

NFPA® 130

Standard for Fixed Guideway Transit and Passenger Rail Systems

2010 Edition



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NFPA® 130

Standard for

Fixed Guideway Transit and Passenger Rail Systems

2010 Edition

This edition of NFPA 130, *Standard for Fixed Guideway Transit and Passenger Rail Systems*, was prepared by the Technical Committee on Fixed Guideway Transit and Passenger Rail Systems and acted on by NFPA at its June Association Technical Meeting held June 8-11, 2009, in Chicago, IL. It was issued by the Standards Council on August 6, 2009, with an effective date of August 26, 2009, and supersedes all previous editions.

This edition of NFPA 130 was approved as an American National Standard on August 26, 2009.

Origin and Development of NFPA 130

The Fixed Guideway Transit Systems Technical Committee was formed in 1975 and immediately began work on the development of NFPA 130. One of the primary concerns of the committee in the preparation of this document centered on the potential for entrapment and injury of large numbers of people who routinely utilize these mass transportation facilities.

During the preparation of the first edition of this document, several significant fires occurred in fixed guideway systems, but fortunately the loss of life was limited. The committee noted that the minimal loss of life was due primarily to chance events more than any preconceived plan or the operation of protective systems.

The committee developed material on fire protection requirements to be included in NFPA 130, *Standard for Fixed Guideway Transit Systems*. This material was adopted by NFPA in 1983. The 1983 edition was partially revised in 1986 to conform with the *NFPA Manual of Style*. Incorporated revisions included a new Chapter 8; a new Appendix F, "Creepage Distance"; minor revisions to the first four chapters and to Appendices A, B, C, and E; and a complete revision of Appendix D.

The scope of the 1988 edition was expanded to include automated guideway transit (AGT) systems. The sample calculations in Appendix C were revised, and Appendix D was completely revised.

The 1990 edition included minor changes to integrate provisions and special requirements for AGT systems into the standard. Table 1 from Appendix D was moved into Chapter 4, "Vehicles," and new vehicle risk assessment material was added to Appendix D.

Definitions for *enclosed station* and *open station* were added in the 1993 edition, along with minor changes to Chapters 2 and 3, and the 1995 edition made minor changes to Chapters 1, 2, and 3.

The 1997 edition included a new chapter on emergency ventilation systems for transit stations and trainways. A new Appendix B addressing ventilation replaced the previous Appendix B, "Air Quality Criteria in Emergencies." Also, the first three sections of Chapter 6 (re-numbered as Chapter 7 in the 1997 edition), "Emergency Procedures," were revised, and several new definitions were added.

The 2000 edition of NFPA 130 addressed fixed guideway transit and passenger rail systems, and changes were made throughout the document to incorporate passenger rail requirements. Additionally, much of Chapter 2 was rewritten to incorporate changes that were made to the egress calculations in NFPA 101®, *Life Safety Code*®. The examples in Appendix C were modified using the new calculation methods. The protection requirements for Chapter 3 were modified, addressing emergency lighting and standpipes. Chapter 4 also was modified to clarify and expand the emergency ventilation requirements.

The 2003 edition was reformatted in accordance with the 2003 *Manual of Style for NFPA Technical Committee Documents*. Beyond these editorial changes, there were technical revisions to the

egress requirements and calculations for stations. The chapter on vehicles was extensively rewritten to include a performance-based design approach to vehicle design as well as changes to the traditional prescriptive-based requirements.

The 2007 edition included revisions affecting station egress calculations, the use of escalators in the means of egress, vehicle interior fire resistance, and power supply to tunnel ventilation systems. The chapter on vehicle maintenance facilities was removed because requirements for that occupancy are addressed in other codes, and the performance-based vehicle design requirements were substantially revised to more accurately address the unique qualities of rail vehicles.

The 2010 edition of NFPA 130 includes provisions that allow elevators to be counted as contributing to the means of egress in stations. The 2010 edition also contains revisions relating to escalators, doors, gates, and turnstile-type fare equipment. The units in the standard have been updated in accordance with the *Manual of Style for NFPA Technical Committee Documents*. Several fire scenarios have been added to Annex A to provide guidance on the types of fires that can occur in vehicles, stations, and the operating environment as well.



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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 pertaining to fire safety requirements for underground, surface, and elevated fixed guideway transit and passenger rail systems including stations, trainways, emergency ventilation systems, vehicles, emergency procedures, communications and control systems and for life safety from fire and fire protection in stations, trainways, and vehicles. Stations shall pertain to stations accommodating occupants of fixed guideway transit and passenger rail systems and incidental occupancies in the stations.

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

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A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex G. 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 publications can be found in Chapter 2 and Annex G.

Chapter 1 Administration**1.1 Scope.**

1.1.1 This standard shall cover life safety from fire and fire protection requirements for underground, surface, and elevated fixed guideway transit and passenger rail systems, including but not limited to stations, trainways, emergency ventilation systems, vehicles, emergency procedures, communications, control systems, and vehicle storage areas.

1.1.2 Fixed guideway transit and passenger rail stations shall pertain to stations accommodating only passengers and employees of the fixed guideway transit and passenger rail systems and incidental occupancies in the stations. This standard establishes minimum requirements for each of the identified subsystems.

1.1.3 This standard shall not cover requirements for the following:

- (1) Conventional freight systems
- (2) Buses and trolley coaches
- (3) Circus trains

- (4) Tourist, scenic, historic, or excursion operations
- (5) Any other system of transportation not included in the definition of fixed guideway transit (*see 3.3.52.1*) or passenger rail (*see 3.3.52.2*) system
- (6)*Shelter stops

1.1.4 To the extent that a system, including those listed in 1.1.3(1) through 1.1.3(6), introduces hazards of a nature similar to those addressed herein, this standard shall be permitted to be used as a guide.

1.2 Purpose. The purpose of this standard shall be to establish minimum requirements that will provide a reasonable degree of safety from fire and its related hazards in fixed guideway transit and passenger rail system environments.

1.3 Application.

1.3.1 This standard shall apply to new fixed guideway transit and passenger rail systems and to extensions of existing systems.

1.3.2 The portion of the standard dealing with emergency procedures shall apply to new and existing systems.

1.3.3* The standard also shall be used for purchases of new rolling stock and retrofitting of existing equipment or facilities except in those instances where compliance with the standard will make the improvement or expansion incompatible with the existing system.

1.3.4 This standard shall apply as a basis for fixed guideway transit and passenger rail systems where nonelectric and combination electric/other (such as diesel) vehicles are used. Where such vehicles are not passenger-carrying vehicles or are buses or trolley coaches, the standard shall not apply to those vehicle, but shall apply to the fixed guideway transit and passenger rail system in which such vehicles are used.

1.4* Equivalency. Nothing in this standard is intended to prevent or discourage the use of new methods, materials, or devices, provided that sufficient technical data are submitted to the authority having jurisdiction to demonstrate that the new method, material, or device is equivalent to or superior to the requirements of this standard with respect to fire performance and life safety.

1.4.1 Technical Documentation. Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.4.2 Approval. The new methods, materials, or devices shall be approved for the intended purpose.

1.4.3* Equivalent Compliance. Alternative systems, methods, materials, or devices approved as equivalent shall be recognized as being in compliance with this standard.

1.5 Units and Formulas.

1.5.1 SI Units. Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI).

1.5.2 Primary and Equivalent Values. If a value for a measurement as given in this standard is followed by an equivalent value in other units, the first stated value shall be regarded as the requirement. A given equivalent value might be approximated.

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*, 2007 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2010 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2007 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 2008 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2008 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2008 edition.

