NFPA® 557

Standard for Determination of Fire Loads for Use in Structural Fire Protection Design

2023 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

Documents
Document Sharing Hub
Full document details: NFPA 557 2023

Documents
Document Sharing Hub

Full document details: NFPA 557 2023

IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA® STANDARDS

NFPA® codes, standards, recommended practices, and guides ("NFPA Standards"), of which the document contained herein is one, are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on fire and other safety issues. While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in NFPA Standards.

The NFPA disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on NFPA Standards. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making NFPA Standards available, the NFPA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the NFPA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of NFPA Standards. Nor does the NFPA list, certify, test, or inspect products, designs, or installations for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the NFPA and is solely the responsibility of the certifier or maker of the statement.

REVISION SYMBOLS IDENTIFYING CHANGES FROM THE PREVIOUS EDITION

Text revisions are shaded. A Δ before a section number indicates that words within that section were deleted and a Δ to the left of a table or figure number indicates a revision to an existing table or figure. When a chapter was heavily revised, the entire chapter is marked throughout with the Δ symbol. Where one or more sections were deleted, a • is placed between the remaining sections. Chapters, annexes, sections, figures, and tables that are new are indicated with an *N*.

Note that these indicators are a guide. Rearrangement of sections may not be captured in the markup, but users can view complete revision details in the First and Second Draft Reports located in the archived revision information section of each code at www.nfpa.org/docinfo. Any subsequent changes from the NFPA Technical Meeting, Tentative Interim Amendments, and Errata are also located there.

REMINDER: UPDATING OF NFPA STANDARDS

Users of NFPA codes, standards, recommended practices, and guides ("NFPA Standards") should be aware that these documents may be superseded at any time by the issuance of a new edition, may be amended with the issuance of Tentative Interim Amendments (TIAs), or be corrected by Errata. It is intended that through regular revisions and amendments, participants in the NFPA standards development process consider the then-current and available information on incidents, materials, technologies, innovations, and methods as these develop over time and that NFPA Standards reflect this consideration. Therefore, any previous edition of this document no longer represents the current NFPA Standard on the subject matter addressed. NFPA encourages the use of the most current edition of any NFPA Standard [as it may be amended by TIA(s) or Errata] to take advantage of current experience and understanding. An official NFPA Standard at any point in time consists of the current edition of the document, including any issued TIAs and Errata then in effect.

To determine whether an NFPA Standard has been amended through the issuance of TIAs or corrected by Errata, visit the "Codes & Standards" section at www.nfpa.org.

ISBN: 978-145592929-0 (Print)

AVA Documents
Document Sharing Hub

Full document details: NFPA 557 2023

ADDITIONAL IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA® STANDARDS

Updating of NFPA Standards

Users of NFPA codes, standards, recommended practices, and guides ("NFPA Standards") should be aware that these documents may be superseded at any time by the issuance of a new edition, may be amended with the issuance of Tentative Interim Amendments (TIAs), or be corrected by Errata. It is intended that through regular revisions and amendments, participants in the NFPA standards development process consider the then-current and available information on incidents, materials, technologies, innovations, and methods as these develop over time and that NFPA Standards reflect this consideration. Therefore, any previous edition of this document no longer represents the current NFPA Standard on the subject matter addressed. NFPA encourages the use of the most current edition of any NFPA Standard [as it may be amended by TIA(s) or Errata] to take advantage of current experience and understanding. An official NFPA Standard at any point in time consists of the current edition of the document, including any issued TIAs and Errata then in effect.

To determine whether an NFPA Standard has been amended through the issuance of TIAs or corrected by Errata, visit the "Codes & Standards" section at www.nfpa.org.

Interpretations of NFPA Standards

A statement, written or oral, that is not processed in accordance with Section 6 of the Regulations Governing the Development of NFPA Standards shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Patents

The NFPA does not take any position with respect to the validity of any patent rights referenced in, related to, or asserted in connection with an NFPA Standard. The users of NFPA Standards bear the sole responsibility for determining the validity of any such patent rights, as well as the risk of infringement of such rights, and the NFPA disclaims liability for the infringement of any patent resulting from the use of or reliance on NFPA Standards.

