alternate Language Yes**

Related Modifications

Building Code Reference Standards Update

Summary of Modification

On behalf of the Fenestration & Glazing Industry Alliance (FGIA), this modification provides standard updates for both AAMA and ASTM standards used in the fenestration industry.

Rationale

These are standard editions that have published since the last Florida cycle and/or were not included in the 2024 I-codes. In addition to edits to the edition years, some titles also required updating.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
None
Impact to building and property owners relative to cost of compliance with code
None
Impact to industry relative to the cost of compliance with code
None
Impact to small business relative to the cost of compliance with code
None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Provides for latest standard editions.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Provides for latest standard editions.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not.

Does not degrade the effectiveness of the code

It does not.

Alternate Language

2nd Comment Period

S1964-A1

Proponent Jennifer Hatfield **Submitted** 8/22/2025 1:27:14 PM **Attachments** No

Rationale:

This alternate language comment removes 2025 updates to FMA/AAMA 100 and AAMA/WDMA/CSA 101/I.S.2/A440 (the latter known as NAFS) that are not yet available. Those will be addressed separately, once available, to ensure the rest of the standard updates in this proposal can be updated. In reviewing the NAFS standard it has also come to our attention that the 2022 edition of NAFS cited currently in both the 8th edition Florida Residential and Building Codebooks is not included in the Florida Energy Codebook - we would ask staff to look into updating that for consistency among the Florida codebooks as it was unintentionally missed.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

None

Impact to building and property owners relative to cost of compliance with code

None

Impact to industry relative to the cost of compliance with code

None

Impact to small business relative to the cost of compliance with code

None

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Provides for latest standard editions.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Provides for latest standard editions.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not.

Does not degrade the effectiveness of the code

It does not.

S11964-A1Text Modification

AAMA Standards by FGIA

Fenestration & Glazing Industry Alliance
1900 E. Golf Road, Suite 1250
Schaumburg IL 60173

AAMA/WDMA/CSA 101/I.S.2/A440—~~08,~~ 11, 17 or 22
North American Fenestration Standards/Specifications for ~~W~~windows, ~~D~~doors and ~~S~~skylights (NAFS)
R308.6.9, R609.3

506—16 or 23
~~Voluntary~~ Specifications for ~~Hurricane~~ Impact and Cycle Testing of Fenestration Products
R301.2.1.2, R609.6.1

711—~~13,~~ 20 or 22
~~Voluntary~~ Specification for Self-Adhering Flashing Used for Installation of Exterior Wall Fenestration Products R703.4, R905.1.1.1, R905.1.1.2

712—20 or 23
Voluntary Specification for Mechanically Attached Flexible Flashing R703.4

714—~~15 or~~ 19 or 2~~3~~2
~~Voluntary~~ Specification for Liquid Applied Flashing Used to Create a Water-resistive Seal ~~a~~Around Exterior Wall Openings in Buildings R703.4

812—~~04(2010) or~~ 19 or 25
Voluntary Practice for Assessment of Frame Deflection When Using Propellant Expanding Foam Sealants ~~One Component Polyurethane Foams~~ for Air-Sealing Rough Openings of Fenestration Installations R703.4

2502—19 or 24
Comparative Analysis Procedure for Window and Door Protocols R609.3.1

AAMA/NSA 2100—19 or 22
Specifications for Sunrooms R301.2.1.1.1

FMA/AAMA 100—12
Standard Practice for the Installation of Windows with Mounting Flanges for Membrane Drainage Systems ~~or Mounting~~ R703.4

ASTM

E330/E330M— ~~14 or~~ 14 (2021)
Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference
R609.4, R609.5, R703.1.2

E331—00 (~~2009 or 2016~~ 2023)
Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference
R703.1.1, R703.2

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E1300— ~~04e01, 07e01, 09e, 12AE1, or~~ 16 or 24
Practice for Determining Load Resistance of Glass in Buildings
R609.3

E1996— ~~2014a,~~ 2017, ~~or~~ 2020 or 2023
Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
R301.2.1.2, R301.2.1.2.1, R609.3.1, R609.6.1

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S11964Text Modification

AAMA Standards by FGIA

Fenestration & Glazing Industry Alliance
1900 E. Golf Road, Suite 1250
Schaumburg IL 60173

AAMA/WDMA/CSA 101/I.S.2/A440—~~08, 11 or~~ 17, ~~or~~ 22, or 25
North American Fenestration Standards/Specifications for ~~W~~windows, ~~D~~doors and ~~S~~skylights (NAFS)
R308.6.9, R609.3

506—16 or 23
~~Voluntary~~ Specifications for ~~Hurricane~~ Impact and Cycle Testing of Fenestration Products
R301.2.1.2, R609.6.1

711—~~13,~~20 or 22
~~Voluntary~~ Specification for Self-Adhering Flashing Used for Installation of Exterior Wall Fenestration Products R703.4, R905.1.1.1, R905.1.1.2

712—20 or 23
Voluntary Specification for Mechanically Attached Flexible Flashing R703.4

714—~~15 or~~ 19 or 2~~3~~2
~~Voluntary~~ Specification for Liquid Applied Flashing Used to Create a Water-resistive Seal ~~a~~Around Exterior Wall Openings in Buildings R703.4

800—16 or 25
Voluntary Specifications and Test Methods for Sealants R703.4

812—~~04(2010) or~~ 19 or 25
Voluntary Practice for Assessment of Frame Deflection When Using Propellant Expanding Foam Sealants ~~One Component Polyurethane Foams~~ for Air-Sealing Rough Openings of Fenestration Installations R703.4

2502—19 or 24
Comparative Analysis Procedure for Window and Door Protocols R609.3.1

AAMA/NSA 2100—19 or 22
Specifications for Sunrooms R301.2.1.1.1

FMA/AAMA 100—~~12~~25
Standard Practice for the Installation of Windows with Mounting Flanges for Membrane Drainage Systems ~~or Mounting~~ R703.4