NFPA 70®, *National Electrical Code®*, 2008 edition.

NFPA 72®, *National Fire Alarm and Signaling Code*, 2010 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, 2004 edition.

NFPA 101®, *Life Safety Code®*, 2009 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems*, 2010 edition.

NFPA 220, *Standard on Types of Building Construction*, 2009 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, 2009 edition.

NFPA 251, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials*, 2006 edition.

NFPA 253, *Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source*, 2006 edition.

• NFPA 262, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces*, 2007 edition.

NFPA 271, *Standard Method of Test for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter*, 2009 edition.

NFPA 286, *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth*, 2006 edition.

NFPA 703, *Standard for Fire Retardant-Treated Wood and Fire-Retardant Coatings for Building Materials*, 2009 edition.

2.3 Other Publications.

2.3.1 AMCA Publications. Air Movement and Control Association International, Inc., 30 West University Drive, Arlington Heights, IL, 60004-1893.

ANSI/AMCA 210, *Laboratory Methods of Testing Fans for Aerodynamic Performance Rating*, 1999.

AMCA 250, *Laboratory Methods of Testing Jet Tunnel Fans for Performance*, 2005.

AMCA 300, *Reverberant Room Method for Sound Testing of Fans*, 1996.

2.3.2 APTA Publications. American Public Transportation Association, 1666 K Street NW, Washington, DC 20006.

APTA Standard SS-PS-002, Rev 2., 1998.

2.3.3 ASHRAE Publications. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 1791 Tullie Circle, N., Atlanta, GA 30329-2305.

ASHRAE *Handbook—Fundamentals*, 2009.

ASHRAE 149, *Standard of Laboratory Methods of Testing Fans Used to Exhaust Smoke in Smoke Management Systems*, 2000.

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

ASTM C 1166, *Standard Test Method for Flame Propagation of Dense and Cellular Elastometric Gaskets and Accessories*, 1991.

ASTM D 2724, *Standard Test Method for Bonded, Fused, and Laminated Apparel Fabrics*, 1987.

ASTM D 3574, *Test I₂ (Dynamic Fatigue Test by the Roller Shear at Constant Force) or Test I₃ (Dynamic Fatigue Test by Constant Force Pounding)*, 2008.

ASTM D 3675, *Standard Test Method for Surface Flammability of Flexible Cellular Materials Using a Radiant Heat Energy Source*, 1994.

ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 1994.

ASTM E 119, *Standard Test Method for Fire Tests of Building Construction and Materials*, 1988, Rev. B, 1992.

ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C*, 2004.

ASTM E 162, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*, 1994.

ASTM E 648, *Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source*, 1994.

ASTM E 662, *Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials*, 1994.

ASTM E 814, *Standard Test Method for Fire Tests of Through-Penetration Fire Stops*, 2002.

ASTM E 1354, *Standard Test Method for Heating and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter*, 2002d.

ASTM E 1537, *Standard Test Method for Fire Testing of Upholstered Furniture*, 2002a.

ASTM E 1590, *Standard Test Method for Fire Testing of Mattresses*, 2002.

ASTM E 2061, *Guide for Fire Hazard Assessment of Rail Transportation Vehicles*, 2003.

2.3.5 California Technical Bulletins. State of California, Department of Consumer Affairs, Bureau of Home Furnishings and Thermal Insulation, 3485 Orange Grove Avenue, North Highlands, CA 95660-5595.

Technical Bulletin 129, *Flammability Test Procedure for Mattresses for Use in Public Buildings*, October 1992.

Technical Bulletin 133, *Flammability Test Procedure for Seating Furniture for Use in Public Occupancies*, January 1991.

• **2.3.6 ICEA Publications.** Insulated Cable Engineers Association, P. O. Box 1568, Carrollton, GA 30112.

ICEA S-73-532/NEMA WC-57, *Standard for Control, Thermocouple Extension, and Instrumentation Cables*, 2004.

ICEA S-95-658/NEMA WC-70, *Nonshielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy*, 1999.

2.3.7 IEC Publications. International Electrotechnical Commission, 3, rue de Varembé, P. O. Box 131, CH-1211 Geneva 20, Switzerland.

IEC 60331-11, *Tests for electric cables under fire conditions — Circuit integrity — Part 11: Apparatus — Fire alone at a flame temperature of at least 750°C*, 1999.

2.3.8 IEEE Publications. Institute of Electrical and Electronics Engineers, Three Park Avenue, 17th Floor, New York, NY 10016-5997.

IEEE 11, *Standard for Rotating Electric Machinery for Rail and Road Vehicles*, 2000.

IEEE 16, *American Standard for Electric Control Apparatus for Land Transportation Vehicles*, 2004.

IEEE 383, *Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations*, 1974.

IEEE 1202, *Standard for Flame-Propagation Testing of Wire and Cable*, 2006.

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

ANSI/UL 44, *Standard for Safety Rubber-Insulated Wires and Cables*, 2005. Revised November 2005.

ANSI/UL 83, *Standard for Safety Thermoplastic-Insulated Wires and Cables*, 2003. Revised April 2006.

ANSI/UL 1685, *Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables*, 2007.

ANSI/UL 2196, *Standard for Safety for Tests for Fire Resistive Cables*, 2001. Revised December 2006.

2.3.10 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Title 14, Code of Federal Regulations, Part 25, Appendix F, Part I, vertical test.

2.3.11 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 72®, *National Fire Alarm and Signaling Code*, 2010 edition.

NFPA 101®, *Life Safety Code*®, 2009 edition.

NFPA 253, *Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source*, 2006 edition.

NFPA 271, *Standard Method of Test for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter*, 2009 edition.

NFPA 402, *Guide for Aircraft Rescue and Fire-Fighting Operations*, 2008 edition.

NFPA 472, *Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents*, 2008 edition.

NFPA 502, *Standard for Road Tunnels, Bridges, and Other Limited Access Highways*, 2008 edition.

NFPA 921, *Guide for Fire and Explosion Investigations*, 2008 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 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* 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.

3.2.5 Shall. Indicates a mandatory requirement.

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

3.3 General Definitions.

3.3.1 Ancillary Area/Ancillary Space. The nonpublic areas or spaces of the stations usually used to house or contain operating, maintenance, or support equipment and functions.

3.3.2 Authority. The agency legally established and authorized to operate a fixed guideway transit and/or passenger rail system.

3.3.3 Backlayering. The reversal of movement of smoke and hot gases counter to the direction of the ventilation airflow.

3.3.4 Blue Light Station. A location along the trainway, indicated by a blue light, where emergency service or authorized personnel can communicate with the operations control center and disconnect traction power.

3.3.5 Building. Any structure or group of structures in which fixed guideway transit and/or passenger rail vehicles are stored or maintained, including those in which inspection and service functions are performed, and other ancillary structures, such as substations and air-conditioning or ventilation facilities.

3.3.6 Combustible Load of a Vehicle. The total value of heat energy that can be released through complete combustion of the components of a vehicle or fuel expressed in joules [British thermal units (Btu)].

3.3.7 Command Post (CP). The location at the scene of an emergency where the incident commander is located and where command, coordination, control, and communications are centralized. [402, 2008]

3.3.8 Communications. Radio, telephone, and messenger services throughout the system and particularly at the operations control center and command post.

3.3.9 Computational Fluid Dynamics. A solution of fundamental equations of fluid flow using computer techniques allowing the engineer to identify velocities, pressures, temperatures, and so forth.

3.3.10* Concourse. Intermediate level(s) or area(s) connecting a station platform(s) to a public way via stairs, escalators, or corridors.