NFPA adheres to the policy of the American National Standards Institute (ANSI) regarding the inclusion of patents in American National Standards ("the ANSI Patent Policy"), and hereby gives the following notice pursuant to that policy:

NOTICE: The user's attention is called to the possibility that compliance with an NFPA Standard may require use of an invention covered by patent rights. NFPA takes no position as to the validity of any such patent rights or as to whether such patent rights constitute or include essential patent claims under the ANSI Patent Policy. If, in connection with the ANSI Patent Policy, a patent holder has filed a statement of willingness to grant licenses under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license, copies of such filed statements can be obtained, on request, from NFPA. For further information, contact the NFPA at the address listed below.

Law and Regulations

Users of NFPA Standards should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of its codes, standards, recommended practices, and guides, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

NFPA Standards are copyrighted. They are made available for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of safe practices and methods. By making these documents available for use and adoption by public authorities and private users, the NFPA does not waive any rights in copyright to these documents.

Use of NFPA Standards for regulatory purposes should be accomplished through adoption by reference. The term "adoption by reference" means the citing of title, edition, and publishing information only. Any deletions, additions, and changes desired by the adopting authority should be noted separately in the adopting instrument. In order to assist NFPA in following the uses made of its documents, adopting authorities are requested to notify the NFPA (Attention: Secretary, Standards Council) in writing of such use. For technical assistance and questions concerning adoption of NFPA Standards, contact NFPA at the address below.

For Further Information

All questions or other communications relating to NFPA Standards and all requests for information on NFPA procedures governing its codes and standards development process, including information on the procedures for requesting Formal Interpretations, for proposing Tentative Interim Amendments, and for proposing revisions to NFPA standards during regular revision cycles, should be sent to NFPA headquarters, addressed to the attention of the Secretary, Standards Council, NFPA, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101; email: stds_admin@nfpa.org.

For more information about NFPA, visit the NFPA website at www.nfpa.org. All NFPA codes and standards can be viewed at no cost at www.nfpa.org/docinfo.

AVA Documents
Document Sharing Hub

Full document details: NFPA 557 2023

Copyright © 2022 National Fire Protection Association®. All Rights Reserved.

NFPA® 557

Standard for

Determination of Fire Loads for Use in Structural Fire Protection Design

2023 Edition

This edition of NFPA 557, *Standard for Determination of Fire Loads for Use in Structural Fire Protection Design*, was prepared by the Technical Committee on Hazard and Risk of Contents and Furnishings. It was issued by the Standards Council on March 20, 2022, with an effective date of April 9, 2022, and supersedes all previous editions.

This edition of NFPA 557 was approved as an American National Standard on April 9, 2022.

Origin and Development of NFPA 557

The 2012 edition marked the first edition of NFPA 557, *Standard for Determination of Fire Loads for Use in Structural Fire Protection Design*. This document dates back to 2003, when it was proposed that NFPA create a document to address the need for guidance and standardization in the area of structural fire engineering. The Technical Committee on Hazard and Risk of Contents and Furnishings was assigned the document, and work began shortly thereafter.

NFPA 557 addresses the determination of the fire load and fire load density to be used as the basis for the evaluation and design of the structural fire performance of a building. The purpose of NFPA 557 is to provide standard methods and values for use in the determination of fire loads and fire load densities for design-basis fires. This is done using a risk framework. Two methodologies are detailed in the document: an occupancy-based density method and a survey-based method.

The 2016 edition contained new language that required the evaluation of a fire load to be prepared by an approved person and required the building owner to be responsible for confirming that anticipated fire load densities would not exceed values used for the design. New language in Chapter 4 provided required performance and test criteria for noncombustible and limited-combustible materials. Additional updates to terminology, definitions, and referenced publications were made throughout the document to reflect current industry standards and technology.

The 2020 edition contained updated language for defining a limited-combustible material and added guidance in the annex regarding fire losses in warehouses. The heat of combustion values were reorganized into a table for ease of use. No technical changes were made to the values. Reference documents were updated to reflect the most current editions available.

The 2023 edition contains guidance on fire load calculations for ignition-resistant materials when the calorific value is unknown. New language provides test requirements for ignition-resistant materials and fire-retardant-treated wood products.

NFPA and National Fire Protection Association are registered trademarks of the National Fire Protection Association, Quincy, Massachusetts 02169.