ASTM

E330/E330M—14 or 14 (2021)
Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference
R609.4, R609.5, R703.1.2

E331—00 (~~2009 or~~ 2016 or 2023)

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Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference

R703.1.1, R703.2

E1300—~~04e01, 07e01, 09e~~09a, 12AE1, ~~or~~ 16 or 24
Practice for Determining Load Resistance of Glass in Buildings

R609.3

E1996—2014a, 2017 or 2020 or 2023
Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

R301.2.1.2, R301.2.1.2.1, R609.3.1, R609.6.1

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Mod11964_TextOfModification.pdf

TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Residential

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S12077

Date Submitted	02/17/2025	**Section**	1	**Proponent**	Robert Zabcik
Chapter	2712	**Affects HVHZ**	Yes	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language No**

Related Modifications

12073

Summary of Modification

Addition of ANSI/MCA FTS-1 Standard (FRC)

Rationale

This proposal adds ANSI/MCA FTS-1 as a referenced standard as required for Proposal 12064. Please see rationale for proposal 12064. A current copy of the FTS-1 standard is attached to this proposal.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
See impact statement for Mod 12073.
Impact to building and property owners relative to cost of compliance with code
See impact statement and attachment for Mod 12073.
Impact to industry relative to the cost of compliance with code
See impact statement and attachment for Mod 12073.
Impact to small business relative to the cost of compliance with code
See impact statement for Mod 12073.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
See statement for Mod 12073.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
See statement for Mod 12073.
Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

See statement for Mod 12073.

Does not degrade the effectiveness of the code

See statement for Mod 12073.

2nd Comment Period

R12077-G1

Proponent Pataya Scott Submitted 8/24/2025 2:21:22 PM Attachments No

Comment:

Requesting approved as submitted in accordance with alternate language comments R12073.

S12077Text Modification

MCA Metal Construction Association

1601 American Lane Suite 310

Schaumburg IL 60631

ANSI/MCA FTS-1 2019 Test Method for Wind Load Resistance of Flashings Used with Metal Roof Systems

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S12077Text Modification

ANSI/MCA FTS-1-2019

Test Method for Wind Load Resistance of Flashings Used with Metal Roof Systems

Approved 6/25/19

1.0 Scope

1.1 This test method evaluates the wind load resistance of flashings to be installed at the roof perimeter and roof plan transitions of metal roof systems by testing the flashing and its attachment to the supporting structure using line loads.

1.2 The provisions of this test method apply to exposed flashings with a face 4 inches or greater that are direct-fastened, and hem-and-cleat connections, or other attachment methods with a face 2 inches or greater.

1.3 This test method provides a standard procedure to demonstrate wind load resistance under uniform line load. This procedure is intended to represent the effects of uniform loading on exposed elements on a building surface. Two methods of testing are provided: 1) Face Load and 2) Face Load and Top Load.

3.0 Terminology

Where the following terms appear in this standard they are in italics and shall have the meaning defined herein. Terms not defined in Section 3 of this standard shall have the ordinary accepted meaning for the context in which they are used.

Anticipated ultimate load – the estimated maximum load that the *specimen* is expected to resist.

Cleat – a continuous metal strip to which a flashing with an open hem is engaged.

Clip – a non-continuous metal component used to secure two or more metal components together.

Coping – the covering piece on top of a parapet wall exposed to the weather, usually made of metal and sloped to carry off water.

Direct-fastened – an attachment method that involves a *fastener* passing through the attached member rather than attaching with a *cleat* or other similar method.

Drip edge – the outward projecting lower edge of a flashing used to control the direction of dripping water and to protect underlying building components.

***Face*—**the exposed surface or surfaces of a flashing to which one load is applied

Failure – fracture, disengagement or unrestrained deformation of components, including *fasteners*, such that the *specimen* is not capable of resisting additional load.

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Fastener – any of a wide variety of mechanical devices and assemblies, including nails, staples, screws, rivets and bolts for securing components to a building.

Load case – one orientation of load or loads that is applied for a *test cycle*.

Specimen – the entire assembled unit submitted for testing.

Sustained load – a load resisted for specified time.

Test cycle – a series of increasing, *sustained loads*.

Ultimate load – the maximum *sustained load* resisted by the *specimen*.

4.0 Units and Terms

Any compatible system of measurement units is acceptable to be used in this standard, except where explicitly stated otherwise. The unit systems in this standard shall include U.S. customary units (force in kips and length in inches) and SI units (force in newtons and length in millimeters).

5.0 Summary of Test Method

5.1 This test method shall include all of the following: (1) attachment of the stiffening plate or other test apparatus components to the flashing *specimen* as needed, (2) attachment of the flashing *specimen* to the bed of the test apparatus, (3) application of a series of uniform line loads to the test *specimen* and (4) observation and recording of the loads resisted and mode or modes of *failure* of the test *specimen*.

5.2 The increments of load application shall be chosen so that results from a minimum of four *sustained loads* are recorded. If *failure* occurs before a minimum of four loads have been sustained, the test shall be deemed invalid.

6.0 Apparatus

6.1 Description of Apparatus

The apparatus for single load tests shall include the major components shown in Figure 1. The apparatus for two load tests shall include the major components shown in Figure 2 and Figure 3. The Optional Stiffening Plate shown in these figures, if used, shall be no wider than 2" (51 mm) and no thicker than 1/8" (3.2 mm). Figures 1, 2 and 3 indicate how loads are applied to various generic flashing configurations. Actual flashing and configuration connection shall be per the design and manufacture of the flashing to be tested.