3.3.11 Critical Radiant Flux. The level of incident radiant heat energy in units of W/cm^2 on a floor covering system at the most distant flameout point. [253, 2006]

3.3.12 Critical Velocity. The minimum steady-state velocity of the ventilation airflow moving toward the fire within a tunnel or passageway that is required to prevent backlayering at the fire site.

3.3.13 Emergency Procedures Plan. A plan that is developed by the authority with the cooperation of all participating agencies and that details specific actions required by all those who will respond during an emergency.

3.3.14* Engineering Analysis/Fire Hazard Analysis. An analysis that evaluates all the various factors that affect the fire safety/life safety of the system or component.

3.3.15 Equivalency. An alternative means of providing an equal or greater degree of safety than that afforded by strict conformance to prescribed codes and standards.

3.3.16 Fire Command Center. The principal attended or unattended location where the status of the detection, alarm communications, and control systems is displayed and from which the system(s) can be manually controlled. [72, 2010]

3.3.17 Fire Emergency. The existence of, or threat of, fire or the development of smoke or fumes, or any combination thereof, that demands immediate action to correct or alleviate the condition or situation. [502, 2008]

3.3.18 Fire Growth Rate. Rate of change of the heat release rate. Some factors that affect the fire growth rate are exposure, geometry, flame spread, and fire barriers.

3.3.19 Fire Load.

3.3.19.1 Effective Fire Load. The portion of the total fire load under a given, specific fire scenario of a certain fuel package that would be expected to be released in a design fire incident (units: joules or Btu). This can include transit and/or passenger rail vehicle(s), luggage, fuel, and/or way-side facilities or structures, that, because of the fuel package configuration, separation, and combustion characteristics, would be expected to be released in a design fire incident.

3.3.19.2 Total Fire Load. The total heat energy of all combustibles available from the constituent materials of a certain fuel package (units: joules or Btu). This can include a transit and/or passenger rail vehicle(s), luggage, fuel, and/or way-side facilities or structures.

3.3.20 Fire Smoke Release Rate. Rate of smoke release for a given fire scenario expressed as a function of time (units: m^2/sec or ft^2/sec).

3.3.21 Flaming Dripping. Periodic dripping of flaming material from the site of material burning or material installation.

3.3.22 Flaming Running. Continuous flaming material leaving the site of material burning or material installation.

3.3.23 Guideway. That portion of the transit or passenger rail line included within right-of-way fences, outside lines of curbs or shoulders, underground tunnels and stations, cut or fill slopes, ditches, channels, and waterways, and including all appertaining structures.

3.3.24 Hazard. Real or potential condition that can cause injury.

3.3.25 Headway. The interval of time between the arrivals of consecutive trains at a platform in a station.

3.3.26* Heat Release Rate (HRR). The rate at which heat energy is generated by burning. [921, 2008]

3.3.26.1 Average Heat Release Rate (HRR_{180}). The average heat release rate per unit area, over the time period starting at time to ignition and ending 180 seconds later, as measured in NFPA 271 or ASTM E 1354 (units: kW/m^2).

3.3.26.2 Fire Heat Release Rate for Ventilation Calculations. Rate of energy release for a given fire scenario expressed as a function of time (units: W or Btu/s).

3.3.27 Incident Commander (IC). The individual responsible for all incident activities, including the development of strategies and tactics and the ordering and the release of resources. [472, 2008]

3.3.28 Local Control. The point of control of the emergency ventilation system or ventilation plant that is remote from the operations control center.

3.3.29 Noncombustible Material. 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. Materials that are reported as passing ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C*, shall be considered noncombustible materials. [101, 2009]

3.3.30 Nonmechanical Emergency Ventilation System. A system of smoke reservoirs, smoke vents, and/or dampers that are designed to support the tenability criteria without the use of fans.

3.3.31 Occupancy.

3.3.31.1 Incidental Occupancies in Stations. The use of the station by others who are neither transit system employees nor passengers.

3.3.31.2 Nonsystem Occupancy Stations. An occupancy not under the control of the system operating authority.

3.3.32 Operations Control Center. The operations center where the authority controls and coordinates the systemwide movement of passengers and trains from which communication is maintained with supervisory and operating personnel of the authority and with participating agencies when required.

3.3.33 Participating Agency. A public, quasipublic, or private agency that has agreed to cooperate with and assist the authority during an emergency.

3.3.34 Passenger Load.

3.3.34.1 Detraining Load. The number of passengers alighting from a train at a platform.

3.3.34.2 Entraining Load. The number of passengers boarding a train at a platform.

3.3.34.3 Link Load. The number of passengers traveling between two stations on board a train or trains.



3.3.35 Point of Safety. A point of safety is one of the following: (1) an enclosed fire exit that leads to a public way or safe location outside the station, trainway, or vehicle; (2) an at-grade point beyond the vehicle, enclosing station, or trainway; (3) any other approved location.

3.3.36 Power Station. An electric-generating plant for supplying electrical energy to the system.

3.3.37 Power Substation. Location of electric equipment that does not generate electricity but receives and converts or transforms generated energy to usable electric energy.

3.3.38 Radiant Panel Index (I_p). The product of the flame spread factor (F_p) and the heat evolution factor (Q_p), as determined in ASTM E 162.

3.3.39 Replace in Kind. As applied to vehicles and facilities, to furnish with new parts or equipment of the same type but not necessarily of identical design.

3.3.40 Retrofit. As applied to vehicles and facilities, to furnish with new parts or equipment to constitute a deliberate modification of the original design (as contrasted with an overhaul or a replacement in kind).

3.3.41 Smoke Obscuration. The reduction of light transmission by smoke, as measured by light attenuation). [271, 2009]

3.3.42 Specific Extinction Area. A measure of smoke obscuration potential per unit mass burnt, determined as the product of the specific extinction coefficient and the volumetric mass flow rate, divided by the mass loss rate, m/kg (ft/lb).

3.3.43 Specific Optical Density (D_p). The optical density, as measured in ASTM E 662, over unit path length within a chamber of unit volume, produced from a specimen of unit surface area, that is irradiated by a heat flux of 2.5 W/cm² for a specified period of time.

3.3.44 Station. A place designated for the purpose of loading and unloading passengers, including patron service areas and ancillary spaces associated with the same structure.

3.3.44.1 Enclosed Station. A station or portion thereof that does not meet the definition of an open station.

3.3.44.2* Open Station. A station that is constructed such that it is directly open to the atmosphere and smoke and heat are allowed to disperse directly into the atmosphere.

3.3.45 Station Platform. The area of a station immediately adjacent to a guideway, used primarily for loading and unloading passengers.

3.3.46 Structure.

3.3.46.1 Elevated Structure. Any structure not otherwise defined as a surface or underground structure.

3.3.46.2 Surface Structure. Any at-grade or unroofed structure other than an elevated or underground structure.

3.3.47 System. See 3.3.52.1, Fixed Guideway Transit System, or 3.3.52.2, Passenger Rail System.

3.3.48 Tenable Environment. In a transportation system, an environment that permits the self-rescue of occupants for a specific period of time.

3.3.49 Tourist, Scenic, Historic, or Excursion Operations. Railroad operations that carry passengers, often using antiquated equipment, with the conveyance of the passengers to a particular destination not being the principal purpose.

3.3.50 Track.

3.3.50.1 Storage Track. A portion of the trainway used for temporary storage or light cleaning of trains and not intended to be used for trains occupied by passengers.

3.3.50.2 Tail Track. A portion of dead-end trainway used for temporary storage, turn-around, or light cleaning of trains and not intended to be used for trains occupied by passengers.