AVA Documents Document Sharing Hub

Full document details: NFPA 557 2023

Technical Committee on Hazard and Risk of Contents and Furnishings

Steven D. Wolin, *Chair*
Reliable Automatic Sprinkler Company, Inc., SC [M]

Craig L. Beyler, JENSEN HUGHES, MD [SE]
David A. Boverman, NSW Rural Fire Service, Australia [E]
Elizabeth C. Buc, Fire & Materials Research Laboratory, LLC, MI [RT]
David G. Bueche, Hoover Treated Wood Products, CO [M]
Michael T. Burr, Safety Engineering Laboratories, Inc., MI [RT]
Jason Daniels, Harrington Group, Inc., GA [SE]
Richard J. Davis, FM Global, MA [I]
Rep. FM Global
Marcelo M. Hirschler, GBH International, CA [SE]
William E. Koffel, Koffel Associates, Inc., MD [SE]
Sergei V. Levchik, Israel Chemicals Ltd. (ICL-IP), NY [M]
James R. Richardson, Lisle Woodridge Fire District, IL [E]
Katherine S. Setser, Miami University, OH [U]
Rep. American Society of Interior Designers
Xiaochuan Shi, Verisk, NJ [I]
Dwayne Sloan, UL LLC, NC [RT]
Bradley Thomson, General Motors, MI [M]

Alternates

Timothy Earl, GBH International, MI [SE]
(Alt. to Marcelo M. Hirschler)
William Randall Edwards, Alliance of Automobile Manufacturers, MI [M]
(Voting Alt.)
John A. Frank, Global Asset Protection Services, LLC, GA [I]
(Voting Alt.)
Nestor R. Iwankiw, JENSEN HUGHES, IL [SE]
(Alt. to Craig L. Beyler)
Jerry W. Wallace, Safety Engineering Laboratories, Inc., MI [RT]
(Alt. to Michael T. Burr)
Shaohua Xia, Fire & Rescue New South Wales, Australia [E]
(Alt. to David A. Boverman)

Camille Levy, NFPA Staff Liaison

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

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on fire hazard calculation procedures for use by other Committees in writing provisions to control the fire hazards of contents and furnishings. This Committee shall also provide guidance and recommendations to Committees in assessing the fire hazard of contents and furnishings. It shall establish classification and rating systems, request the development and standardization of appropriate fire tests, and identify and encourage necessary research as it relates to the fire hazards of contents and furnishings. It shall act in a liaison capacity between NFPA and the committees of other organizations with respect to the hazard of contents and furnishings.

Documents
Document Sharing Hub
Full document details: NFPA 557 2023

Contents

Chapter 1 Administration **557–** 4
1.1 Scope. **557–** 4
1.2 Purpose. **557–** 4
1.3 Application. **557–** 4
1.4 Equivalency. **557–** 4
1.5 Units and Formulas. **557–** 4
1.6 Approved Qualifications. **557–** 4

Chapter 2 Referenced Publications **557–** 4
2.1 General. **557–** 4
2.2 NFPA Publications. **557–** 4
2.3 Other Publications. **557–** 4
2.4 References for Extracts in Mandatory Sections. **557–** 5

Chapter 3 Definitions **557–** 5
3.1 General. **557–** 5
3.2 NFPA Official Definitions. **557–** 5
3.3 General Definitions. **557–** 5

Chapter 4 Design Fundamentals **557–** 6
4.1 Methodology. **557–** 6
4.2 Fire Load. **557–** 6
4.3 Statistical Distribution of Fire Load. **557–** 6
4.4 Frequency of Fire Initiations. **557–** 6
4.5 Effectiveness of Fire Protection Features. **557–** 6
4.6 Combustibility of Materials. **557–** 6

Chapter 5 Development of Fire Loads **557–** 6
5.1 Types of Fire Loads. **557–** 6
5.2 Defining the Compartment. **557–** 7
5.3 Distributed Fire Loads. **557–** 7
5.4 Localized Fire Loads. **557–** 7
5.5 Frequency of Structurally Significant Fires. **557–** 7
5.6 Approvals and Limitations. **557–** 7
5.7 Application of the Frequencies of Structurally Significant Fires to Occupancies. **557–** 7

