

NFPA®

1402

**Standard on
Facilities for Fire Training
and Associated Props**

2019



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NFPA® 1402

Standard on

Facilities for Fire Training and Associated Props

2019 Edition

This edition of NFPA 1402, *Standard on Facilities for Fire Training and Associated Props*, was prepared by the Technical Committee on Facilities for Fire Training and Associated Props. It was issued by the Standards Council on November 5, 2018, with an effective date of November 25, 2018, and supersedes all previous editions.

This edition of NFPA 1402 was approved as an American National Standard on November 25, 2018.

Origin and Development of NFPA 1402

In 1963, a subcommittee of the Fire Service Training Committee developed a document titled *How to Build Firemen's Training Centers*. That informative report was published and circulated as a guide and served to improve the scope and efficiency of fire fighter training. By 1985, the report had evolved into the first edition of NFPA 1402, *Guide to Building Fire Service Training Centers*. Revisions to NFPA 1402 were published in 1992 and 1997.

The Fire Service Training Committee appointed a task group to review the 1997 edition and make recommendations concerning the functionality of the document. After that review, the task group recommended a general updating of NFPA 1402, which was undertaken for the 2002 edition.

In addition to minor edits to address the general evolution of the subject, the committee placed more emphasis in the 2002 edition on needs analysis before design and construction, establishing policies and procedures for effective use of the structure, and the environmental impact of training and training props.

New material was added to the chapter on gas-fired burn props. The chapter on design and construction was renamed Selecting an Architect/Engineer (A/E) and placed more emphasis on the important roles played by these professionals and on the contract documents that form the foundation of projects for building fire service training centers. The chapter on burn buildings was renamed Live Fire Training Structure and placed more attention on these structures, especially regarding the impact of repeated high temperatures.

The 2007 edition of the guide included updated material on needs and cost analysis, training center components and considerations, and infrastructure considerations and exposures. The guide also included many new and updated illustrations.

The 2012 edition included a rewritten Chapter 7, Design and Construction Process, to aid the user in the workflow. Chapter 10, Live Fire Training Structure, was also rewritten to clarify some issues and make the document more user friendly, with Section 10.7 including suggested gas-fired live fire training safeguards.

The 2019 edition changes from a guide to a standard, changing the title to *Standard on Facilities for Fire Training and Associated Props*. A new technical committee, Facilities for Fire Training and Associated Props, was formed in 2015 to oversee the document. This new committee worked extensively to convert recommended language to mandatory language throughout the document, as well as to update requirements throughout to reflect general technological and industry updates. Two new chapters on gas-fueled live fire training systems were added. The chapter on smoke buildings was removed and replaced with a chapter on requirements for technical rescue training facilities. A new chapter on fire investigation training facilities was also added.

Two new annexes were added as well, providing guidance on the design and construction of fire service training centers and administrative and classroom buildings.

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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 the design, construction, and maintenance of facilities for fire training and for fire training props. Responsibilities of the committee include standards relating to gas-fire props; training structures, props, and simulators used for live fire training, rescue training and related tactical and skill training exercises.

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NFPA 1402

Standard on

Facilities for Fire Training and Associated Props

2019 Edition

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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.

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 advisory sections of this document are given in Chapter 2 and those for extracts in the informational sections are given in Annex E. 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 should be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1 Scope. This standard contains the minimum design, construction, and maintenance requirements for fire service training centers, fire training structures and props, gas-fueled and flammable liquid-fueled live fire training systems, mobile fire training props, and associated training props.

1.2 Purpose.

1.2.1 The purpose of this standard is to establish consistent, minimum criteria for facilities, structures, and props that are used for conducting fire and rescue training classes and exercises.

1.2.2* The building code(s) and gas code(s) do not address the unique and specific requirements for specialized fire train-

ing structures, props, and systems. The minimum requirements of this standard are intended to bridge that gap.

1.3 Application.

1.3.1 This standard supplements, not supersedes, the building code(s) and gas code(s).

1.3.2 For any items covered by this standard and other NFPA standards on training, and for any conflicting items between them, the most stringent requirement shall govern.

