

NFPA 502

Standard for Road Tunnels, Bridges, and Other Limited Access Highways

2004 Edition



NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
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Standard for
Road Tunnels, Bridges, and Other Limited Access Highways
2004 Edition

This edition of NFPA 502, *Standard for Road Tunnels, Bridges, and Other Limited Access Highways*, was prepared by the Technical Committee on Road Tunnel and Highway Fire Protection and acted on by NFPA at its May Association Technical Meeting held May 23–26, 2004, in Salt Lake City, UT. It was issued by the Standards Council on July 16, 2004, with an effective date of August 5, 2004, and supersedes all previous editions.

This edition of NFPA 502 was approved as an American National Standard on August 5, 2004.

Origin and Development of NFPA 502

A tentative standard, NFPA 502T, *Standard for Limited Access Highways, Tunnels, Bridges and Elevated Structures*, was prepared by the Technical Committee on Motor Vehicle Fire Protection and was adopted by the National Fire Protection Association on May 16, 1972, at its Annual Meeting in Philadelphia, PA. It was withdrawn in November 1975. In 1980, the committee rewrote the document as a recommended practice and included a chapter on air-right structures. It was adopted at the 1981 NFPA Annual Meeting.

Minor revisions to Chapters 2 through 5, primarily to water supply and fire apparatus requirements, were made in the 1987 edition.

The recommended practice was reconfirmed in 1992.

The 1996 edition incorporated a totally revised chapter on tunnels. Other revisions were made to correlate the new material in tunnel and air-right structure requirements with existing chapters and to update NFPA 502 with respect to current technology and practices.

The 1998 edition was developed by a task group appointed by the chairman of the Technical Committee on Motor Vehicle and Highway Fire Protection.

With the planned revision from a recommended practice to a standard, the task group reviewed and completely revised all chapters of the document, with special emphasis on incorporating the lessons learned following completion of the full-scale fire ventilation test program at the Memorial Tunnel in West Virginia. Specific to the Memorial Tunnel Fire Ventilation Test Program, changes were made to Chapter 7, “Tunnel Ventilation During Fire Emergencies.” The title of the standard was also changed to more accurately reflect the contents and to properly identify the major focus of the standard. The previous title, *Recommended Practice on Fire Protection for Limited Access Highways, Tunnels, Bridges, Elevated Roadways, and Air Right Structures*, was changed to *Standard for Road Tunnels, Bridges, and Other Limited Access Highways*.

The 2001 edition contained a significant editorial rewrite and reorganization of the document.

Technical changes regarding emergency communication, emergency egress and lighting in tunnels, and tunnel ventilation were incorporated into that edition. Further changes were made to clarify the application of this standard based on tunnel length.

The 2004 edition includes new requirements for the protection of concrete and steel tunnel structures, specific requirements for emergency lighting, and clarification of the travel distance to emergency exits in tunnels. This edition also updates the vehicle tunnel fire data in Annex A to more recent international research.

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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 on fire prevention and fire protection measures to reduce loss of life and property damage for road tunnels, air-right structures, bridges, and limited access highways. Excluded from this scope is the protection for facilities for the storage, repair, and parking of motor vehicles.

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Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

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 mandatory extracts are given in Chapter 2 and those for nonmandatory extracts are given in Annex J. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. 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 J.

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard provides fire protection and fire life safety requirements for limited access highways, road tunnels, bridges, elevated highways, depressed highways, and roadways that are located beneath air-right structures.

1.1.2 This standard establishes minimum requirements for each of the identified facilities.

1.1.3 This standard does not apply to the following facilities:

- (1) Parking garages
- (2) Bus terminals
- (3) Truck terminals
- (4) Any other facility in which motor vehicles travel or are parked

1.1.4 This standard is applicable where a facility, including those specified in 1.1.3(1) through (4), is deemed appropriate by the authority having jurisdiction.

1.2 Purpose. The purpose of this standard is to establish minimum criteria that provide protection from fire and its related hazards.

1.3 Application.

1.3.1* The provisions of this standard are necessary to provide protection from loss of life and property from fire.

1.3.2 The authority having jurisdiction determines the application of this standard to facility alterations and fire protection system upgrades.

1.3.3 The portion of this standard that covers emergency procedures applies to both new and existing facilities.

1.4 Retroactivity. The provisions of this standard reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this standard at the time the standard was issued.