Chapter 6 Occupancy-Based Fire Load Density **557–** 11
6.1 Fire Load Density. **557–** 11
6.2 Design Fire Load Density. **557–** 11

Chapter 7 Survey Method-Based Fire Load Density .. **557–** 11
7.1 Fire Load Density **557–** 11
7.2 Fire Load. **557–** 11
7.3 Heats of Combustion. **557–** 12
7.4 Methodology and Limitations. **557–** 12

Chapter 8 Documentation, Inspection, and Maintenance **557–** 13
8.1 Documented Fire Load. **557–** 13
8.2 Change in Occupancy. **557–** 13
8.3 Repairs. **557–** 13
8.4 Formal Review. **557–** 13

Annex A Explanatory Material **557–** 13

Annex B Summary of Occupancy Based Fuel and Fire Load Survey Data **557–** 18

Annex C Guidance for Fuel or Fire Load Surveys (Special Facility and Occupancy Based) **557–** 18

Annex D Analyses of Structurally Significant Fires in Buildings with Selected Characteristics . **557–** 19

Annex E Informational References **557–** 26

Index **557–** 28

Documents 2023 Edition Document Sharing Hub

Full document details: NFPA 557 2023

NFPA 557

Standard for

Determination of Fire Loads for Use in Structural Fire Protection Design

2023 Edition

IMPORTANT NOTE: This NFPA document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading "Important Notices and Disclaimers Concerning NFPA Standards." They can also be viewed at www.nfpa.org/disclaimers or obtained on request from NFPA.

UPDATES, ALERTS, AND FUTURE EDITIONS: New editions of NFPA codes, standards, recommended practices, and guides (i.e., NFPA Standards) are released on scheduled revision cycles. This edition may be superseded by a later one, or it may be amended outside of its scheduled revision cycle through the issuance of Tentative Interim Amendments (TIAs). An official NFPA Standard at any point in time consists of the current edition of the document, together with all TIAs and Errata in effect. To verify that this document is the current edition or to determine if it has been amended by TIAs or Errata, please consult the National Fire Codes® Subscription Service or the "List of NFPA Codes & Standards" at www.nfpa.org/docinfo. In addition to TIAs and Errata, the document information pages also include the option to sign up for alerts for individual documents and to be involved in the development of the next edition.

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex E.

Chapter 1 Administration

1.1* Scope. The scope of this standard is the determination of the fire load and fire load density to be used as the basis for the evaluation and design of the structural fire performance of a building.

1.1.1 The determination of a design-basis fire is outside the scope of this standard.

1.1.2* This document is not intended to address facilities for storage of hazardous materials.

1.2 Purpose. The purpose of this standard is to provide standard methods and values for use in the determination of fire loads and fire load densities for design-basis fires, which is done using a risk framework.

1.3 Application. This standard applies to the determination of fire loads and fire load densities based on occupancy.

1.4 Equivalency. Nothing in this standard is intended to prevent the use of methods equivalent or superior in effectiveness and safety over those prescribed by this standard.

1.5 Units and Formulas.

1.5.1 The units of measure in this standard are presented in the International System (SI) of Units.

1.5.2 The values presented for measurements in this standard are expressed with a degree of precision appropriate for practical application and enforcement. It is not intended that the application or enforcement of these values be more precise than the precision expressed.

1.5.3 Where extracted text contains values expressed in only one system of units, the values in the extracted text have been retained without conversion to preserve the values established by the responsible technical committee in the source document.

1.6 Approved Qualifications. The evaluation of the fire load shall be prepared by an approved person.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 70®, National Electrical Code®, 2023 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems,* 2021 edition.

NFPA *101®, Life Safety Code®,* 2021 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials,* 2018 edition.

2.3 Other Publications.

2.3.1 ASCE Publications. American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA 20191-4400.

ASCE/SEI 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, 2017.

2.3.2 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959. www.astm.org

ASTM E84, *Test Method for Surface Burning Characteristics of Building Materials*, 2021a.

ASTM E136, *Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*, 2019a.

ASTM E2652, *Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C*, 2018.

ASTM E2768, *Test Method for Extended Duration Surface Burning Characteristics of Building Materials (30 min Tunnel Test)*, 2011 (2018).

ASTM E2965, *Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, 2017.