1.3.3 The items listed in 1.3.3.1 through 1.3.3.4 are covered by this standard, whether located at a fire service training center or located elsewhere, such as at a fire station.

1.3.3.1 The design, manufacturing, installation, certification, testing, commissioning, and maintenance of gas-fueled live fire training systems and flammable liquid-fueled live fire training systems used for live fire training are covered by this standard.

1.3.3.2 The design, manufacturing, installation, certification, testing, commissioning, and maintenance of mobile training props are covered by this standard.

1.3.3.3 The design, construction, and maintenance of training structures and props used for live fire training are covered by this standard.

1.3.3.4 The design, construction, and maintenance of training structures and props used for rescue training, hazmat training, and related tactical training exercises that do not require live fire are covered by this standard.

1.3.4* Acquired structures used for live fire training evolutions are not covered by this standard.

1.3.5* Conventional facilities found at fire service training centers are typically not covered by this standard unless they are also being used as training structures or props. Further information can be found in Annexes B, C, and D.

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 or structures 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 The requirements of Chapters 4, 5, and 8 through 14, and Sections 6.2 and 7.2 shall apply to existing facilities.

1.4.3 The requirements of Sections 6.1 and 7.1 shall apply to existing facilities beginning 3 years from the effective date of this standard.

1.4.4 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.

1.4.5 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.

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 14, *Standard for the Installation of Standpipe and Hose Systems*, 2016 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2017 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2018 edition.

NFPA 54, *National Fuel Gas Code*, 2018 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2017 edition.

NFPA 70®, *National Electrical Code®*, 2017 edition.

NFPA 86, *Standard for Ovens and Furnaces*, 2015 edition.

NFPA 1403, *Standard on Live Fire Training Evolutions*, 2018 edition.

NFPA 5000®, *Building Construction and Safety Code®*, 2018 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI Z21.21/CSA 6.5, *Automatic valves for gas appliances*, 2017.

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

ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*, 2010.

2.3.3 ICC Publications. International Code Council, 500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001.

International Building Code, 2015.

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

UL 508A, *Standard for Industrial Control Panels*, 2001, revised 2014.

2.3.5 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 101®, *Life Safety Code®*, 2018 edition.

NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, 2017 edition.

NFPA 1006, *Standard for Technical Rescue Personnel Professional Qualifications*, 2017 edition.

NFPA 1410, *Standard on Training for Initial Emergency Scene Operations*, 2015 edition.

NFPA 1451, *Standard for a Fire and Emergency Service Vehicle Operations Training Program*, 2018 edition.

NFPA 1500™, *Standard on Fire Department Occupational Safety and Health Program*, 2018 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* 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.

3.2.2 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.

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

3.2.4 Shall. Indicates a mandatory requirement.

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

3.2.6 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase “standards development process” or “standards development activities,” the term “standards” includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Acquired Prop. A piece of equipment acquired by the AHJ for the purposes of conducting fire training evolutions, technical rescue training, hazardous materials training, or other fire rescue training whether including live fire or not.

3.3.2 Acquired Structure. A building or structure acquired by the AHJ from a property owner for the purposes of conducting fire training evolutions, technical rescue training, hazardous materials training, or other fire rescue training whether including live fire training or not.

3.3.3 Appliance. See 3.3.17, Gas-Fueled Training Appliance.

3.3.4 Burn Room. Space or compartment inside a live fire training structure in which live fires are conducted.

3.3.5 Containerized Training Structure. A structure consisting of one or more shipping (intermodal) containers assembled together for the purpose of conducting live fire, nonlive fire, rescue, hazmat, and/or other related training evolutions. If the containerized training structure is to support live fire training, then it is classified as a live fire training structure.

3.3.6 Dead Loads. Dead loads consist of the weight of all materials of construction incorporated into the building including but not limited to walls, floors, roofs, ceilings, stairways, built-in partitions, finishes, cladding and other similarly incorporated architectural and structural items, and fixed service equipment including the weight of cranes. [ASCE/SEI 7:3.1.1]

3.3.7* Designed Anchor Point. An anchor point designed by an engineer or other qualified person, and installed in accordance with the manufacturer's recommendations, to support the forces generated in rope rescue systems.