1.4.1 Unless otherwise specified, the provisions of this standard shall not apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the standard. Where specified, the provisions of this standard shall be retroactive.

1.4.2 In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.4.3 The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, and only where it is clearly evident that a reasonable degree of safety is provided.

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 over those prescribed by this standard.

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

1.5.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.6 Units.

1.6.1* Metric units of measure in this standard are in accordance with the modernized metric system known as the International System of Units (SI). The liter unit (L), which is outside of but recognized by SI, is commonly used in the international fire protection industry. The appropriate units and conversion factors are specified in Table A.1.6.1.

1.6.2 If a value for measurement as provided 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 can be an approximation.

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*, 2002 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2002 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2003 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2003 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 2003 edition.

NFPA 70, *National Electrical Code*®, 2005 edition.

NFPA 72®, *National Fire Alarm Code*®, 2002 edition.

NFPA 80, *Standard for Fire Doors and Fire Windows*, 1999 edition.

NFPA 101®, *Life Safety Code*®, 2003 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems*, 2002 edition.

NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, 2001 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, 2004 edition.

NFPA 820, *Standard for Fire Protection in Wastewater Treatment and Collection Facilities*, 2003 edition.

NFPA 1561, *Standard on Emergency Services Incident Management System*, 2002 edition.

NFPA 1963, *Standard for Fire Hose Connections*, 2003 edition.

2.3 Other Publications.

2.3.1 ASTM Publication. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, 1997.

2.3.2 The Port Authority of New York and New Jersey Publication. The Port Authority of New York and New Jersey, 225 Park Avenue South, 18th Floor, New York, NY 10003-1604.

Hazardous Material Transportation Regulations at Tunnel and Bridge Facilities, November 23, 1987.

2.3.3 U.S. Department of Transportation Publications. U.S. Department of Transportation, 400 7th Street SW, Washington, DC 20590.

Title 49, *Code of Federal Regulations*, Part 177.825, "Routing and Training Requirements for Class 7 (Radioactive) Materials."

Title 49, *Code of Federal Regulations*, Subtitle B, Parts 100–199.

Title 49, *Code of Federal Regulations*, Part 397, Subpart C, "Routing of Non-Radioactive Hazardous Materials."

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 included, common usage of the terms shall apply.

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 require-

ments 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.

3.2.7 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 Agency. The organization legally established and authorized to operate a facility.

3.3.2 Alteration. A modification, replacement, or other physical change to an existing facility.

3.3.3 Alternative Fuel. A motor vehicle fuel other than gasoline and diesel.

3.3.4 Ancillary Facility(ies). A structure(s) usually used to house or contain operating, maintenance, or support equipment and functions.

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

3.3.6 Bridge. A structure spanning and providing a highway across an obstacle such as a waterway, railroad, or another highway.

3.3.7* Building. Any structure used or intended for supporting or sheltering any use or occupancy.

3.3.8 Central Supervising Station (CSS). A dedicated operations center where the agency controls and coordinates the facility operations and from which communication is maintained with the agency's supervisory and operating personnel and with participating agencies where required.

3.3.8.1 Alternate Central Supervising Station. A prearranged location that is equipped, or that can quickly be equipped, to function as the central supervising station in the event the central supervising station is inoperative, untenable, or inaccessible for any reason.

3.3.9 Combustible. Capable of undergoing combustion.

3.3.10 Command Post. The location at the scene of an emergency where the incident commander is located and where command, coordination, control, and communications are centralized. [402:3.3]

3.3.11 Communications. Radio, telephone, and messenger services throughout the facility and particularly at the central supervising station and command post.

3.3.12 Control Valve. A valve controlling flow to water-based fire protection systems. Control valves do not include hose valves, inspector's test valves, drain valves, trim valves for dry pipe, preaction and deluge valves, check valves, or relief valves. [25:3.3]

3.3.13 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.

3.3.14 Design Fire. A fire's heat-release rate, in megawatts, designated in conjunction with the authority having jurisdiction as the design fire size.

3.3.15 Dry Standpipe. A standpipe system that is designed to contain water only while the system is being used.

3.3.16 Dynamic Vehicle Envelope. The space within the tunnel roadway that is allocated for maximum vehicle movement.

3.3.17 Emergency Response Plan. A plan developed by an agency, with the cooperation of all participating agencies, that details specific actions to be performed by all personnel who are expected to respond during an emergency.