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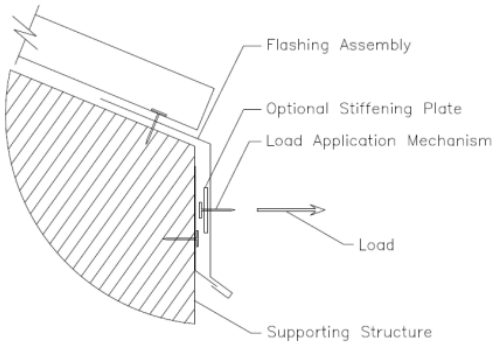


Figure 1 – Single Load Test Apparatus

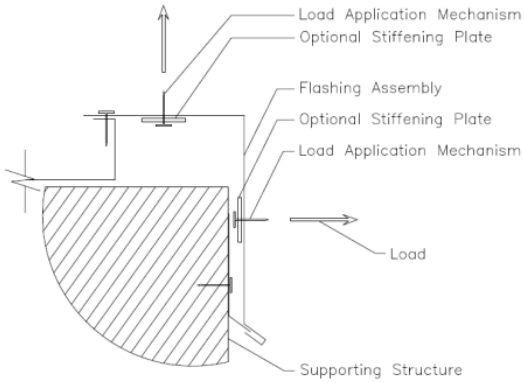


Figure 2 – Two Load Test Apparatus

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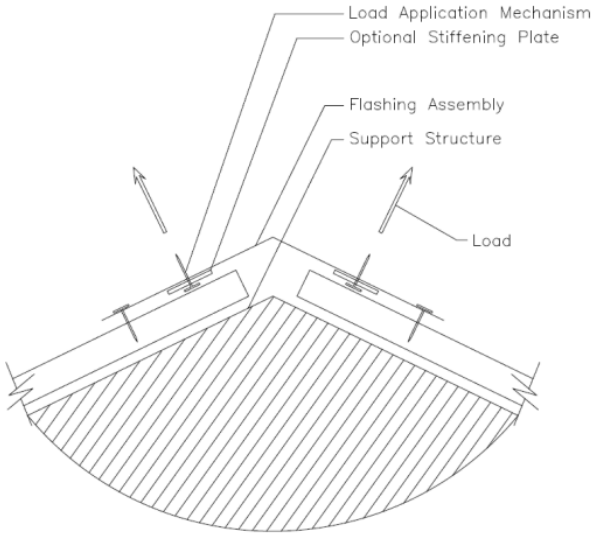


Figure 3 – Two Load Test Apparatus

6.2 Supporting Structure

The supporting structure shall be representative of field conditions and sized to allow the secure attachment of the *specimen*. Anchorage shall be required to hold the supporting structure in place while load is applied during the test. The supporting structure shall be representative of field conditions.

6.3 Load Application System

6.3.1 The load application system shall consist of a tensile tester or other device capable of providing concentrated load and fitted with a load cell capable of indicating loads of at least the *anticipated ultimate load*.

6.3.2 The load application system shall be attached to the *specimen* in the center of the tested face and shall be capable of uniformly distributing the load to the *specimen*. The spacing of the *specimen* attachment to the load application system shall be no greater than 12 inches (300 mm) on center. The load application system shall be attached to the face centered on its width.

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S12077Text Modification

6.3.3 The precision of the load application system shall be +/- 10 pounds (4.5 kg) based on calibration within 12 months of the test date. The maximum calibration load shall not be exceeded in testing.

7.0 Test Specimen

7.1 The *specimen* shall consist of all parts relevant to the assembly. Field-application conditions of the *specimen* shall be simulated. The *specimen* shall be full size. Supporting structure shall be of a length no less than the length of the test *specimens*.

The ends of the *specimen* shall not be restrained, but free to deflect under load. End and edge restraint shall be representative of field conditions and shall be documented in the test report.

7.2 The flashing *specimen* shall be a minimum of 120 inches (3000 mm) in length, without laps in the flashing, unless the flashing is only produced in lengths less than 120 inches (3000 mm).

7.3 A face shall consist of a flat segment of a flashing profile plus adjacent segments such as *drip edge* or hem that are within 45 degrees of being inline. Two parallel, flat segments offset by less than 1 inch (25 mm) shall be tested as one face.

7.4 The minimum number of *specimens* shall be based on the number of *load cases* and *test cycles* required for the flashing. Three *test cycles* shall be performed for each *load case*. A new specimen shall be used for each test cycle.

7.4.1 For flashings with only one exposed face, one *load case* shall be required, therefore three *specimens* are required. Loads shall be applied perpendicular to the exposed face. The Single Load Test Apparatus shall be employed for this purpose.

7.4.2 For flashings with two exposed faces, one *load case* shall be required; therefore, three specimens are required. Loads shall be applied to the two faces simultaneously. Loads shall be applied with a ratio of 2 psf (96 Pa) vertical to 1 psf (48 Pa) horizontal. If both faces are expected to receive approximately equal loading in field applications (e.g. ridge cap), then both faces shall be tested with equal load simultaneously. The Two Load Test Apparatus shall be employed for flashings in this category. Load shall be applied perpendicular to the face.

7.4.3 For flashings with three or more exposed faces, the number of required *load cases* shall equal the number of pairs of adjacent faces. In the case of a *coping*, two *load cases* shall be required; therefore, six specimens are required. In the first *load case*, loads shall be applied simultaneously to the top (upward) and to one of the vertical faces (lateral). In the second *load case*, loads shall be applied simultaneously to the top (upward) and

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S12077 Text Modification

to the other vertical face (lateral). Loads shall be applied with a ratio of 2 psf (96 Pa) upward on the top surface to 1 psf (48 Pa) horizontal on the wall coverage surfaces. The Two Load Test Apparatus shall be employed for flashings in this category. Load shall be applied to each face in a manner that is perpendicular to the roof or wall surface plane covered by that face. For top surfaces sloped less than 10 degrees, the top surface load is permitted to be applied vertically.

8.0 Loading Procedure

8.1 Orientation

The test set up shall be oriented such that gravity shall not have an undue influence on the test other than that experienced by in-place field applications. Only loads resisted by the *specimen* shall be included in the reported loads.

8.2 Procedure

This procedure shall be designed to produce a *test cycle* with a minimum of four *sustained loads*.