3.3.8 Emergency Medical Services. The provision of treatment, such as first aid, cardiopulmonary resuscitation, basic life support, advanced life support, and other pre-hospital procedures including ambulance transportation, to patients. [1500, 2018]

3.3.9 Evolution. A set of prescribed actions that result in an effective fireground activity. [1410, 2015]

3.3.10 Factored Load. Working load multiplied by a factor of safety that is greater than 1.

3.3.11 Fire Investigation Burn Cell (Burn Cell). A smaller subdivision of either a fire investigation training structure or fire investigation training prop, designed or intended to contain the arrangement of fuels used in fire investigation training.

3.3.12 Fire Investigation Set (Set). The constructed, arranged, or adapted use of furniture, fixtures, equipment, and fuels intended for burning as part of fire investigation training, within a fire investigation burn cell.

3.3.13 Fire Investigation Training Prop. A vehicle, vessel, equipment, or fabricated mock-up acquired or specifically built or manufactured to facilitate fire conditions, behavior, and patterns for conducting fire investigation training. This prop is not used for live fire training.

3.3.14 Fire Investigation Training Structure. A permanent structure acquired or specifically built to facilitate fire conditions, behavior, and patterns for conducting fire investigation training on a repetitive basis, with each use being a single burn. This structure is not used for live fire training.

3.3.15 Fire Prop. A noncombustible assembly used for repeatable live fire training exercises containing the gas burners of the gas-fueled training appliance and located inside the burn space.

3.3.16* Gas-Fueled Live Fire Training System. An engineered system comprised of the gas-fueled training appliance(s), the associated piping, and the fire prop(s).

3.3.17 Gas-Fueled Training Appliance. An engineered product comprised of burner controls, safety systems, and ignition system used to operate the fire prop.

3.3.18 Highline System. A system of using rope or cable suspended between two points for movement of persons or equipment over an area that is a barrier to the rescue operation, including systems capable of movement between points of equal or unequal height. [1006, 2017]

3.3.19 Intermittent Pilot. A pilot that burns during light-off and while the main burner is firing.

3.3.20 Interrupted Pilot. A pilot that is ignited and burns during light-off and is automatically shut off at the end of the trial-for-ignition period of the main burner(s).

3.3.21 Liquid-Fueled Live Fire Training System. A training prop used for live fire training on a repetitive basis, fueled by gasoline, diesel, kerosene, reduced-emissions flammable liquid, or other flammable or combustible liquid.

3.3.22 Live Fire. Any open flame capable of emitting thermal load or toxic by-products of combustion that would necessitate the use of personal protective equipment (PPE).

3.3.23 Live Fire Training Prop. A training prop utilized for conducting live fire training evolutions on a repetitive basis.

3.3.24* Live Fire Training Structure. A structure utilized for conducting live fire training evolutions on a repetitive basis.

3.3.25 Live Loads. Live loads are those produced by the use and occupancy of the building or other structure and do not include construction or environmental loads such as wind load, snow load, rain load, earthquake load, flood load, or dead load. Live loads on a roof are those produced (1) during maintenance by workers, equipment, and materials; and (2) during the life of the structure by movable objects such as planters and by people. [ASCE/SEI 7:4.1]

3.3.26 Means of Egress. A continuous and unobstructed way of travel from any point in a building or structure to a public way consisting of three separate and distinct parts: (1) the exit access, (2) the exit, and (3) the exit discharge. [101, 2018]

3.3.27 Means of Escape. A way out of a building or structure that does not conform to the strict definition of means of egress but does provide an alternate way out. [101, 2018]

3.3.28 Mobile Training Prop. A training prop intended to be transported over roads for conducting fire, rescue, hazmat, or related training evolutions on a repetitive basis, whether including live fire or not, at different locations.

3.3.29 Mock-Up. A noncombustible assembly that can be used in association with the fire prop to change its appearance to enhance training realism.

3.3.30 Owner/Operator. The organization with fiscal responsibility for the operation, maintenance, and profitability of the facility. [654, 2017]

3.3.31 Portable Training Prop. A training prop that is not permanently mounted to a trailer or fixed to the ground and can be moved around the training site. Transportation on roadways requires a trailer or transport vehicle.