3.3.18* Engineering Analysis. An analysis that evaluates all factors that affect the fire safety of a facility or a component of a facility.

3.3.19 Facility. A limited access highway, road tunnel, bridge, or elevated highway.

3.3.20 Fire Apparatus. A vehicle designed to be used under emergency conditions to transport personnel and equipment, and to support the suppression of fires and mitigation of other hazardous situations. [1901:3.3]

3.3.21 Fire Department Connection. A connection through which the fire department can pump supplemental water into the sprinkler system, standpipe, or other system, furnishing water for fire extinguishment to supplement existing water supplies.

3.3.22 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.

3.3.23 Highway. Any paved facility on which motor vehicles travel.

3.3.23.1* Depressed Highway. An uncovered, below-grade highway or boat section where walls rise to the grade surface and where emergency response access is usually limited.

3.3.23.2 Elevated Highway. A highway that is constructed on a structure that is above the surface but that does not cross over an obstacle as in the case of a bridge.

3.3.23.3 Limited Access Highway. A highway where preference is given to through-traffic by providing access connections that use only selected public roads and by prohibiting crossings at grade and at direct private driveways.

tions that use only selected public roads and by prohibiting crossings at grade and at direct private driveways.

3.3.24 Hose Connection. A combination of equipment provided for the connection of a hose to a standpipe system that includes a hose valve with a threaded outlet.

3.3.25 Hose Valve. The valve to an individual hose connection.

3.3.26 Incident Commander. The person who is responsible for all decisions relating to the management of the incident and is in charge of the incident site. [472:3.3]

3.3.27 Length of Tunnel. The length from face of portal to face of portal that is measured using the centerline alignment along the tunnel roadway.

3.3.28 Motorist. A motor vehicle occupant, including the driver and passenger(s).

3.3.29 Noncombustible Material. A substance that will not ignite and burn when subjected to a fire. [220:2.1]

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

3.3.31* Point of Safety. An enclosed fire exit that leads to a public way or safe location outside the structure; or an at-grade point beyond any enclosing structure; or another area that affords adequate protection for motorists.

3.3.32 Portable Fire Extinguisher. A portable device, carried or on wheels and operated by hand, containing an extinguishing agent that can be expelled under pressure for the purpose of suppressing or extinguishing fire. [10:3.3]

3.3.33 Portal. The interface between a tunnel and the atmosphere through which vehicles pass; a connection point to an adjacent facility.

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

3.3.35 Queue. A line of stored vehicles.

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

3.3.37 Road Tunnel. An enclosed roadway for motor vehicle traffic with vehicle access that is limited to portals.

3.3.38 Roadway. The volume of space that is located above the pavement surface through which motor vehicles travel.

3.3.39 Structure. That which is built or constructed and limited to buildings and non-building structures as defined herein. [5000:3.3]

3.3.39.1* Air-Right Structure. A structure other than a skywalk bridge that is built over a roadway using the roadway's air rights. [5000:3.3]

Chapter 4 General Requirements

4.1* Characteristics of Fire Protection. The level of fire protection necessary for the entire facility shall be achieved by implementing the requirements of this standard for each subsystem.

4.2 Safeguards During Construction. During the course of construction or alteration of any facility addressed in this standard, the provisions of NFPA 241 shall apply.

4.3 Fire Protection and Fire Life Safety Factors.

4.3.1 As a minimum the following factors shall be evaluated in an engineering analysis and where applying the fire and life safety requirements for the facilities covered by this standard:

- (1) Protection of life
- (2) Restricted vehicle access and egress
- (3) Fire emergencies ranging from minor incidents to major catastrophes
- (4) Fire emergencies occurring at one or more locations
- (5) Fire emergencies occurring in remote locations at a long distance from emergency response facilities
- (6) Exposure of structure to elevated temperatures
- (7) Traffic congestion and control during emergencies
- (8) Built-in fire protection features, such as the following:
 - (a) Fire alarm systems
 - (b) Standpipe systems
 - (c) Sprinkler systems
 - (d) Ventilation systems
- (9) Protection of facility components
- (10) Evacuation and rescue requirements
- (11) Emergency response time
- (12) Separate emergency vehicle access points
- (13) Emergency communications to appropriate agencies
- (14) Protection of vehicles and property being transported
- (15) Facility location, such as the following:
 - (a) Urban
 - (b) Rural
- (16) Physical dimensions

4.3.2* Limited Access Highways. Fire protection for limited access highways shall comply with the requirements of Chapter 5.

