

NFPA®

520

Standard on
Subterranean Spaces

2021



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.

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: sds_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.

Copyright © 2020 National Fire Protection Association®. All Rights Reserved.

NFPA® 520

Standard on

Subterranean Spaces

2021 Edition

This edition of NFPA 520, *Standard on Subterranean Spaces*, was prepared by the Technical Committee on Subterranean Spaces. It was issued by the Standards Council on October 5, 2020, with an effective date of October 25, 2020, and supersedes all previous editions.

This edition of NFPA 520 was approved as an American National Standard on October 25, 2020.

Origin and Development of NFPA 520

In 1993, a symposium was convened by the United States Fire Administration to examine the problem of fire in subterranean spaces that have been converted for commercial use. The symposium was the result of a fire in a developed subterranean space in Kansas City, Kansas, that burned from December 1991 to April 1992. The symposium examined several unique fire and life safety issues that exist in subterranean spaces, including means of egress issues such as orientation and excessive travel distances, poor ventilation, communication difficulties, and nontraditional behavior of fire. The result was a recommendation to the National Fire Protection Association to develop a standard that addresses fire and life safety in these occupancies.

For the 2005 edition, the committee made only minor revisions to the document by adding some definitions, clarifying some provisions that users had found unclear, and expanding several concepts that had been found to work well.

For the 2010 edition, the committee found that NFPA 520 generally had been an effective document over the past 15 years. The committee made only minor revisions, revising two definitions with appropriate extracts from other documents and clarifying the provisions of three subsections.

For the 2016 edition, the committee determined that NFPA 520 generally has been an effective document over the past 20 years. The committee made only minor revisions, changing the phrase “areas of refuge” to “refuge areas” and updating various reference documents.

For the 2021 edition, NFPA 520 went through a substantial change as two new chapters have been added to the document to address performance-based design. These new chapters allow performance-based design to be an option and provide guidance on the required considerations for performance-based design. The committee changed *fire department* to *emergency response*. The required tests for fire resistance rating determination were added for clarification.

Technical Committee on Subterranean Spaces

Jack Poole, *Chair*

Poole Fire Protection, Inc., KS [SE]

Andrew Diekemper, Lenexa Fire Department, KS [E]

John H. Hastings, Kansas City Fire Department, MO [E]

John A. Kay, Rockwell Automation, Canada [M]

James Priest, FERMI National Accelerator Laboratory, IL [U]

Oriol Rios, CERN, Switzerland [SE]

Michael L. Savage, Sr., Marion County Building Safety, FL [E]

Jason Szukics, Specialty Rescue and Fire Service, TX [U]

Alternates

Bradley Austin, Poole Fire Protection, Inc., KS [SE]

(Alt. to Jack Poole)

James Niehoff, Fermilab-Fermi National Accelerator Laboratory, IL [U]

(Alt. to James Priest)

Baran Ozden, 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 safeguarding life and property against fire, explosion, and related hazards associated with occupancies located in subterranean spaces not addressed by other documents.

Contents

Chapter 1 Administration	520- 4	7.2 Means of Egress from the Common Space.	520- 11
1.1 Scope.	520- 4	7.3 Occupant Load Determination.	520- 11
1.2 Purpose.	520- 4	7.4 Egress Capacity.	520- 11
1.3 Application.	520- 4	7.5 Exit Doors.	520- 12
1.4 Retroactivity.	520- 4	7.6 Illumination in Common Spaces.	520- 12
1.5 Equivalency.	520- 4	7.7 Marking.	520- 12
Chapter 2 Referenced Publications	520- 4	7.8 Refuge Areas and/or Refuge Chambers.	520- 12
2.1 General.	520- 4	7.9 Exit Passageway.	520- 12
2.2 NFPA Publications.	520- 4	Chapter 8 Fire Alarm, Detection, and Suppression	
2.3 Other Publications.	520- 5	Systems	520- 12
2.4 References for Extracts in Mandatory Sections.	520- 5	8.1 Fire Alarm Systems.	520- 12
Chapter 3 Definitions	520- 5	8.2 Sprinkler Systems.	520- 13
3.1 General.	520- 5	8.3 Standpipe Systems.	520- 13
3.2 NFPA Official Definitions.	520- 5	8.4 Water Supply.	520- 13
3.3 General Definitions.	520- 5	8.5 Maintenance.	520- 13
Chapter 4 Fire Protection Approaches	520- 6	8.6 Emergency Power.	520- 13
4.1 Fire Protection Approach.	520- 6	8.7 Standby Power.	520- 14
4.2 Fire Risk Assessment.	520- 6	8.8 Alternative Power Supplies.	520- 14
Chapter 5 Performance-Based Design Approach	520- 7	Chapter 9 Emergency Preparedness	520- 14
5.1 Performance-Based Design Approach.	520- 7	9.1 Emergency Action Plan.	520- 14
5.2 Goals and Objectives.	520- 7	9.2 Breathing Apparatus.	520- 14
5.3 Qualifications.	520- 7	9.3 Fire Exit Drills.	520- 14
5.4 Independent Review.	520- 7	9.4 Fire Extinguishers.	520- 14
5.5 Final Determination.	520- 7	Chapter 10 Emergency Response Provisions	520- 14
5.6 Maintenance of Design Feature.	520- 7	10.1 Communications.	520- 14
5.7 Performance Criteria.	520- 7	10.2 Pre-Fire Planning.	520- 14
Chapter 6 Construction Features	520- 7	10.3 Emergency Response Access.	520- 14
6.1 Noncombustible Material.	520- 7	Annex A Explanatory Material	520- 15
6.2 Occupancy in Subterranean Spaces.	520- 7	Annex B Diagrams of Subterranean Spaces	520- 16
6.3 Compartmentation Requirements.	520- 10	Annex C Informational References	520- 18
6.4 Interior Finish.	520- 11	Index	520- 19
6.5 Electrical Installations.	520- 11		
6.6 Control of Smoke Spread.	520- 11		
Chapter 7 Means of Egress	520- 11		
7.1 Means of Egress Within the Building.	520- 11		