3.3.32 Qualified Person. A person who, by possession of a recognized degree, certificate, professional standing, or skill, and who, by knowledge, training, and experience, has demonstrated the ability to deal with problems related to the subject matter, the work, or the project. [1451, 2018]

3.3.33 Seismic Forces. The assumed forces prescribed herein [ASCE/SEI 7], related to the response of the structure to earthquake motions, to be used in the design of the structure and its components. [ASCE/SEI 7:11.2]

3.3.34 Technical Search and Rescue. The application of special knowledge, skills, and equipment to resolve unique and/or complex search and rescue situations. [1006, 2017]

3.3.35* Training Prop. A facility utilized for conducting fire, rescue, hazmat, or related training evolutions on a repetitive basis, whether including live fire or not.

3.3.36 Training Structure. A live fire training structure, training tower, or containerized training structure.

3.3.37 Training Tower. A multistory building or structure specifically built for conducting fire, rescue, hazmat, and/or other related training evolutions on a repetitive basis, without the use of live fire. A training tower could be constructed of conventional materials (masonry, concrete, steel, or wood), or it could be a containerized training structure. If the multistory building or structure is to support live fire training, then it is classified as a live fire training structure.

3.3.38 Trial-for-Ignition Period (Flame-Establishing Period). The interval of time during light-off that a combustion safeguard allows the fuel safety shutoff valve to remain open before the flame detector is required to supervise the flame.

3.3.39* Working Load. The force specified for weight of materials and personnel, actions, environmental effects, differential movement, and restrained dimensional changes with no factor of safety applied.

Chapter 4 Establishing Policies and Standard Operating Procedures

4.1 Written Policies and Procedures.

4.1.1* Written policies and standard operating procedures for the fire training center and each training structure and prop shall be established by the AHJ.

4.1.2 The following shall be incorporated into the written policies and procedures:

- (1) Requirements of other NFPA standards
- (2) Manufacturers' requirements and recommendations for proper use of training structures and props

Chapter 5 Site and Infrastructure

5.1 Water Supply.

5.1.1* In addition to domestic and fire protection water that is required for occupied building(s) and facilities on site, the water required for training evolutions shall be provided.

5.1.2 When hydrants are supplied at the training center, the hydrant connection(s) shall be those specified by the AHJ.

5.2 Security.

5.2.1* The training center shall be capable of restricting access to unauthorized personnel.

5.2.1.1 Props that present a special hazard, as determined by the AHJ, shall be provided with additional security measures.

5.3* Personnel Gross Decontamination. The training center shall facilitate personnel wash-down after training exercises that expose personnel to products of combustion in accordance with the requirements of the AHJ.

5.4* Environmental Consideration. The training center shall be designed to meet the minimum environmental requirements of the AHJ as they relate to fire training centers.

Chapter 6 Training Structures and Props — General

6.1 Design and Construction.

6.1.1* Training structures and props shall meet the design and construction requirements of the AHJ and local building official, including whether a building permit or professional engineering stamp are required.

6.1.2 Training structures and props shall be designed for loading from wind, earthquakes, snow, ice, retained soil, flood, operations, equipment, and any other applied loading.

6.1.2.1 Training structures and props shall be positioned and anchored to ensure stability.

6.1.3 Training structures and props shall be designed and built for exposure to weather and seasonal temperature changes.

6.1.4 Depending on their intended use, training structures and props shall be designed and built for exposure to training water and impact forces inherent in training, such as impact from high pressure hose streams, tools, and self-contained breathing apparatus (SCBA) tanks.

6.1.5 Stairs in or adjacent to training structures and props shall meet requirements of the building code for tread and riser dimensions, stair and landing widths, and railing heights and strengths.

6.1.6 Guardrails and handrails at training structures and props shall be provided at locations required by the building code for an occupied building and shall meet the building code requirements for height and loading.

6.1.7 Where railing(s) would prohibit the intended use of the training structure or prop, such as pitched roofs of training structures simulating residential occupancy or the wing of a simulated aircraft prop, railings shall be permitted to be optional.