3.3.51 Trainway. That portion of the system in which the vehicles operate.

3.3.52 Transportation Systems.

3.3.52.1 Fixed Guideway Transit System. An electrified transportation system, utilizing a fixed guideway, operating on right-of-way for the mass movement of passengers within a metropolitan area, and consisting of its fixed guideways, transit vehicles, and other rolling stock; power system; buildings; maintenance facilities; stations; transit vehicle yard; and other stationary and movable apparatus, equipment, appurtenances, and structures.

3.3.52.1.1 Automated Fixed Guideway Transit System. A fixed guideway transit system that operates fully automated, driverless vehicles along an exclusive right-of-way.

3.3.52.2 Passenger Rail System. A transportation system, utilizing a rail guideway, operating on right-of-way for the movement of passengers within and between metropolitan areas, and consisting of its rail guideways, passenger rail vehicles, and other rolling stock; power systems; buildings; maintenance facilities; stations; passenger rail vehicle yard; and other stationary and movable apparatus, equipment, appurtenances, and structures.

3.3.53 Vehicle.

3.3.53.1 Fixed Guideway Transit Vehicle. An electrically propelled passenger-carrying vehicle characterized by high acceleration and braking rates for frequent starts and stops and fast passenger loading and unloading.

3.3.53.2 Passenger Rail Vehicle. A vehicle and/or power unit running on rails used to carry passengers and crew.

Chapter 4 General

4.1 Fire Safety of Systems.

4.1.1 Fire safety of systems shall be achieved through a composite of facility design, operating equipment, hardware, procedures, and software subsystems that are integrated to provide requirements for the protection of life and property from the effects of fire.

4.1.2 The level of fire safety desired for the whole system shall be achieved by integrating the required levels for each subsystem.

4.2 Goal.

4.2.1 The goal of this standard shall be to provide an environment for occupants of fixed guideway and passenger rail system elements that is safe from fire and similar emergencies to a practical extent based on the following measures:

- (1) Protect occupants not intimate with the initial fire development
- (2) Maximize the survivability of occupants intimate with the initial fire development

4.2.2 This standard is prepared with the intent of providing minimum requirements for those instances where noncombustible materials (as defined in 3.3.29) are not used due to other considerations in the design and constructions of the system elements.

4.3 Objectives.

4.3.1 Occupant Protection. Systems shall be designed, constructed, and maintained to protect occupants who are not intimate with the initial fire development for the time needed to evacuate or relocate them, or to defend such occupants in place during a fire or fire-related emergency.

4.3.2 Structural Integrity. Structural integrity of stations, trainways, and vehicles shall be maintained for the time needed to evacuate, relocate, or defend in place occupants who are not intimate with the initial fire development.

4.3.3 Systems Effectiveness. Systems utilized to achieve goals stated in Section 4.2 shall be effective in mitigating the hazard or condition for which they are being used, shall be reliable, shall be maintained to the level at which they were designed to operate, and shall remain operational.

4.4* Assumption of a Single Fire Event. The protection methods described in this standard shall assume a single fire event from a single fire source.

4.5* Shared Use by Freight Systems. Where passenger and freight systems are operated concurrently through or adjacent to stations and trainways, the design of the station and trainway life safety from fire and fire protection systems shall consider the hazards associated with both uses, as approved.

4.6* Fire Scenarios. Design scenarios shall consider the location and size of a fire or a fire-related emergency.

Chapter 5 Stations

5.1 General.

5.1.1 Occupancy.

5.1.1.1 The primary purpose of a station shall be for the use of the passengers who normally stay in a station structure for a period of time no longer than that necessary to wait for and enter a departing passenger-carrying vehicle or to exit the station after arriving on an incoming passenger-carrying vehicle.

5.1.1.2 Where contiguous commercial occupancies share common space with the station, or where the station is integrated into a building the occupancy of which is neither for fixed guideway transit nor for passenger rail, special considerations beyond this standard shall be necessary.

5.1.1.3 A station shall also be for the use of employees whose work assignments require their presence in the station structures.

5.2 Construction and Compartmentation.

5.2.1 Safeguards During Construction. During the course of construction or major modification of any structure, provisions of NFPA 241 shall apply.

5.2.2 Construction.

5.2.2.1 Building construction for all new enclosed stations shall be not less than Type I or Type II or combinations of Type I and Type II noncombustible construction as defined in NFPA 220, in accordance with the requirements of NFPA 101, Chapter 12, for

the station configuration or as determined by an engineering analysis of potential fire exposure hazards to the structure.

5.2.2.2 Other types of construction as defined in NFPA 220 shall be permitted for open stations in accordance with the provisions of NFPA 101, Chapter 12, for corresponding station configurations.

5.2.2.3 Where access for firefighting is restricted, standpipes sized for water flow and pressure for the maximum predicted construction fire load shall be installed to within 61 m (200 ft) of the most remote portion of the station. The flow and pressure required at the outlet shall be approved.

5.2.2.4* Illumination levels of enclosed stations shall not be less than 2.7 lx (0.25 ft-candles) at the walking surface.

5.2.3 Compartmentation.

5.2.3.1 Interconnected Floor Levels.

5.2.3.1.1* Stair and Escalator Enclosure. Stairs and escalators used by passengers shall not be required to be enclosed.

5.2.3.1.2 Open Stations. Public areas on different levels in open stations are permitted to be interconnected.

5.2.3.1.3 Enclosed Stations. Public areas on different levels in enclosed stations shall be permitted to be interconnected, provided fire separation is not required for smoke control or other fire protection purposes.

5.2.3.2* Separation Between Public and Nonpublic Floor Areas. All public areas shall be fire separated from adjacent nonpublic areas.

5.2.3.3 Ancillary Spaces. Fire resistance ratings of separations between ancillary occupancies shall be established as required by NFPA 101 in accordance with NFPA 251.

5.2.3.4* Agents' and Information Booths.

5.2.3.4.1 Agents' or information booths shall be constructed of noncombustible materials.

5.2.3.4.2 Booths used only as agents' and information booths shall not be required to be fire separated from public station areas.

5.2.3.5* Separation Between System and Nonsystem Occupancies. All station public areas shall be fire separated from adjacent non-system occupancies.

5.2.4 Seating Furniture. Seating furniture in stations shall be noncombustible, or it shall have limited rates of heat release when tested in accordance with ASTM E 1537, as follows:

- (1) The peak rate of heat release for the single seating furniture item shall not exceed 80 kW (270 kBTu/hr).
- (2) The total energy released by the single seating furniture item during the first 10 minutes of the test shall not exceed 25 MJ (23,700 Btu).

5.3 Ventilation. Emergency ventilation shall be provided in enclosed stations in accordance with Chapter 7.

5.4 Wiring Requirements.

5.4.1 All wiring materials and installations within stations other than for traction power shall conform to requirements of NFPA 70 and, in addition, shall satisfy the requirements of 5.4.2 through 5.4.9.

5.4.2 Conduits, raceways, ducts, boxes, cabinets, and equipment enclosures shall be constructed of noncombustible materials in accordance with the requirements of ASTM E 136.

5.4.2.1 Other materials when encased in concrete shall be acceptable.

5.4.3 All conductors shall be insulated.

5.4.3.1 Ground wire installed in a metallic raceway shall be insulated.

5.4.3.2 Other ground wires shall be permitted to be bare.

5.4.4 All insulations shall conform to *NFPA 70* and shall be moisture- and heat-resistant type carrying temperature ratings corresponding to either of the following conditions:

- (1) 75°C (167°F) for listed fire-resistive cables
- (2) 90°C (194°F) for all other applications

5.4.4.1 All insulated conductors and cables shall be listed for wet locations.

5.4.5 All wires and cables used shall be listed as being resistant to the spread of fire and shall have reduced smoke emissions, by complying with 5.4.5.1 or 5.4.5.2.