4.3.3 Bridges and Elevated Highways.

4.3.3.1* Critical structural members shall be protected from collision and high-temperature exposure that can result in dangerous weakening or complete collapse of the bridge or elevated highway.

4.3.3.2 Fire protection for bridges and elevated highways shall comply with the requirements of Chapter 6.

4.3.4* Depressed Highways.

4.3.4.1 Standpipe systems or fire extinguishers, or both, shall be installed on depressed highways where physical factors prevent or impede access to the water supply or fire apparatus.

4.3.4.2 Additional requirements for fire protection of depressed highways are described in Chapter 8.

4.3.5* Road Tunnels. Fire protection for road tunnels shall comply with the requirements of Chapter 7.

4.3.6* Roadway Beneath Air-Right Structures.

4.3.6.1 The limits that an air-right structure imposes on the emergency accessibility and function of the roadway that is located beneath the structure shall be assessed.

4.3.6.2 Where an air-right structure encloses both sides of a roadway, it shall be considered a road tunnel for fire protection purposes and shall comply with the requirements of Chapter 7.

4.3.6.3 Where an air-right structure does not fully enclose the roadway on both sides, the decision to consider it as a road tunnel shall be made by the authority having jurisdiction after an engineering analysis in accordance with 4.3.1.

4.3.6.4 Fire protection for roadways that are located beneath air-right structures shall comply with the requirements of Chapter 8.

Chapter 5 Limited Access Highways

5.1 General. This chapter shall provide fire protection requirements for limited access highways.

5.2 Emergency Communications. Emergency communications, where required by the authority having jurisdiction, shall be provided by the installation of outdoor-type telephone boxes, coded alarm telegraph stations, radio transmitters, or other approved devices. Such devices shall meet the following requirements:

- (1) They shall be made conspicuous by means of indicating lights or other approved markers.
- (2) They shall be identified by a readily visible number plate or other approved device.
- (3) They shall be posted with instructions for use by motorists.
- (4) They shall be located in approved locations so that motorists can park vehicles clear of the travel lanes.
- (5) Emergency communication devices shall be protected from physical damage from vehicle impact.
- (6) Emergency communication devices shall be connected to a staffed or monitored facility.

5.3 Signage. Signs, mile markers, or other approved location reference markers shall be installed along the highway to allow motorists to provide authorities with accurate locations for accident or emergency areas.

5.4* Fire Apparatus.

5.4.1 Arrangements for the response of nearby fire companies and emergency squads shall be made a part of the emergency response planning process.

5.4.2 Where a means of access that allows outside aid companies to enter the facility is provided, procedures for using such access shall be included in the emergency response plan.

5.4.3 Precautions shall be taken at the points of entry to alert and control traffic to allow emergency equipment to enter safely.

5.5* Ancillary Facilities. All related ancillary facilities that support the operation of limited access highways shall be protected as required by all applicable NFPA standards and local building codes and shall not be subject to the provisions of this standard.

5.6 Emergency Response Plan.

5.6.1 A designated authority shall carry out a complete and coordinated program of fire protection that shall include written preplanned emergency response procedures and standard operating procedures.

5.6.2 Emergency traffic-control procedures shall be established to regulate traffic during an emergency.

5.6.3 Emergency procedures and the development of an emergency response plan shall be completed in accordance with the requirements of Chapter 12.

Chapter 6 Bridges and Elevated Highways

6.1* General. This chapter shall provide fire protection requirements for bridges and elevated highways.

6.2 Emergency Communications. Emergency communications, where required by the authority having jurisdiction, shall be provided by the installation of outdoor-type telephone boxes, coded alarm telegraph stations, radio transmitters, or other approved devices. Such devices shall meet the following requirements:

- (1) They shall be made conspicuous by means of indicating lights or other approved markers.
- (2) They shall be identified by a readily visible number plate or other approved device.
- (3) They shall be posted with instructions for use by motorists.
- (4) They shall be located in approved locations so that motorists can park vehicles clear of the travel lanes.