6.1.8* Floors and roofs of training structures and props shall be designed to support dead loads plus a minimum live load of 50 lb/ft² (244 kg/m²), unless heavier live loads are anticipated or required by the building code or AHJ.

6.1.9* Drainage for training water used in training structures and props shall be provided in the design.

6.1.9.1* If floors and roofs slope to interior or exterior drains, then the floor and roof structures shall be designed to support the weight of the maximum quantity of water that could accumulate on the floors and roofs if the drains clog.

6.1.10 Calcium aluminate concrete ("refractory concrete") shall not be used for structural slabs, beams, walls, columns, or other load-bearing structural components.

6.1.11* Grounding and bonding locations at or on training structures and props shall be provided in accordance with the requirements of the AHJ.

6.1.12 When standpipes and/or sprinklers are subjected to freezing temperatures, they shall be equipped with a drainage system and instructions posted to prevent damage to the system.

6.2* Maintenance.

6.2.1 Training structures and props shall be maintained by the owner/operator or an entity retained by the owner/operator.

6.2.2 When standpipes are installed, they shall be maintained and inspected in accordance with NFPA 14.

Chapter 7 Live Fire Training Structures

7.1* Design and Construction.

7.1.1 Live fire training structures shall meet the requirements of Chapters 6 and 7.

7.1.2 Structural components in burn rooms and all structural components supporting, enclosing, and bracing burn rooms and structural components outside burn rooms that are exposed to flame impingement, fire extension, and heat from training fires shall be constructed of noncombustible materials.

7.1.3* Live fire training structures shall be designed by a licensed design professional to meet the structural requirements of the building code for materials, vertical loads, lateral loads, long-term loads, permanent foundations, and stability.

7.1.3.1 If the AHJ has not adopted a building code, the structural requirements of the latest edition of the *International Building Code* or *NFPA 5000* shall apply.

7.1.4* All components in burn rooms and components in areas outside burn rooms that are exposed to flame impingement, fire extension, and heat from training fires shall be designed for exposure to high temperatures, high volumes of water, thermal shock, steam, expansion and contraction, and other project and site-specific design considerations.

7.1.4.1* Load-bearing structural elements that will be exposed to temperatures exceeding 350°F (177°C), whether in or out of a burn room, shall be protected with a thermal lining or other thermal protection system to keep temperatures at the face of the structural elements at or below 350°F (177°C).

7.1.4.2 Components shall be free of asbestos.

7.1.4.3 Components shall be free of plastic, rubber, and sealed components that could burst when heated.

7.1.5 All burn rooms shall have, as a minimum, one of the following:

- (1) Two doors that exit the burn room to an adjacent room or to an exterior grade, a balcony, a roof, or stairs
- (2) One door to an adjacent room and one window to either another room, a balcony, a roof, or another tenable location

Exception: In the case of a gas-fired burn room where the fire cannot be between the participant and the door, one door shall be acceptable.

7.1.6* Burn areas that are fully below grade shall be prohibited, but burn areas that are at a belowgrade level but with full, at-grade walkout capability at a minimum of one full side of the training structure shall be permitted.

7.1.7 Electrical conduits, wiring, and devices shall not be permitted in Class A burn rooms or compartments.

Exception: Low-voltage wiring, conduits, and devices shall be permitted in Class A burn rooms and, except for thermocouples, shall be protected from the heat of training fires.

7.1.8 Doors and window shutters that are exposed to elevated temperatures related to live fire training shall meet the following requirements:

- (1) Resist binding when exposed to temperature cycles associated with live fire training, which could cause significant expansion and contraction
- (2) Operate from both sides of the door or shutter without special tools or keys during live fire training

7.1.9* The site area around the live fire training structure shall be free of combustible materials for a distance of at least 10 ft (3 m) and designed to accommodate the training requirements.

7.2 Maintenance, Evaluations, and Testing.

7.2.1* The structural integrity of live fire training structures shall be evaluated and documented annually by the owner/operator or AHJ.

7.2.1.1 If visible structural defects are found, such as cracks, rust, spalls, or warps in structural floors, columns, beams, walls, or metal panels, the owner/operator shall have a follow-up evaluation conducted by a licensed professional engineer with live fire training structure experience and expertise, or by another qualified professional as determined by the owner/operator or AHJ.