5.4.5.1 All wires and cables shall comply with the FT4/IEEE 1202 exposure requirements for cable char height, total smoke released, and peak smoke release rate of ANSI/UL 1685.

5.4.5.2 Wires and cables listed as having adequate fire-resistant and low-smoke-producing characteristics, by having a flame travel distance that does not exceed 1.5 m (5 ft) and generating a maximum peak optical density of smoke of 0.50 and a maximum average optical density of smoke of 0.15 when tested in accordance with NFPA 262 shall be permitted for use instead of the wires and cables specified in 5.4.5.1.

5.4.6 All conductors, except radio antennas, shall be enclosed in their entirety in armor sheaths, conduits, or enclosed raceways, boxes, and cabinets except in ancillary areas or other nonpublic areas.

5.4.6.1* Conductors in conduits or raceways shall be permitted to be embedded in concrete or run in concrete electrical duct banks, but they shall not be installed exposed or surface-mounted in air plenums unless cables are listed fire-resistive cables in accordance with 5.4.10.

5.4.7 Overcurrent elements that are designed to protect conductors serving emergency equipment motors (pumps, etc.), emergency lighting, and communications equipment that are located in spaces other than the main electrical distribution system equipment rooms shall not depend on thermal properties for operation.

5.4.8 The emergency lighting and communications circuits shall be protected from physical damage by system vehicles or other normal system operations and from fires in the system for a period of not less than 1 hour. The circuits shall be protected from ASTM E 119 fire conditions by any of the following:

- (1) Suitable embedment or encasement
- (2) Routing external to the interior underground portion of the system facility
- (3) Diversity in system routing (such as separate redundant or multiple circuits separated by a 1-hour fire barrier) so that a single fire or emergency event will not lead to a failure of the system
- (4) Be a listed fire-resistive cable system with a minimum 1-hour rating in accordance with 5.4.10

5.4.9 Power Supply for Emergency Ventilation Fans. See Chapter 7.

5.4.10 Fire-resistive cables shall be listed and have a minimum 1-hour fire-resistive rating in accordance with ANSI/UL 2196 and shall be installed per the listing requirements.

5.4.11 Emergency Power. Emergency power in accordance with Article 700 of *NFPA 70*, and Chapter 4 of NFPA 110 shall be provided for enclosed stations.

5.4.11.1 The supply system for emergency purposes, in addition to the normal services to the station building, shall be one or more of the types of systems described in subsections 700.12(A) through 700.12(E) of *NFPA 70*.

5.4.11.2 The emergency power system shall have a capacity and rating sufficient to supply all equipment required to be connected by 5.4.11.4.

5.4.11.3 Selective load pickup and load shedding shall be permitted in accordance with *NFPA 70*.

5.4.11.4 The following systems shall be connected to the emergency power system:

- (1) Emergency lighting
- (2) Protective signaling systems
- (3) Emergency communication system
- (4) Fire command center

5.5* Means of Egress.

5.5.1* General. The provisions for means of egress for a station shall comply with Chapter 7 and Chapter 12 of NFPA 101, except as herein modified.

5.5.1.1 For a station, the design of the means of egress shall be based on an emergency condition requiring evacuation of the train(s) and station occupants to a point of safety.

5.5.1.2 Stairs and escalators permitted by 5.2.3.1 to be unenclosed shall be permitted to be counted as contributing to the means of egress capacity in stations as detailed in 5.5.2 and 5.5.6.

5.5.1.3 Alternate Egress. At least two means of egress remote from each other shall be provided from each station platform.

5.5.1.3.1 Means of egress from separate platforms shall be permitted to converge.

5.5.1.3.2 Where means of egress routes from separate platforms converge, the subsequent capacity of the egress route shall be sufficient to maintain the required evacuation time from the incident platform.

5.5.1.4* Common Path of Travel. A common path of travel from the platform ends shall not exceed 25 m (82 ft) or one car length, whichever is greater.

5.5.1.5* Horizontal exits compliant with NFPA 101 shall be permitted for up to 100 percent of the number and required egress capacity provided that not more than 50 percent of the number and required capacity is into a single building.

5.5.2 Escalators. (See also Section C.2.)

5.5.2.1 Escalators shall be permitted as a means of egress in stations, provided the following criteria are met:

- (1)*The escalators shall be constructed of noncombustible materials.
- (2)*Escalators running in the direction of egress shall be permitted to remain operating.

- (3) Escalators running reverse to the direction of egress shall be capable of being stopped locally and remotely as follows:
 - (a) Locally by manual stopping device at the escalator
 - (b) Remotely by one of the following:
 - i. A manual stopping device at a remote location
 - ii. As part of a pre-planned evacuation response
- (4)*Where provision is made for remote stopping of escalators counted as means of egress, where one of the following shall apply:
 - (a) The stop shall be delayed until it is preceded by a minimum 15-second audible signal or warning message sounded at the escalator
 - (b) Where escalators are equipped with the necessary controls to decelerate in a controlled manner under the full rated load, the stop shall be delayed for at least 5 seconds before beginning deceleration and the deceleration rate shall be no greater than 0.052 m/sec^2 (0.17 ft./sec^2).
- (5) Where an audible signal or warning message is used, the following shall apply:
 - (a) The signal or message shall have a sound intensity that is at least 15 dBA above the average ambient sound level for the entire length of the escalator.
 - (b) The signal shall be distinct from the fire alarm signal.
 - (c) The warning message shall meet audibility and intelligibility requirements.

5.5.2.2 Escalators with or without intermediate landings shall be acceptable as a means of egress, regardless of vertical rise.

5.5.2.3 Escalators exposed to the outdoor environment shall be provided with slip-resistant landing and floor plates, and if they are exposed to freezing temperatures, the landing and floor plates and steps shall be heated to prevent the accumulation of ice and snow.

5.5.2.4 Stopped escalators shall be permitted to be started in the direction of egress in accordance with the requirements for stopping of escalators described in 5.5.2.1 (3), (4), and (5), provided that the escalators can be restarted in a fully loaded condition and that passengers are given warning.

5.5.3 Fare Collection Gates or Turnstiles. The design features of 5.5.3.1 and 5.5.3.2 shall be provided to facilitate the exit of passengers in the event of an emergency.

5.5.3.1 The fare gates or turnstiles shall assume an emergency exit mode in the event of loss of power to the fare gates or turnstiles or upon actuation of a manual or remote control.

5.5.3.2 Fare collection gates or turnstiles shall be designed so that their failure to operate properly will not prohibit movement of passengers in the direction of the emergency egress.

5.5.4 Platform Screen and Edge Doors. Horizontal sliding platform screen or platform edge doors shall be permitted to separate the platform from the trainway in stations, provided that the following criteria are met:

- (1) The doors permit emergency egress from the train to the platform regardless of the stopping position of the train.
- (2) The doors provide egress when a force not exceeding 220 N (50 lb) is applied from the train side of the doors.
- (3) The doors are designed to withstand positive and negative pressures caused by passing trains.

5.5.5 Occupant Load.

5.5.5.1* The occupant load for a station shall be based on the train load of trains simultaneously entering the station on all tracks in normal traffic direction plus the simultaneous entraining load awaiting trains.