AVA Documents Document Sharing Hub
Full document details: NFPA 557 2023

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

UL 723, *Test for Surface Burning Characteristics of Building Materials,* 2018.

2.3.4 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA *101®*, *Life Safety Code®*, 2021 edition.

NFPA 555, *Guide on Methods for Evaluating Potential for Room Flashover,* 2017 edition.

NFPA 5000®, *Building Construction and Safety Code®*, 2021 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Shall. Indicates a mandatory requirement.

3.2.4 Should. Indicates a recommendation or that which is advised but not required.

3.2.5 Standard. An NFPA standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA manuals of style. When used in a generic sense, such as in the phrases "standards development process" or "standards development activities," the term "standards" includes all NFPA standards, including codes, recommended practices, and guides.

3.3 General Definitions.

3.3.1 Alteration. See 3.3.12, Renovation.

3.3.2 Change of Use. A change in the purpose or level of activity within a structure that involves a change in the application of code requirements.

3.3.3 Contents and Furnishings. Any movable objects in a building that normally are secured or otherwise put in place for functional reasons, excluding (1) parts of the internal structure of the building and (2) any items meeting the definition of interior finish. [**555,** 2017]

3.3.4 Design-Basis Fire. The set of conditions that define the development of a fire and the spread of combustion products throughout a building or portions thereof.

3.3.5 Fire Load. The total energy content of combustible materials in a building, space, or area including furnishing and contents and combustible building elements expressed in MJ.

3.3.5.1* *Contents Fire Load.* The fire load of all movable or secured contents and furnishings and all occupant possessions within a compartment, including all the items that can be placed into a compartment or taken out of it without causing structural damage, expressed in MJ.

3.3.5.2 *Distributed Fire Load.* The overall fire load of the compartment, expressed in MJ.

3.3.5.3* *Fixed Fire Load.* The fire load of all combustible materials used as structural elements or as interior finish or trim (wall, ceiling, and floor) or installed concealed behind walls, floor, or ceiling, expressed in MJ.

3.3.5.4* *Localized Fire Load.* The fire load at a location within the compartment that is outside the scope of normal variations in the distributed fire load, expressed in MJ.

3.3.6* Fire Load Density. The heat energy, expressed in MJ/m^2, that could be released per unit floor area of a compartment by the combustion of the contents of the compartment and any combustible part(s) of the building itself.

3.3.7 Fuel Load. The total wood equivalent mass of combustible materials in a building, space, or area, including furnishings and contents and combustible building elements, expressed in kg.

3.3.8* Interior Finish. The exposed surfaces of walls, ceilings, and floors within buildings. [***101,*** 2021]

3.3.9 Material.

3.3.9.1 *Limited-Combustible Material.* See 4.6.2.

3.3.9.2 *Noncombustible Material.* See 4.6.1.

3.3.10* Modification. The reconfiguration of any space; the addition or elimination of any door or window; the addition or elimination of load-bearing elements; the reconfiguration or extension of any system; or the installation of any additional equipment. [***101,*** 2021]

3.3.11 Occupancy. The purpose for which a building or other structure, or part thereof, is used or intended to be used. [**ASCE/SEI 7-16:**1.2.1]

Δ **3.3.12 Renovation.** The replacement in kind, strengthening, or upgrading of building elements, materials, equipment, or fixtures that does not result in a reconfiguration of the building or spaces within.

3.3.13 Repair. The patching, restoration, or painting of materials, elements, equipment, or fixtures for the purpose of maintaining such materials, elements, equipment, or fixtures in good or sound condition. [***101,*** 2021]

3.3.14 Structurally Significant Fire. A fire that grows to a size that poses a threat to the structural elements.

Documents 2023 Edition Document Sharing Hub

Full document details: NFPA 557 2023

Chapter 4 Design Fundamentals

4.1* Methodology. The methodology developed in this standard shall provide a risk-based design fire load and fire load densities for use in design and evaluation of structural fire performance.