8.2.1 The typical loading cycle shall consist of two phases: a load phase and an unload phase.

8.2.2 The load phase shall apply the line loading in increasing magnitudes. The first loading shall be at one third of the *anticipated ultimate load*. Subsequent loadings shall be increased by up to one sixth of the *anticipated ultimate load*. For loads of up to 150 psf (7.2 kPa), the load shall be achieved within 1 minute. For loads greater than 150 psf (7.2 kPa), the load shall be achieved within 2 minutes. Each loading shall be held for at least 1 minute.

Loads shall be recorded to a precision of five percent of the *anticipated ultimate load* during applications of the test loads.

8.2.3 The unload phase shall relax the load to zero. This phase shall last no longer than 5 minutes. This phase shall be followed by the next loading cycle.

8.2.4 For flashings loaded on two separate faces simultaneously, the loading shall progress as described above based upon the *anticipated ultimate* vertical *load* (applied to the more horizontal surface.

8.2.5 The test shall be concluded when any of the following happen, the *specimen* fails, the capacity of the test apparatus is reached, or at the direction of the party conducting

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S12077 Text Modification

the test. *Failure* in the *specimen* shall be when any of the following conditions occur: 1) *Fastener failure* (ex. pull-out, pull-over or breakage), 2) Unlatching of a panel or flashing, 3) Component *failure* (ex. Rupture, tearing or cracking),

8.2.6 A minimum of four *sustained loads* shall be recorded before a *test cycle* is concluded. If the *specimen* fails before four *sustained loads* are recorded the *test cycle* shall be deemed invalid and shall be repeated with a lower *anticipated ultimate load* that will yield four *sustained loads*.

9.0. Test Report

9.1 Date of test and date of report shall be included in the test report along with the name of the testing organization and location. The observers, their qualifications and affiliation shall be included.

9.2 The test report shall describe the *specimen*, including the manufacturer, location of manufacture and dimensions. The testing equipment including load cell and load application device shall be described.

9.3 The test report shall include cross-section drawings of the *specimen* including flashing, panels, panel attachment method and supporting structure. The drawings shall identify type, location and spacing of *fasteners* and show how and where the test apparatus is attached to the specimen.

9.5 The test report shall include the measured thickness and yield strength of the *specimen*.

9.6 Tabulation of the loadings and load durations, including the *anticipated ultimate load*, shall be included in the test report.

9.7 The test report shall include visual observations including *failure* mode, the *sustained loads* applied, and the *ultimate loads*. The *ultimate loads* from the performed *test cycles* shall be averaged and recorded as the test result.

9.8 The test report shall include a statement that the test(s) were conducted in accordance with this test method, noting any deviations.

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S12077 Text Modification

ANSI/MCA FTS-1-2019

Commentary

This commentary consists of explanatory and supplementary material designed to help in applying the requirements of the preceding Standard.
This commentary is intended to create an understanding of the requirement through brief explanations of the reasoning employed in arriving at these requirements.
The sections of this commentary are numbered to correspond to sections of the Standard to which they refer. Since having comments for every section of the Standard is not necessary, not all section numbers appear in this commentary.

C1.0 Scope

In significant wind events, *failure* frequently begins at the flashing attachment at the roof edge, e.g. eaves and gables, and at roof plane transitions with a reflex angle, e.g. hips and ridges. This test method is intended to determine the capacity of these flashings to withstand the anticipated wind loads.

C1.2 For *direct-fastened* faces less than 4 inches (100 mm) it is anticipated that the mode of *failure* will be *fastener* pull-out; therefore, testing of faces less than 4 inches (100 mm) is not required. *Fasteners* used to *direct-fasten* faces less than 4 inches (100 mm) must have adequate pull-out resistance for the design loads.

For *cleated* faces less than 2 inches (50 mm) the design loads will yield a line load that is too low to allow for a significantly meaningful series of *test cycles*; therefore, testing is not required for flashing with faces less than 2 inches (50 mm).

C2.0 Referenced Documents

The following documents were considered during the development of this document.

1. ASTM E 1592-05(2017) Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

2. 2017 Florida Building Code Test Protocols for High Velocity Hurricane Zones:
(TAS) No. 111(B)-95 Test Procedure for Edge Metal Pull-Off Performance
(TAS) No. 111(C)-95 Test Procedure for Coping Cap Pull-Off Performance

3. ANSI/SPRI/FM 4435/ES-1 2017 Test Standard for Edge Systems Used with Low Slope Roofing Systems

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S12077Text Modification

C5.0 Summary of Test method

This summary is to outline the general steps that are required for testing. The attachment of test apparatus connections to the test *specimen* may be made before or after the *specimen* is mounted to the apparatus test bed.

C5.2 Metal flashings are subjected to repeated loading from gusting winds; therefore, a critical component of the test is that the test load is applied and relaxed a minimum of four times prior to the application of the *Ultimate Load*. If *failure* occurs before four loads are applied, the *anticipated ultimate load*, and therefore the load increments, must be decreased and the test repeated, until a minimum of four *sustained loads* have been recorded.

C6.0 Apparatus

C6.1 The apparatus is general in nature. Any equipment capable of performing the test procedure within the allowable tolerances described in this section is acceptable.

The purpose of the Optional Stiffening Plate is to reduce complications of fastener(s) in the Load Application Mechanism pulling through the flashing, or the flashing bending along the line of fasteners, by better distributing the load on the loaded face.

C6.2 To simplify and standardize testing, the apparatus does not need to be an exact replication of the substrate expected in field application; however, the apparatus must provide no greater pull-out resistance for the *specimen fasteners* than what will be achieved in field application.

C7.0 Test Specimen

C7.1 The *specimen* includes the supporting structure such as wood or steel, the exterior metal panel(s), panel *clips*, sealant, *fasteners, cleats* and the flashing as applicable.

C7.4.2 and 7.4.3 The ratio between the vertical and horizontal GC_p values used to calculate wind loads vary with building height, roof zone location, and the version of ASCE7 being used. To standardize the testing, and to avoid necessitating that multiple tests be run with several different vertical:horizontal ratios, a simple and conservative ratio of 2:1 was selected.