5.5.5.2 The train load shall consider only one train at any one track.

5.5.5.2.1 The basis for calculating train and entraining loads shall be the peak period ridership figures as projected for design of a new system or as updated for an operating system.

5.5.5.3* For station(s) servicing areas such as civic centers, sports complexes, and convention centers, the peak ridership figures shall consider events that establish occupant loads not included in normal passenger loads.

5.5.5.4 At multilevel, multiline, or multiplatform stations, the maximum occupant load for each platform shall be considered separately for the purpose of sizing the means of egress from that platform.

5.5.5.4.1* At multilevel stations, multiline, or multiplatform simultaneous loads shall be considered for all egress routes passing through each level of that station.

5.5.5.5 Where an area within a station is intended for use by other than passengers or employees, the occupant load for that area shall be determined in accordance with the provisions of NFPA 101 as appropriate for the class of occupancy.

5.5.5.5.1 The additional occupant load shall be included in determining the required egress from that area.

5.5.5.5.2 The additional occupant load shall be permitted to be omitted from the station occupant load when the area has independent means of egress of sufficient number and capacity.

5.5.5.6* Calculation of Platform Occupant Load. The platform occupant load for each platform in a station shall be the maximum peak period loads calculated according to 5.5.5.6.1 through 5.5.5.6.4.

5.5.5.6.1 The peak period occupant load for each platform shall be based on the simultaneous evacuation of the entraining load and the train load for that platform in the peak period.

5.5.5.6.2 The entraining load for each platform shall be the sum of the entraining loads for each track serving that platform.

5.5.5.6.2.1* The entraining load for each track shall be based on the entraining load per train headway factored to account for service disruptions and system reaction time.

5.5.5.6.2.2* Where a platform serves more than one line on one track, the calculation of entraining load shall consider the combined effect of accumulation for each of the lines served.

5.5.5.6.3 The train load for each platform shall be the sum of the train loads for each track serving that platform.

5.5.5.6.3.1 The maximum train load for each track shall be based on the train load per train headway factored to account for service disruptions and system reaction time.

5.5.5.6.4 The maximum train load at each track shall be the maximum passenger capacity for the largest capacity train operating on that track during the peak period.



5.5.6* Number and Capacity of Means of Egress.

5.5.6.1* Platform Evacuation Time. There shall be sufficient egress capacity to evacuate the platform occupant load as defined in 5.5.5.6 from the station platform in 4 minutes or less.

5.5.6.1.1 The maximum travel distance on the platform to a point at which a means of egress route leaves the platform shall not exceed 100 m (325 ft).

5.5.6.1.2* Modification of the evacuation time and travel distance shall be permitted based on an engineering analysis by evaluating material heat release rates, station geometry, and emergency ventilation systems.

5.5.6.2* Evacuation Time to a Point of Safety. The station also shall be designed to permit evacuation from the most remote point on the platform to a point of safety in 6 minutes or less.

5.5.6.2.1 For open stations where the concourse is below or protected from the platform by distance or materials as determined by an appropriate engineering analysis, that concourse shall be permitted to be defined as a point of safety.

5.5.6.2.2 For enclosed stations equipped with an emergency ventilation system designed in accordance with Chapter 7, where the emergency ventilation system provides protection for the concourse from exposure to the effects of a train fire at the platform as confirmed by engineering analysis, that concourse is permitted to be defined as a point of safety.

5.5.6.2.3* Modification of the evacuation time shall be permitted based on an engineering analysis by evaluating material heat release rates, station geometry, and emergency ventilation systems.

5.5.6.3 Capacity of Means of Egress Components. The capacity of the means of egress shall be computed in persons per millimeter per minute (p/mm-min) [persons per inch per minute (pim)], and passenger travel speeds in meters per minute (m/min) [feet per minute (fpm)] in accordance with 5.5.6.3.1 through 5.5.6.3.4.

5.5.6.3.1 Platforms, Corridors, and Ramps.

5.5.6.3.1.1 A minimum clear width of 1120 mm (44 in.) shall be provided along all platforms, corridors, and ramps serving as means of egress.

5.5.6.3.1.2* In computing the means of egress capacity available on platforms, corridors, and ramps, 300 mm (12 in.) shall be deducted at each sidewall and 450 mm (18 in.) at open platform edges.

5.5.6.3.1.3 The maximum means of egress capacity of platforms, corridors, and ramps shall be computed at 0.0819 p/mm-min (2.08 pim).

5.5.6.3.1.4 The maximum means of egress travel speed along platforms, corridors, and ramps shall be computed at 38 m/min (124 fpm).

5.5.6.3.1.5* The means of egress travel speed for concourses and other areas where a lesser pedestrian density is anticipated shall be computed at 61.0 m/min (200 fpm).

5.5.6.3.2 Stairs and Escalators.

5.5.6.3.2.1 Stairs in the means of egress shall be a minimum of 1120 mm (44 in.) wide.

5.5.6.3.2.2* Escalators shall be permitted to be used as a means of egress.

5.5.6.3.2.3* Capacity and travel speed for stairs and escalators shall be computed as follows:

- (1) Capacity — 0.0555 p/mm-min (1.41 pim)
- (2)*Travel speed — 15 m/min (48 fpm) (indicates vertical component of travel speed)

5.5.6.3.2.4* Escalators shall not account for more than half of the means of egress capacity at any one level.

5.5.6.3.2.5 Escalators shall be permitted to account for more than one-half of the required means of egress capacity at any one level where the following criteria are met:

- (1) The escalators are capable of being remotely brought to a stop in accordance with the requirements of 5.5.2.1(3)(b), 5.5.2.1(4), and 5.5.2.1(5).
- (2) A portion of the means of egress capacity from each station level is comprised of stairs.
- (3) For enclosed stations, at least one enclosed exit stair or exit passageway shall provide continuous access from the platforms to the public way.

5.5.6.3.2.6* In calculating the egress capacity of escalators, one escalator at each level shall be considered as being out of service.

5.5.6.3.2.7 The escalator chosen shall be the one having the most adverse effect upon egress capacity.

5.5.6.3.3 Elevators.

5.5.6.3.3.1 Elevators meeting the requirements of sections 5.5.6.3.3.2 through 5.5.6.3.3.4 shall be permitted to account for part of the means of egress capacity in stations.

5.5.6.3.3.2 Capacity and Numbers. Where elevators are counted as contributing to the means of egress capacity, the following shall apply:

- (1) They shall comprise no more than 50 percent of the required egress capacity.
- (2)*At least one elevator shall be considered out of service, and one elevator shall be reserved for fire service.
- (3)*The capacity of each elevator shall be the carrying capacity of the elevator within 30 minutes.

5.5.6.3.3.3 Holding Area. Elevators counted as contributing to the means of egress capacity shall be accessed via holding areas or lobbies that shall be designed as follows:

- (1) The holding areas or lobbies shall be separated from the platform by a smoke-tight fire separation having a fire resistance rating of at least 1 hour, but not less than the time required to evacuate the holding area occupant load.
- (2) At least one stair shall be accessible from the holding area.
- (3) The holding area shall be sized to accommodate one person per 0.46 m² (5 ft²).
- (4) If the holding area includes portions of the platform, the area within 460 mm (18 in.) of the trainway shall not be considered in the calculation.
- (5) Upon activation of smoke control in the platform or adjacent trainway areas, the holding area shall be pressurized to a minimum of 25 Pa (or 0.051 in. of water gauge).
- (6) The holding area shall be provided with emergency voice alarm devices with two-way communication to the system operations control center.

5.5.6.3.3.4 Design Features. Elevators counted as contributing to the means of egress capacity shall be designed as follows:

- (1) Shaft enclosures shall be constructed as smoketight fire separations having a 2-hour fire resistance rating.
- (2)*The design shall limit water flow into the shaft.