4.2 Fire Load. The fire load for design-basis fires shall be determined by a combination of all of the following:

(1) Statistical distribution of fire loads in buildings
(2) Fire initiation frequency
(3) Effectiveness and reliability of the fire protection features that contribute to fire control in the early stages of the fire

4.3 Statistical Distribution of Fire Load. The statistical distribution of the fire load of the building shall be determined by one of the following:

(1) Statistical sampling and analysis of the subject or similar buildings, as provided in Chapter 7
(2) Through the use of suitable occupancy-based means and standard deviation of the fire load distribution, as provided in Chapter 6

4.4 Frequency of Fire Initiations. The frequency of fire initiations in the building shall be determined from national statistical studies of fire incident data.

4.5 Effectiveness of Fire Protection Features.

4.5.1 The effectiveness of fire protection features in controlling fires before the fire becomes structurally significant shall be assessed by all of the following:

(1) Functional analysis
(2)* National statistical analysis for the country of the design site

4.5.2 Explanation of Statistics Used. If the statistics used for compliance with 4.5.1 are local or regional, an explanation shall be provided as to why these statistics are applicable for this analysis.

4.6 Combustibility of Materials.

4.6.1* Noncombustible Material.

4.6.1.1 A material that complies with any of the following shall be considered a noncombustible material:

(1)* A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat.
(2) A material that is reported as passing ASTM E136, *Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C.*
(3) A material that is reported as complying with the pass/fail criteria of ASTM E136 when tested in accordance with the test method and procedure in ASTM E2652, *Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C.*

4.6.1.2 Where the term *limited-combustible* is used in this standard, it shall also include the term *noncombustible.*

Δ **4.6.2 Limited-Combustible Material.** A material shall be considered a limited-combustible material where one of the following is met:

(1) The conditions of 4.6.2.1 and 4.6.2.2 and the conditions of either 4.6.2.3 or 4.6.2.4 shall be met.
(2) The conditions of 4.6.2.5 shall be met.

[**5000:**7.1.4.2]

N **4.6.2.1** The material does not comply with the requirements for a noncombustible material in accordance with 4.6.1. [**5000:**7.1.4.2.1]

N **4.6.2.2** The material, in the form in which it is used, exhibits a potential heat value not exceeding 8141 kJ/kg (3500 Btu/lb), when tested in accordance with NFPA 259. [**5000:**7.1.4.2.2]

Δ **4.6.2.3** The material shall have a structural base of noncombustible material with a surfacing not exceeding a thickness of 3.2 mm (⅛ in.) where the surfacing exhibits a flame spread index not greater than 50 when tested in accordance with ASTM E84, *Test Method for Surface Burning Characteristics of Building Materials*, or UL 723, *Test for Surface Burning Characteristics of Building Materials.* [**5000:**7.1.4.2.3]

Δ **4.6.2.4** The material shall be composed of materials that in the form and thickness used neither exhibit a flame spread index greater than 25 nor exhibit evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723, and are of such composition that all surfaces that would be exposed by cutting through the material on any plane would neither exhibit a flame spread index greater than 25 nor exhibit evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723. [**5000:**7.1.4.2.4]

4.6.2.5 Materials shall be considered limited-combustible materials where tested in accordance with ASTM E2965, *Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, at an incident heat flux of 75 kW/m^2 for a 20-minute exposure, and both the following conditions are met:

(1) The peak heat release rate shall not exceed 150 kW/m^2 for longer than 10 seconds.
(2) The total heat released shall not exceed 8 MJ/m^2.

[**5000:**7.1.4.2.5]

4.6.2.6 Where the term *limited-combustible* is used in this standard, it shall also include the term *noncombustible.* [**5000:**7.1.4.2.6]

Chapter 5 Development of Fire Loads

5.1 Types of Fire Loads. Fire loads shall be calculated as both localized fire loads and distributed fire loads.

5.1.1* Prior to a change of use or occupancy, renovation, or modification, the building owner shall be responsible for the evaluation of the new fire load.

5.1.2 If there is a change of use or occupancy, and the fire load in the new use or occupancy exceeds the fire load that was originally developed, then the fire resistance of the building shall be analyzed to evaluate if the existing passive fire protection meets the design objectives for the new use or occupancy.

AVA Documents Document Sharing Hub
Full document details: NFPA 557 2023

5.2 Defining the Compartment.

5.2.1 The compartment shall be selected as either the entire building or that portion of the building that is bounded by exterior surfaces of the building and by fire-rated boundaries that are capable of containing a fire for the entire duration through burnout.