NFPA 520

Standard on

Subterranean Spaces

2021 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 C.

Chapter 1 Administration

1.1* Scope.

1.1.1 This standard addresses the safeguarding of life and property against fire, explosion, and related hazards associated with developed subterranean spaces.

1.1.2 This standard does not cover the following types of subterranean spaces:

- (1) Tourist caverns
- (2) Wine storage caverns
- (3) Gas and oil storage reservoirs
- (4) Hazardous waste repositories
- (5) Utility installations such as pump stations
- (6) Working mines
- (7) Transportation and pedestrian tunnels
- (8) Aboveground buildings with belowground stories
- (9) Cut and cover underground structures specifically addressed in the building code

1.2 Purpose. The purpose of this standard is to provide minimum requirements for the design, operation, and maintenance

of developed subterranean spaces for safety to life and property from fire and similar hazards.

1.3 Application.

1.3.1 General.

N 1.3.1.1 A documented risk assessment is permitted to be the basis for implementation of this standard.

1.3.1.2 The requirements of this standard apply to newly developed subterranean spaces.

1.3.1.3 Where specifically noted, this standard also applies to existing facilities.

N 1.3.1.4 The application of this standard is permitted to be based on the risk considerations outlined in Chapter 4.

1.3.2* Modifications, Remodeling, and Additions. Where modifications are made, remodeling is done, or additional space is created in an existing developed subterranean space, the requirements of this standard apply to those modifications, remodeling, or additions.

1.4 Retroactivity. When requirements of this standard apply to existing subterranean spaces, a limited but reasonable time shall be allowed for compliance that is commensurate with the magnitude of the expenditure, the disruption of services, and the degree of hazard.

1.5 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety as alternatives to those prescribed by this standard, provided sufficient technical documentation is submitted to the authority having jurisdiction to demonstrate the system, method, or device is approved for the intended purpose and is equivalent.

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 10, *Standard for Portable Fire Extinguishers*, 2018 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2019 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2019 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2019 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 2018 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2019 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2020 edition.

NFPA 70®, *National Electrical Code*®, 2020 edition.

NFPA 72®, *National Fire Alarm and Signaling Code*®, 2019 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, 2019 edition.

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

NFPA 110, *Standard for Emergency and Standby Power Systems*, 2019 edition.

NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, 2019 edition.

NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*, 2021 edition.

NFPA 600, *Standard on Facility Fire Brigades*, 2020 edition.

2.3 Other Publications.

2.3.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, 2019.

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

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

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

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

UL 263, *Fire Tests of Building Construction and Materials*, 2019.

2.4 References for Extracts in Mandatory Sections.

NFPA 72®, *National Fire Alarm and Signaling Code*®, 2019 edition.

NFPA 101®, *Life 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* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.4 Shall. Indicates a mandatory requirement.

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

3.2.6 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 phrase “standards development process” or “standards development activities,” the term “standards” includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Building. An area of the subterranean space that is separated from the common space or the undeveloped space by fire-resistive construction.

3.3.2 Control Area. An area within a building for storage and use of high-hazard materials.

3.3.3 Exit Passageway. An enclosed passageway that leads from the subterranean space to the exterior public way.

3.3.4 Exterior Building Wall. The rock surface or constructed wall that separates a building in the subterranean space from the remainder of the space.

3.3.5 Fire Command Center. The principal attended or unattended room or area where the status of the detection, alarm communications, control systems, and other emergency systems is displayed and from which the system(s) can be manually controlled. [72, 2019]

3.3.6 Floor Area.

3.3.6.1 Gross Floor Area. The floor area within the inside perimeter of the outside walls of the building under consideration with no deduction for hallways, stairs, closets, and thickness of interior walls, columns, or other features. Where the term *area* is used elsewhere in this standard, it shall be understood to be gross floor area unless otherwise specified.

3.3.6.2 Net Floor Area. The gross floor area minus the area of support columns.

3.3.7 Hazard.

3.3.7.1 High Hazard. Contents that are likely to burn with extreme rapidity or from which explosions are likely.

3.3.7.2 Low Hazard. Contents of such low combustibility that no self-propagating fire therein can occur.

3.3.7.3 Ordinary Hazard. Contents that are likely to burn with moderate rapidity or to give off a considerable volume of smoke.

3.3.8 Noncombustible Material. See Section 6.1.

3.3.9 Parking Area. An area used for parking of occupant vehicles that is not intended to serve as storage of vehicles.

3.3.10 Portal. A horizontal roadway or pedestrian entry to or exit from the subterranean space.