- (3) No more than two elevators used for means of egress or fire department access shall share the same machine room.
- (4) Machine rooms shall be separated from each other by fire separations having a minimum fire resistance rating of 2 hours.
- (5) The elevators shall be connected to emergency power.
- (6)*During emergency evacuation, the elevators shall travel only between the incident platform level and a point of safety.

5.5.6.3.4 Doors, Gates, and Exit Hatches.

5.5.6.3.4.1 Doors and gates in the means of egress shall have a minimum clear width of 910 mm (36 in.).

5.5.6.3.4.2 The maximum means of egress capacity for doors and gates shall be computed as follows:

- (1) 60 people per minute (ppm) for single leaf doors and gates
- (2)*0.0819 p/mm-min (2.08 pim) for bi-parting multileaf doors and gates measured for the clear width dimension.

5.5.6.3.4.3 Emergency exit gates shall be in accordance with NFPA 101.

5.5.6.3.4.4* Gate-type exits shall be provided for at least 50 percent of the required emergency exit capacity unless fare collection equipment provides unobstructed exiting under all conditions.

5.5.6.3.4.5 Where used, exit hatches shall comply with the requirements of 6.2.2.5.

5.5.6.3.5 Fare Collection Equipment.

5.5.6.3.5.1 Gate-type fare collection equipment shall meet the following criteria:

- (1) They shall provide a minimum of 450 mm (18 in.) clear width at and below a height of 960 mm (38 in.) and 710 mm (28 in.) clear width above a height of 960 mm (38 in.) when deactivated.
- (2) Consoles shall not exceed 1010 mm (40 in.) in height.
- (3) They shall have a capacity of 50 ppm for egress calculations.

5.5.6.3.5.2 Turnstile-type fare collection equipment shall be permitted in accordance with NFPA 101 and shall account for a capacity of 25 ppm for egress calculations.

5.5.6.3.5.3 Electronically operated fare collection equipment in the required means of egress shall be designed to release, permitting unimpeded travel in the direction of egress upon the following conditions:

- (1) Power failure or ground fault condition
- (2) Activation of the station fire alarm signal
- (3) Manual activation from a switch in a constantly attended location in the station or operations control center

5.6 Emergency Lighting.

5.6.1 Illumination of the means of egress in stations shall be in accordance with Section 7.8 of NFPA 101, except as otherwise noted in this standard.

5.6.2 Means of egress shall be provided with a system of emergency lighting in accordance with Section 7.9 of NFPA 101, except as otherwise noted in this standard.

5.6.2.1 Emergency lighting for stairs and escalators shall be designed to emphasize illumination on the top and bottom steps and landings.

5.6.2.2 All newel- and comb-lighting on escalator steps shall be on emergency power circuits.

5.7 Fire Protection.

5.7.1 Protective Signaling Systems.

5.7.1.1 Stations equipped with fire alarm devices shall be protected by a proprietary system as defined in NFPA 72.

5.7.1.2* Each station having fire alarm initiating devices shall be provided with a fire alarm annunciator panel at a location that is accessible to emergency response personnel in accordance with NFPA 72.

5.7.1.2.1 The location of the fire alarm annunciator panel shall be approved.

5.7.1.2.2 Annunciator panels shall announce by audible alarm the activation of any fire alarm-initiating device in the station and visually display the location of the actuated device.

5.7.1.3 When activated, all indicator signals for fire alarms, smoke detection, valve switches, and waterflow shall be transmitted simultaneously to the local station and to the operations control center.

5.7.1.4* Separate zones shall be established on local station annunciator panels to monitor waterflow on sprinkler systems and supervise main control valves.

5.7.1.5 Automatic fire detection shall be provided in all ancillary spaces by the installation of listed combination fixed-temperature and rate-of-rise heat detectors or listed smoke detectors except where protected by automatic sprinklers.

5.7.2 Emergency Communication.

5.7.2.1 A public address (PA) system and emergency voice alarm reporting devices, such as emergency telephone boxes or manual fire alarm boxes conforming to NFPA 72, shall be required in stations.

5.7.2.2 The operations control center and each system station shall be equipped with an approved emergency voice/alarm communication system so that appropriate announcements can be made regarding fire alarms, including provisions for giving necessary information and directions to the public upon receipt of any manual or automatic fire alarm signal.

5.7.2.2.1 These notification devices shall be placed in approved locations at each facility.

5.7.2.3 Emergency alarm reporting devices shall be located on passenger platforms and throughout the stations such that the travel distance from any point in the public area shall not exceed 100 m (325 ft) unless otherwise approved.

5.7.2.3.1 Such emergency devices shall be distinctive in color, and their location shall be plainly indicated by appropriate signs.

5.7.3 Automatic Sprinkler Systems.

5.7.3.1 An automatic sprinkler protection system shall be provided in areas of stations used for concessions, in storage areas, in trash rooms, and in the steel truss area of all escalators and other similar areas with combustible loadings, except trainways.

5.7.3.1.1 Sprinkler protection shall be permitted to be omitted in areas of open stations remotely located from public spaces.

5.7.3.2 Installation of sprinkler systems shall comply with NFPA 13 or applicable local codes as required.



5.7.3.3 A sprinkler system waterflow alarm and supervisory signal service shall be installed.

5.7.3.4 Other fire suppression systems, if approved, shall be permitted to be substituted for automatic sprinkler systems in the areas listed in 5.7.3.1.

5.7.3.5 Automatic fire sprinkler systems shall be tested and maintained in accordance with NFPA 25.

5.7.4 Standpipe and Hose Systems.

5.7.4.1 Class I or Class III standpipes shall be installed in enclosed stations in accordance with NFPA 14 except as modified herein.

5.7.4.1.1 Standpipe systems shall not be required to be enclosed in fire-rated construction provided the following conditions are met:

- (1) The system is cross-connected or fed from two locations.
- (2) Isolation valves are installed not more than 245 m (800 ft) apart.

5.7.4.2 In addition to the usual identification required on fire department connections for standpipes, there shall also be wording to identify the fire department connection as part of the station system.

5.7.4.3 Where underground stations include more than one platform level (such as crossover subway lines), there shall be a cross-connection pipe of a minimum size of 100 mm (4 in.) in diameter between each standpipe system, so that supplying water through any fire department connection will furnish water throughout the entire system.

5.7.4.4 Standpipe and hose systems shall be tested and maintained in accordance with NFPA 25.

5.7.5 Portable Fire Extinguishers. Portable fire extinguishers in such number, size, type, and location as determined by the authority having jurisdiction shall be provided.

5.7.5.1 Portable fire extinguishers shall be maintained in accordance with NFPA 10.

5.7.6* Fire Command Center.

5.7.6.1 Underground stations shall be provided with a fire command center in accordance with NFPA 72.

5.7.6.2 The ventilation systems at adjacent tunnels and stations shall be permitted to be omitted from the controls of the fire command center.

5.8 Storage Tanks and Service Stations.

5.8.1 Aboveground storage tanks above subsurface stations shall meet the requirements of 6.6.4.

5.8.2 Underground storage tanks above subsurface station structures shall meet the requirements of 6.6.5.

5.8.3 Service stations above subsurface station structures shall meet the requirements of 6.6.6.

5.8.4 Existing storage tanks in or under buildings shall meet the requirements of 6.6.7.

5.9 Interior Finish.

5.9.1 Enclosed Stations.

5.9.1.1 Interior wall and ceiling finish materials in enclosed stations shall comply with one of the following:

- (1) Interior wall and ceiling finish materials shall be noncombustible materials.