6.3 Signage. Signs, mile markers, or other approved location reference markers shall be installed along the highway to allow motorists to provide authorities with accurate locations for accident or emergency areas.

6.4 Traffic Control.

6.4.1 A traffic control procedure shall be established so that vehicles either stop or proceed with caution.

6.4.2 Traffic shall not be permitted to block or otherwise interfere with the response of emergency and fire equipment.

6.5* Standpipe and Water Supply. Where the distance from an acceptable water supply source as defined in 9.2.3 to any point on the bridge exceeds 120 m (400 ft), the bridge shall be provided with a standpipe system in accordance with Chapter 9.

6.6 Drainage.

6.6.1 On bridges and elevated highways, drainage systems to channel and collect spilled hazardous or flammable liquids shall be designed to drain areas that cannot cause additional hazards.

6.6.2 Expansion joints shall be designed to prevent spillage to the area below the bridge or elevated highway.

6.7* Ancillary Facilities. All related ancillary facilities that support the operation of bridges and elevated highways shall be protected as required by all applicable NFPA standards and local building codes and shall not be subject to the provisions of this standard.

6.8 Control of Hazardous Materials. Control of hazardous materials shall be in accordance with the requirements of Chapter 13.

6.9 Emergency Response Plan.

6.9.1 A designated authority shall carry out a complete and coordinated program of fire protection that shall include written preplanned emergency response procedures and standard operating procedures.

6.9.2 Emergency response procedures and the development of an emergency response plan shall comply with the requirements of Chapter 12.

Chapter 7 Road Tunnels

7.1* General. This chapter shall provide fire protection and life safety requirements for road tunnels.

7.2 Road Tunnel Length. For the purpose of this standard, tunnel length shall dictate the minimum fire protection requirements, as follows:

- (1) Where tunnel length is less than 90 m (300 ft), the provisions of this standard shall not apply.
- (2) Where tunnel length is 90 m (300 ft) or greater, standpipe systems and traffic control systems shall be installed in accordance with the requirements of Chapter 9 and Section 7.6, respectively.
- (3) Where tunnel length equals or exceeds 240 m (800 ft) and where the maximum distance from any point within the tunnel to a point of safety exceeds 120 m (400 ft), all provisions of this standard shall apply.
- (4) Where the tunnel length equals or exceeds 300 m (1000 ft), all provisions of this standard shall apply.

7.3* Protection of Concrete and Steel Structures. Regardless of tunnel length, all primary structural concrete and steel elements shall undergo a fire engineering analysis to ensure that the tunnel structure can withstand the anticipated fire severity based on the type of traffic to be permitted.

7.4 Fire Detection.

7.4.1 At least two systems to detect, identify, or locate a fire in a tunnel, including one manual means, shall be provided.

7.4.1.1 Manual Double-Action Fire Alarm Boxes.

7.4.1.1.1 Manual fire alarm boxes mounted in NEMA Enclosure Type 4 (IP 65) or equivalent boxes shall be installed at intervals of not more than 90 m (300 ft) and at all cross passages and means of egress from the tunnel.

7.4.1.1.2 The manual fire alarm boxes shall be accessible to the public and the tunnel personnel.

7.4.1.1.3 The location of the manual fire alarm boxes shall be approved.

7.4.1.1.4 The alarm shall indicate the location of the manual fire alarm boxes at the monitoring station.

7.4.1.1.5 The system shall be installed, inspected, and maintained in compliance with *NFPA 72*.

7.4.1.2 Closed-Circuit Television Systems (CCTVs).

7.4.1.2.1 Closed-circuit television systems (CCTVs) with or without traffic-flow indication devices shall be permitted to identify fires in tunnels with 24-hour supervision.

7.4.1.2.2* Ancillary spaces within tunnels (pump stations, utility rooms, cross passages, ventilation structures) and other areas shall be supervised by automatic fire alarm systems.

7.4.1.3 Automatic Fire Detection Systems.

7.4.1.3.1 Automatic fire detection systems installed in accordance with the requirements of *NFPA 72* shall be installed in tunnels where 24-hour supervision is not provided.

7.4.1.3.2 Where a fire detection system is installed in accordance with the requirements of 7.4.1.3.1, signals for the purpose of evacuation and relocation of occupants shall not be required.