C9.0 Test Report

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S12077Text Modification





ANSI/MCA FTS-1-2019

C9.5 Both material thickness and yield strength can greatly affect the performance of a flashing system; therefore, the thickness and strength of the tested specimen is needed to confirm that the product produced for use in the field is of equal or greater thickness and yield strength. Yield strength may be determined by methods such as ASTM A 370-17a, ASTM B 557-15, etc. as appropriate for the material being tested.

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TAC: Structural

Total Mods for **Structural** in **Denied : 27**

Total Mods for report: 37

Sub Code: Test Protocols

37

SP12040

Date Submitted	02/13/2025	**Section**	204	**Proponent**	Jaime Gascon
Chapter	1	**Affects HVHZ**	Yes	**Attachments**	**Yes**
TAC Recommendation	Denied				
Commission Action	Pending Review				

Comments

General Comments Yes **Alternate Language Yes**

Related Modifications

12034

Summary of Modification

New Testing Application Standard (TAS) 204 - Flood Resistant Test Procedures for passive in place system.

Rationale

This protocol serves to cover the procedures for conducting the flood resistance test of materials as required by the FBC Building Section 1612 and is applicable to Dry Flood Proofing in special hazard areas of A-Zone.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code
Saves the local entity time by having a standard to reference for compliance.
Impact to building and property owners relative to cost of compliance with code
Saves cost by knowing what standard is acceptable for code compliance.
Impact to industry relative to the cost of compliance with code
Saves cost by having an available test standard to use to show code compliance.
Impact to small business relative to the cost of compliance with code
Saves cost by having an available test standard to use to show code compliance.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public
Improves the code by use of an adopted standard that is acceptable for code compliance.
Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction
Strengthens the code by providing a standard to reference for code compliance.
Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not discriminate since the test is designed to be performance-based.

Does not degrade the effectiveness of the code

It does not degrade the code, but improves it by supplementing the code with an additional TAS.

Alternate Language

2nd Comment Period

SP12040-A1

Proponent Jaime Gascon **Submitted** 8/13/2025 12:54:53 PM **Attachments** No

Rationale:

This MOD was denied by the Special Occ TAC and Approved and Submitted by the Structural TAC. The code lacks guidance on how to test passive flood resistant systems and this new protocol serves to address the need. The protocol was derived through collaboration with testing laboratories and product manufacturers in Florida. This Alternative Language comment corrects a typo in the text of section 6.2.2.2 of the protocol to match the impactor's cut angle with that shown on the sketch.

Fiscal Impact Statement

Impact to local entity relative to enforcement of code

Saves time by making available a standard that is acceptable for code compliance.

Impact to building and property owners relative to cost of compliance with code

Saves cost by providing an acceptable standard for code compliance.

Impact to industry relative to the cost of compliance with code

Saves costs by testing to an adopted standard that is acceptable for code compliance.

Impact to small business relative to the cost of compliance with code

Saves cost by having an available test standard to use to show code compliance.

Requirements

Has a reasonable and substantial connection with the health, safety, and welfare of the general public

Improves the code by providing guidance on use of a test standard.

Strengthens or improves the code, and provides equivalent or better products, methods, or systems of construction

Strengthens the code by referencing a standard that is acceptable for code compliance.

Does not discriminate against materials, products, methods, or systems of construction of demonstrated capabilities

It does not discriminate since it allows for other approved testing to also be used.

Does not degrade the effectiveness of the code

It does not degrade the code, but serves to improve it by providing guidance with a standard for testing.

2nd Comment Period

SP12040-G1

Proponent Rebecca Quinn obo FL Div Emerg Mgnt | Submitted 8/24/2025 11:16:43 AM | Attachments Yes

Comment:
At the first TAC meetings the FDEM Office of Floodplain Management representative raised a number of concerns and asked questions about the Miami-Dade proposal to require passive dry floodproofing measures/materials to meet the County's TAS 204 or an "approved flood resistance test." We offer the following for consideration by the TACs before approving the proposal (SB12034) and the TAS (SP12040): 1. What was the make-up of the committee that developed TAS 204 and did it include jurisdictions from other parts of the State where dry floodproofing is common? TAS 204 would be required statewide, unlike most of the TAS which are cited in the High Velocity Hurricane Zone sections of the FBC that apply only to Miami-Dade and Broward. 2. The TAS refers to testing of materials, which is confusing given the FBC defines "flood damage-resistant materials." We think "material" isn't the appropriate term to use for passive measures. It does define "specimen" as "entire assembled unit." 3. The TAS states it is not applicable in Coastal A Zones, which may be appropriate if the test protocol doesn't include moderate waves – but the FBC modifies ASCE 24 to permit dry floodproofing in Coastal A Zones. 4. The TAS defines "floodproofing" based on the NFIP Code of Federal Regulations definition instead of ASCE 24 definition or the FBC definition "dry floodproofing." 5. The SP12034 proposal requires all passive measures to meet the TAS or "approved flood resistance test." Approved by whom? 6. By requiring all passive measures to meet a test, design professionals would not be able to certify use of ANY untested products, ending +50 years of practice. 7. The TAS footer indicates it is "for HVHZ," yet the SP12034 proposal would be statewide. 8. It's not clear that the TAS could be used for permanently installed flood doors that provide protection every time they are closed.

SP12040-A1Text Modification

6.2.2.2 The impactor for the debris impact load test fixture consists of a 12-inch+/- ½ inch diameter by 30 inch long Southern Pine #2 wood log having a density of 36-41 lbs./ft^3 at 19-20% moisture contents. The impactor must have a ~~25~~15-degree cut on the impact leading edge and be suspended from a carriage and support system using two 1/8-inch diameter steel cables or other suitable device as shown in Figure 1. The total weight of the impactor assembly must be…

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SP12040Text Modification

See attached file.