- (2) Interior wall and ceiling finish materials, other than textile wall coverings or foam plastic insulation, shall exhibit a flame spread index not exceeding 25 and a smoke developed index not exceeding 450, when tested by ASTM E 84.

5.9.1.2 Interior wall and ceiling finish materials, when tested in accordance with NFPA 286, shall comply with the following:

- (1) Flames shall not spread to the ceiling during the 40 kW (135 kBTu/hr) exposure.
- (2) During the 160 kW (545 kBTu/hr) exposure, the following criteria shall be met:
 - (a) Flame shall not spread to the outer extremities of the sample on the 2.45 m × 3.7 m (8 ft × 12 ft) wall.
 - (b) The peak heat release rate shall not exceed 800 kW (2730 kBTu/hr).
 - (c) Flashover shall not occur.
- (3) The total smoke released throughout the test shall not exceed 1000 m² (10,764 ft²).

5.9.1.3 Interior Floor Finish. Interior floor finish materials in enclosed stations shall be noncombustible or shall exhibit a critical radiant flux not less than 0.8 W/cm² when tested in accordance with ASTM E 648.

5.9.2 Open Stations.

5.9.2.1 Interior finish in open stations shall comply with the requirements of NFPA 101, Chapter 12.

5.10 Rubbish Containers. Rubbish containers shall be manufactured of noncombustible materials.

5.11* Combustible Furnishings and Contents. Where combustible furnishings or contents not specifically addressed in this standard are installed in a station, a fire hazard analysis shall be conducted to determine that the level of occupant fire safety is not adversely affected by the furnishings and contents.

Chapter 6 Trainways

6.1* Applicability. This chapter applies to all portions of the trainway, including pocket storage and tail tracks not intended for occupancy by passengers.

6.2 Egress and Emergency Access.

6.2.1 General.

6.2.1.1* The system shall incorporate a walk surface or other approved means for passengers to evacuate a train at any point along the trainway so that they can proceed to the nearest station or other point of safety.

6.2.1.2 System egress points shall be illuminated.

6.2.1.3 Where the trainway track bed serves as the emergency egress pathway, it shall be nominally level and free of obstructions.

6.2.1.4 Walking surfaces shall have a uniform, slip-resistant design.

6.2.1.5 In areas where cross-passageways are provided, walkways shall be provided on the cross-passageway side of the trainway for unobstructed access to the cross-passageway.

6.2.1.6 Crosswalks shall be provided at track level to ensure walkway continuity.

6.2.1.7 Crosswalks shall have uniform walking surface at the top of the rail.

6.2.1.8 Walkway continuity shall be maintained at special track sections (e.g., crossovers, pocket tracks).

6.2.1.9* The means of egress within the trainway shall be provided with an unobstructed clear width graduating from the following:

- (1) 610 mm (24 in.) at the walking surface to
- (2) 760 mm (30 in.) at 1420 mm (56 in.) above the walking surface and to
- (3) 610 mm (24 in.) at 2025 mm (80 in.) above the walking surface

6.2.1.10* Guards.

6.2.1.10.1 Raised walkways that are more than 760 mm (30 in.) above the floor or grade below shall be provided with a continuous guard to prevent falls over the open side.

6.2.1.10.2 Guards shall not be required along the trainway side of raised walkways where the bottom of the trainway is closed by a deck or grating.

6.2.1.10.3 Guards shall not be required on raised walkways that are located between two trainways.

6.2.1.11* Handrails.

6.2.1.11.1 Raised walkways shall be provided with a continuous handrail along the side opposite the trainway.

6.2.1.11.2 Raised walkways that are greater than 1120 mm (44 in.) wide and located between two trainways shall not be required to have a handrail.

6.2.1.12 Passengers shall enter the trainways only in the event that it becomes necessary to evacuate a train.

6.2.1.13 Evacuation shall take place only under the guidance and control of authorized, trained system employees or other authorized personnel as warranted under an emergency situation.

6.2.2 Means of Egress Underground.

6.2.2.1 General. Exit stairs and doors shall comply with Chapter 7 of NFPA 101, except as herein modified.

6.2.2.2* Number and Location of Means of Egress Routes.

6.2.2.2.1 Within underground or enclosed trainways, the maximum distance between exits shall not exceed 762 m (2500 ft).

6.2.2.2.2 For exit stairs serving underground or enclosed trainways, the width of exit stairs shall not be required to exceed 1120 mm (44 in.).

6.2.2.3 Cross-Passageways.

6.2.2.3.1 Cross-passageways shall be permitted to be used in lieu of emergency exit stairways to the surface where trainways in tunnels are divided by a minimum of 2 hour-rated fire walls or where trainways are in twin bores.

6.2.2.3.2 Where cross-passageways are utilized in lieu of emergency exit stairways, the following shall apply:

- (1) Cross-passageways shall not be farther than 244 m (800 ft) apart.
- (2)*Cross-passageways shall not be farther than 244 m (800 ft) from the station or tunnel portal.

(3) Cross-passageways shall be a minimum of 1120 mm (44 in.) in clear width and 2100 mm (7 ft) in height.

(4) Openings in open passageways shall be protected with fire door assemblies having a fire protection rating of 1½ hours with a self-closing fire door.

(5) A tenable environment shall be maintained in that portion of the trainway that is not involved in an emergency and that is being used for evacuation.

(6) A ventilation system for the contaminated tunnel shall be designed to control smoke in the vicinity of the passengers.

(7) Provisions shall be made for evacuating passengers via the non-incident trainway to a nearby station or other emergency exit.

(8)*The provisions shall include measures to protect passengers from oncoming traffic and from other hazards.

6.2.2.4 Doors.

6.2.2.4.1 Doors in the means of egress, except cross-passageway doors, shall open in the direction of exit travel.

6.2.2.4.2 Doors in the means of egress shall comply with the following:

- (1) Open fully when a force not exceeding 220 N (50 lb) is applied to the latch side of the door
- (2) Be adequate to withstand positive and negative pressures caused by passing trains and tunnel ventilation system

6.2.2.4.3* Doors in egress routes serving trainways shall have a minimum clear width of 810 mm (32 in.).

6.2.2.4.4 Horizontal sliding doors shall be permitted in cross-passageways.

6.2.2.5 Exit Hatches.

6.2.2.5.1 Exit hatches shall be permitted in the means of egress, provided the following conditions are met:

- (1) Hatches shall be equipped with a manual opening device that can be readily opened from the egress side.
- (2) Hatches shall be operable with not more than one releasing operation.
- (3) The force required to open the hatch when applied at the opening device shall not exceed 130 N (30 lb).
- (4) The hatch shall be equipped with a hold-open device that automatically latches the door in the open position to prevent accidental closure.

6.2.2.5.2 Exit hatches shall be capable of being opened from the discharge side to permit access by authorized personnel.

6.2.2.5.3* Exit hatches shall be conspicuously marked on the discharge side to prevent possible blockage.

6.2.3 Surface and Elevated Emergency Access.

6.2.3.1 Surface.

6.2.3.1.1 If security fences are used along the trainway, access gates shall be provided in security fences, as deemed necessary by the authority having jurisdiction.

6.2.3.1.2 Access gates shall be a minimum of 1120 mm (44 in.) wide and shall be of the hinged or sliding type.

6.2.3.1.3 Access gates shall be placed as close as practical to the portals to permit easy access to tunnels.

6.2.3.1.4 Information that clearly identifies the route and location of each gate shall be provided on the gates or adjacent thereto.