5.2.2 For areas where there are no fire-rated boundaries, the entire building shall be selected.

5.3 Distributed Fire Loads.

5.3.1 Distributed fire loads shall be determined to reflect the total fire load throughout a compartment.

5.3.2 Distributed fire loads shall be determined in accordance with Chapter 6 or Chapter 7.

5.4 Localized Fire Loads.

5.4.1 Localized fire loads shall be determined to reflect concentrations of combustible material that have the potential to pose a more severe thermal exposure than the thermal exposure that would result from the uniform fire load.

5.4.2* Combustible materials shall be considered concentrated whenever the mass per unit area of one or more items is a factor of 2.57 greater than the established distributed fire load.

5.4.3 Localized fire loads shall be determined based upon surveys as described in Chapter 7 or upon architectural design data.

5.4.4 The localized fire load determined in accordance with this section shall be subject to the approval of the authority having jurisdiction (AHJ).

5.4.5 Localized fire loads shall be reported by location in the building and shall include the expected value and a measure of the variability of the value (mean and standard deviation).

5.5 Frequency of Structurally Significant Fires.

5.5.1 Methodology.

5.5.1.1 The frequency of structurally significant fires shall be developed by estimating the rate of fires per year relative to the numbers of buildings and to the area of floor space, for buildings of similar occupancy to the building being designed.

5.5.1.2* The frequency of structurally significant fires shall be determined by multiplying the rate of reportable fires per year per floor area by the fraction of fires that are structurally significant in buildings with similar construction and fire protection systems as proposed for the building.

5.5.1.3 The frequency of structurally significant fires, f_{ss}, shall be calculated as the product of the fire frequency, f_f, and the floor area, A_f, as follows:

$$f_{ss} = f_f \times A_f \qquad \textbf{[5.5.1.3]}$$

where:
f_{ss} = frequency of structurally significant fires (fires/year)
f_f = fire frequency (fires/m^2 year)
A_f = floor area (m^2)

5.6 Approvals and Limitations.

5.6.1* The limitations on the estimates of the frequency of structurally significant fires along with any limitations of the applicability of the structurally significant fire frequency for a particular building shall be subject to the approval of the AHJ.

5.6.2 The limitations of the applicability on the estimate of the frequency of the structurally significant fire for each particular building or facility shall be addressed within a technical report and provided to the AHJ for review and approval.

5.6.3* The frequency of structurally significant fires shall be developed from national statistics per Section 5.7 and Annex D.

5.6.4 As an alternative to the procedures in Section 5.6, other published data shall be used subject to approval of the applicability of the data by the AHJ.

5.7* Application of the Frequencies of Structurally Significant Fires to Occupancies.

5.7.1* Office/Business Occupancies.

5.7.1.1* For office/business occupancies, the frequency of fires shall be taken as 6 fires per million square meters per year.

5.7.1.2* For office/business occupancies, the frequency of structurally significant fires shall be determined by multiplying the fire frequency in 5.7.1.1 by the value in Table 5.7.1.2 that corresponds to the construction type and fire protection systems specified for the building.

5.7.2* Religious Properties.

5.7.2.1* For religious properties, the frequency of fires shall be taken as 6 fires per million square meters per year.

5.7.2.2* For religious properties, the frequency of structurally significant fires shall be determined by multiplying the fire frequency in 5.7.2.1 by the value in Table 5.7.2.2 that corresponds to the construction type and fire protection systems specified for the building.

5.7.3* Eating and Drinking Establishments.

5.7.3.1* For eating and drinking establishments, the frequency of fires shall be taken as 81 fires per million square meters per year.

5.7.3.2* For eating and drinking establishments, the frequency of structurally significant fires shall be determined by multiplying the fire frequency in 5.7.3.1 by the value in Table 5.7.3.2 that corresponds to the construction type and fire protection systems specified for the building.

5.7.4* Other Public Assembly.

5.7.4.1* For other public assembly buildings, the frequency of fires shall be taken as 10 fires per million square meters per year.

5.7.4.2* For other public assembly buildings, the frequency of structurally significant fires shall be determined by multiplying the fire frequency in 5.7.4.1 by the value in Table 5.7.4.2 that corresponds to the construction type and fire protection systems specified for the building.

Documents 2023 Edition Document Sharing Hub
Full document details: NFPA 557 2023