Mod12040_TextOfModification.pdf

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SP12040Text Modification

TESTING APPLICATION STANDARD (TAS) 204-26

FLOOD RESISTANT TEST PROCEDURES (FOR PASSIVE IN PLACE SYSTEMS)

1. Scope:

1.1 This protocol covers procedures for conducting the flood resistance test of materials as required by Section 1612 of the *Florida Building Code, Building*. This protocol is applicable to *Dry Flood Proofing* in *Special Flood Hazards Areas* (*SFHAs*) of A-zone (A, AE, A1-30, AH, AO or AR on FEMA's *FIRM* maps), other Coastal High Hazard Areas (V, VO, VE or VI-30) or Coastal A-zones, are not covered under this protocol.

2. Referenced Documents:

2.1 *The Florida Building Code, Building*

2.2 ASCE 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures

2.3 ASCE 24: Flood Resistant Design and Construction

2.4 FEMA: Federal Emergency Management Agency

2.5 USACE: (US Army Corps of Engineers)

2.6 NFIP: National Flood Insurance Program

3. Terminology:

3.1 *Specimen*—The entire assembled unit containing all the parts needed to install the product onto a building's substrate submitted for testing.

3.2 *Test Chamber*—A watertight enclosure (flood simulation tank) of sufficient depth to allow proposed flood water design height (H_D), capable of resisting imposed flood loads, and capable of accommodating the debris impact load fixture and the impactor movement to the specified level.

3.3 *Exposed linear foot of perimeter* (ft) – the linear distance along the test chamber's submerged perimeter in contact with the specimen.

3.4 *L*eakage *P*erimeter (ft): The exposed perimeter of test specimen with total base lineal width + 2X flood water design height (H_D).

3.5 *Maximum Deflection*—The maximum displacement of the specimen measured to the nearest $^1/_8$ of an inch attained from the original position, while the maximum Hydro Static Load is being applied.

3.6 *Permanent Deformation*—The permanent displacement of the specimen measured to the nearest $^1/_8$ of an inch from the original position to the final position that remains after the maximum Hydro Static Load has been removed.

3.7 *Flood water design height* (H_D) (ft) – The depth of the water in the chamber used to simulate the flood design depth corresponding to FBC Section 1612.

3.8 *Special Flood Hazards Area* (*SFHA*): Land in flood plain subjected to 1% or greater chance of flooding in any given year.

3.9 *Design Flood Elevation* (*DFE*) – Elevation of design flood, including wave height, relative to datum specified the community's flood hazard map.

3.10 *Hydro Static Load* – Load imposed on an object by the standing mass of water.

3.11 *Hydro Dynamic Loads* – Loads imposed on an object by the water flowing against and around it.

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3.12 *Impact loads* - Loads that result from the debris, ice, or any debris transported by the flood water striking against structure or parts thereof.

3.13 *Flood glazing* – A passive permanent in-place, flood resistant system constructed of single or multiple glazed panels, where reinforced glass is set, captured or sealed in a frame with structural silicone or other adhesive, gaskets, glazing beads and/or flood water resistant materials to prevent flood water into the interior (dry side) of the glazed system.

3.14 *Design flood height (ft)* – Manufacturer selected *design flood height* (HD) or *DFE* +1 ft, whichever is greater.

3.15 *Flood Insurance Rate Map* (*FIRM*) – An official map of the community on which Federal Management Agency (FEMA) has delineated *Special Flood Hazards Areas* (*SFHAs*) and the risk premium zones applicable to the community.

3.16 *Floodproofing* – Any combination of structure and non-structure addition, changes or adjustment to structure which reduces or eliminate flood damage to real estate or improved real property, water and sanitary facilities structure and contents (Title 44 code of Federal Regulations (CFR) 59.1.)

3.17 *Specimen F*ailure – A change in condition of the specimen indicative of deterioration under flood load or incipient failure, such as material cracking, fastener loosening, local yielding, or loss of adhesive bond. For a glazed system that resists flood loads and dynamic impact loads, a crack forming larger than 5 inches by 1/16 inch in width through which air and water can pass constitutes failure.

4. Significance and Use:

4.1 The test procedures outlined in this protocol provide a means of determining whether a particular product used as *flood glazing*; window walls, curtain walls, storefront, exterior fixed windows, sidelites, glass blocks and any other similar devices (passive permanent in place systems) used as external protection to maintain the envelope of the building, provides sufficient resistance to flood loads and flood debris, as required per Section 1612 of the *Florida Building Code, Building*, ASCE 24 and ASCE-7.

5. Test Specimen:

5.1 *Test specimen* – All parts of the test *specimen* shall be full size, using the same materials, components, details, methods of construction and methods of attachment as proposed for actual use. The *specimen* shall consist of the entire assembled unit attached to a given type of structural framing of the building and shall contain all devices used to resist flood induced forces and flood debris. Such substrates shall become part of the approval. The test *specimen* must be fully assembled in a factory or in the field per the manufacturer's installation instructions. The test *specimen* must be secured and sealed to the test frame/stand/chamber.

6 Apparatus:

6.1 The description of the apparatus is general in nature. Any equipment, properly certified, calibrated, and approved by the Authority Having Jurisdiction (AHJ) capable of performing this test within the allowable tolerance is permitted.

6.2 Major Components:

6.2.1 Hydrostatic Load Test

6.2.1.1 The *test chamber*, as defined in 3.2.

6.2.1.2 A water collection device capable of capturing and measuring the total amount of water managing to seep through the installed *specimen* must be provided. Water collected for a prescribed period must be quantified. The measuring devices shall have a +/- 2% accuracy.

6.2.2 Debris Impact Load Test Fixture (see Figure 1).

6.2.2.1 A flood test chamber with removable frame used to attach test *specimen* is required to simulate the *flood water design height* (HD) and accommodate the debris impact load test fixture in Figure 1.

6.2.2.2 The impactor for the debris impact load test fixture consists of a 12-inch+/- ½ inch diameter by 30 inch long Southern Pine #2 wood log having a density of 36-41 lbs./ft^3 at 19-20% moisture contents. The impactor must have a 25-degree cut on the impact leading edge and be suspended from a carriage and support system using two 1/8-inch diameter steel cables or other suitable device as shown in Figure 1. The total weight of the impactor assembly must be 111 lbs. +/- 1 lb. and capable of delivering 444 ft-lb (600 J) energy from a height of 4 feet. The impactor must

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be conditioned at room temperature for 1 hour before the test and must impact the test specimen when it reaches 0.25 to 1 inch off the surface of the water in the flood test chamber. See Figure 2 for impactor assembly design construction details.

6.2.2.3 A suitable timing device with +/- 2% accuracy is required.

6.2.2.4 Test temperature – The test shall be conducted at a test temperature range of 59° F to 95° F.

6.2.2.5 Deflection-Measuring System—The deflection-measuring system must measure the deflection within a tolerance of 0.01 of an inch.

7. Calibration:

7.1 All pressure, temperature, deflection, impactor, timing, scales and water head measuring devices, shall be calibrated to be within the tolerance provided, and be no more than six months prior to testing.

7.2 The calibration report shall include: the date of the calibration, the name of the agency conducting the calibration, methods and equipment used in the calibration process, the equipment being calibrated and any pertinent comments.

8. Acceptance Requirements

8.1 Flood resistant glazed systems shall withstand *Hydro Static Loads* as specified for the test. The maximum leakage rate shall not exceed 0.011 ft^3/hr. (0.08 gph) of flood water *per exposed lineal foot of perimeter*.

8.2 Glass edge support systems must be sufficiently stiff to limit the lateral Hydro Static Load deflections of the glazed flood systems per ASTM E-1300 requirements. The *Permanent deformation* shall not exceed 0.2% of the glass frame supporting members or spans.

8.3 The *specimen* shall be capable of withstanding impactor energy per 6.2.2.2 without damage that may affect intended functions.

8.4 The measured *leakage rates*, after the Hydro Static Test, Dynamic Impact Test and Post Hydro Static test, shall not exceed *leakage rate* per section 8.1 per *exposed lineal foot of perimeter*.

8.5 The *specimen* does not exhibit failure criteria per 3.17.

9 Test Procedures

9.1 Hydro Static Load Test:

9.1.1 Install the test *specimen* in the *test chamber*.

9.1.2 Apply and maintain *Hydro Static Load* at 1/3 *design flood height* H_D (ft) +/-0.5" for 2 hr. duration.

9.1.3 Repeat *Hydro Static Load* at 2/3 design flood height (ft) +/-0.5" for 4-hr duration.

9.1.4 Repeat *Hydro Static Load* Test at the design flood height (ft) +/-0.5" for 24 hours duration.

9.1.5 Water leakage to be measured at 1-hour, 2-hours, 4-hours, 6-hours and at end of the 24-hour periods.

9.1.6 *Permanent deformation* and *maximum deflection* must be measured at the end of 24 hours *Hydro Static Load* Test with *design flood height* at the center of vertical and horizontal mullion spans or the glazing supporting frame members, as applicable.

9.1.7 The *specimen* is deemed compliant to the *Hydro Static Load* Test requirements if it does not exceed the *maximum leakage rate* specified in section 8.1, the *permanent deformation* of the framing system is no greater than 0.2% where measured, *maximum deflection* of the specimen mullions (if used) was no greater than span/180 criteria and the specimen did not exhibit any *specimen failure* per section 3.17.

9.2 Hydro Dynamic Impact Load Test:

9.2.1 Upon completion of the *Hydro Static Load* Test, the *Hydro Dynamic Impact Load* Test is to be conducted.

9.2.2 Keep the chamber flood tank water level up to the specified *design flood height* H_D (ft).

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9.2.3 Apply the first impact at the center of the *specimen* using impact energy as defined in 6.2.2.2, and as shown in Figure 1.

9.2.4 Lower the flood water level to 2/3 of the *design flood height* (HD).

9.2.5 Apply the second impact to the specimen at 2/3 of the *design flood height* (HD) as shown in Figure 1.

9.2.6 Measure the total water leakage, the *maximum deflection* and *permanent deformation* upon completion of the test.

9.2.7 The *specimen* is deemed compliant to the Hydro Dynamic Impact Load Test requirements if it does not exceed the *maximum leakage rate* specified in section 8.1, the *permanent deformation* of the framing system is no greater than 0.2% where measured, *maximum deflection* of the specimen mullions (if used) is no greater than span/180 criteria and did not exhibit any *specimen failure* per section 3.17.

9.3 Post Hydro Static Load Test:

9.3.1 This test is to be performed upon completion of the Hydro Static Load Test and Hydro Dynamic Impact Load Tests.

9.3.2 Apply Post Hydro Static Load at 100% *design flood height* (HD) +/-0.5" for 4-HRS duration.

9.3.3 Measure the total water leakage, the maximum *deflection* and *permanent deformation* upon completion of the test.

9.3.4 The *specimen* is deemed compliant to the Post Hydro Static Load Test requirements if it does not exceed the *maximum leakage rate* specified in section 8.1, the *permanent deformation* of the framing system is no greater than 0.2% where measured, *maximum deflection* of the specimen mullions (if used) is no greater than span/180 criteria and did not exhibit any *specimen failure* per section 3.17.

10. Test Notification

The manufacturer shall notify the Authority Having Jurisdiction seven (7) working days prior to the per- forming of the test. The Authority Having Jurisdiction reserves the right to observe the test. The Authority Having Jurisdiction must be notified of the place and time the test will take place. The test must be recorded on video and retained by the laboratory per TAS 301.

11 Test Report

The following minimum information shall be included in the submitted report:

11.1 Date of the test, date of the report, and the report number.

11.2 The name and address of the requester of the test.

11.3 Identification of the *specimen* (manufacturer, source of supply, dimension, model types, material, procedure of selection and any other pertinent information).

11.4 Detailed drawings of the *specimen* showing dimensioned section profiles, type of framing to which the *specimen* was attached to, panel arrangement, installation and spacing of anchorage, sealants, adhesive, hardware, product markings and their location, and any other pertinent construction details. Any deviation from the drawings or any modifications made to the *specimen* to obtain the reported values shall be noted in the drawings and in the report.

11.5 *Maximum deflection* recorded.

11.6 *Permanent deformation* (identify measurement locations).

11.7 Name, address, signature and seal of Florida professional engineer, witnessing the test and preparing the report.

11.8 The results of the testing shall be reported for each tested *specimen.*

11.9 Result of *leakage* and *deflection/deformation*, as applicable and locations after Hydro Static Load Test.

11.10 Location of dynamic impacts on the test *specimen*.

11.11 Result of *leakage*, *deflection/deformation* after Hydro Dynamic Impacts Load Test.

11.12 Result of *leakage* and *deflection/deformation*, as applicable and locations, after Post Hydro Static Test.

11.13 A description of the condition of the *test specimens* after testing, including details of any damage and any other

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pertinent observations.

11.14 A statement that the tests were conducted in accordance with this test protocol.

11.15 A statement of whether, upon completion of all testing, the *specimen* meets the acceptance requirements per Section 8.

11.16 Signatures of persons responsible for supervision of the tests and a list of official observers.

11.17 All data not required herein, but useful for a better understanding of the test results, conclusion, or recommendations, should be appended to the report.

12 Additional Testing

The Authority Having Jurisdiction reserves the right to require any additional testing necessary to assure full compliance with the intent of the *Florida Building Code, Building*.

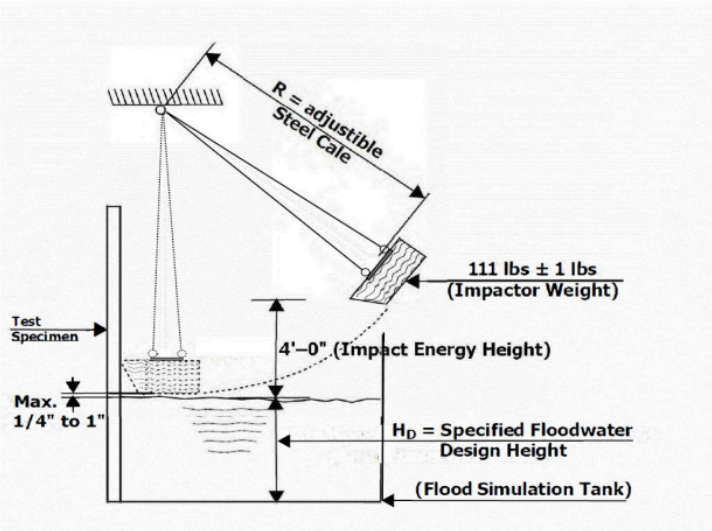
13 Flood Hazards Documentation

Compliance with this standard serves to document flood resistance performance of the tested *specimen* pursuant to FBC 1612.4.

14 Product Marking

14.1 All approved products shall be permanently labeled with the manufacturer's name, city, state, and the following statement: "Miami-Dade County Product Approved."

14.2 Permanently labeled shall be a metallic label fixed permanently to the frame of the specimen by rivets or permanent adhesive.



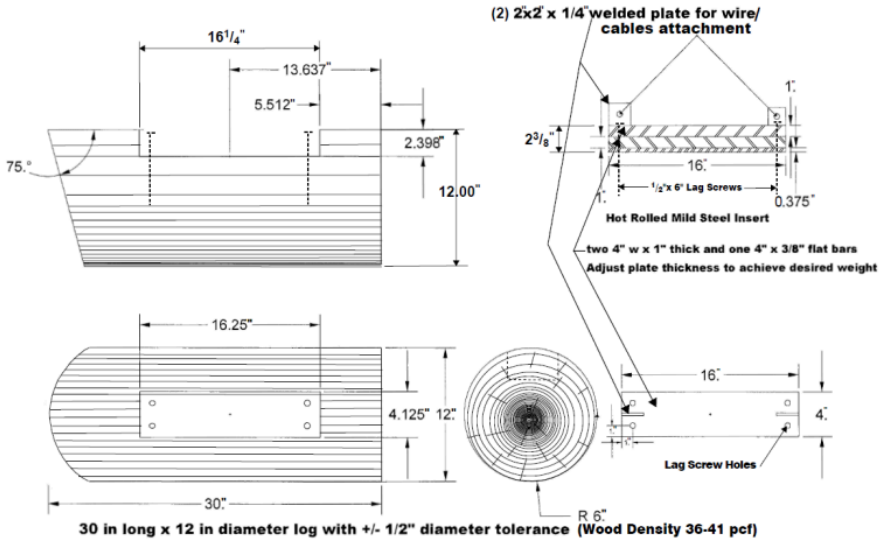
Dynamic Impact Test (Flood Debris Impact Load Simulation)

Fig. 1

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30 in long x 12 in diameter log with +/- 1/2" diameter tolerance (Wood Density 36-41 pcf)

Weight of Wood Impactor: 67.11 lbs @0.023 lbs/in3
Weight of mild steel plates: 43.74 nominal density 0.284 lbs/in3
Weight of 1/2" x 6" lag bolt to attach steel plates to wood impactor:1.1 lbs (Total of 4)

Fig. 2 (Impactor Design)

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SP12040-G1General Comment

SUBMITTED: Rebecca Quinn, obo FDEM Office of Floodplain Management

COMMENT for SP12040, the TAS

At the first TAC meetings the FDEM Office of Floodplain Management representative raised a number of concerns and asked questions about the Miami-Dade proposal to require passive dry floodproofing measures/materials to meet the County's TAS 204 or an "approved flood resistance test." We offer the following for consideration by the TACs before approving the proposal (SB12034) and the TAS (SP12040):

1. What was the make-up of the committee that developed TAS 204 and did it include jurisdictions from other parts of the State where dry floodproofing is common? TAS 204 would be required statewide, unlike most of the TAS which are cited in the High Velocity Hurricane Zone sections of the FBC that apply only to Miami-Dade and Broward.
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