7.2.2* The structural integrity of the live fire training structure shall be evaluated and documented by a licensed professional engineer with live fire training structure experience and expertise, or by another qualified professional as determined by the AHJ, at the following intervals:

- (1) For gas-fired live fire training structures, at least once every 10 years or more frequently if determined to be required by the evaluator.
- (2) For non-gas-fired live fire training structures, at least once every 5 years or more frequently if determined to be required by the evaluator.
- (3)* For structures constructed with calcium aluminate refractory structural concrete, every 3 years or more frequently if determined to be required by the evaluator.

7.2.2.1 The structural evaluation of structures constructed with calcium aluminate refractory structural concrete shall include removal of concrete core samples from the structure to check for delaminations within the concrete.

7.2.2.2* Part of the live fire training structure evaluation shall include, at the same intervals listed in 7.2.2, the removal and reinstallation of a representative area of thermal linings (if any) to evaluate the concealed conditions behind the linings.

Chapter 8 Gas-Fueled Live Fire Training Systems — Interior

8.1 General.

8.1.1* A gas-fueled fire training system shall include, at a minimum, a gas-fueled training appliance and a fire prop that generates and controls repeatable flames for training fire fighters on suppression techniques.

8.1.2 Burners, along with associated valves, regulators, safety controls, and other auxiliary components, shall be selected for the intended application, type, and pressure of the fuel gases to be used and the temperatures to which they are subjected.

8.1.3 Fire props and mock-ups shall maintain structural integrity while being used for training in accordance with NFPA 1403.

8.1.3.1 After extended use, mock-ups shall be able to be maintained or replaced without the replacement of the fire prop.

8.2 Gas Equipment.

8.2.1 Fuel Storage. Installation of LP-Gas storage and handling systems (if applicable) shall comply with NFPA 58 or other applicable standards as recognized by the AHJ.

8.2.2 Gas Piping and Fittings.

8.2.2.1 Piping from the point of delivery to the equipment isolation valve shall comply with NFPA 54 or other applicable standards as recognized by the AHJ.

8.2.2.2 Fuel gas piping materials shall be in accordance with NFPA 54 or other applicable standards as recognized by the AHJ.

8.2.2.3 Fuel gas piping shall be sized to provide flow rates and pressure to maintain a stable flame throughout the burner operating range.

8.2.3 Control of Contaminants.

8.2.3.1 A sediment trap shall be installed downstream of the appliance isolation valve and upstream of all other fuel gas system components.

8.2.3.2 Sediment traps shall have a vertical leg with a minimum length of three pipe diameters [minimum of 3 in. (80 mm)] of the same size as the supply pipe.

8.2.3.3 A minimum of one gas filter or strainer shall be installed in the fuel gas piping and shall be located to protect the downstream gas components.

8.2.4 Exterior Shutoff. A system fuel shutoff valve shall be located on the fuel gas supply line on the exterior of the structure or prop, immediately adjacent to the supply line entry point into the structure or prop, and be accessible for access and service, as follows:

- (1) The valve shall be a quarter-turn valve with stops.
- (2) The handle shall remain affixed to valve and shall be oriented with respect to the valve port to indicate the following:
 - (a) An open valve when the handle is parallel to the pipe
 - (b) A closed valve when the handle is perpendicular to the pipe

- (3) The valve shall be accessible.
- (4) The valve shall be able to be operated from full open to full close and return without the use of tools.

8.2.5 Appliance Isolation Valves. Manually operated equipment isolation valves shall meet the following requirements:

- (1) They shall be provided for each appliance.
- (2) They shall be quarter-turn valves with stops.
- (3) Handles shall remain affixed to valves and shall be oriented with respect to the valve port to indicate the following:
 - (a) An open valve when the handle is parallel to the pipe
 - (b) A closed valve when the handle is perpendicular to the pipe
- (4) They shall be accessible.
- (5) They shall be able to be operated from full open to full close and return without the use of tools.

8.2.6 Fuel Pressure Regulators.

8.2.6.1 A fuel pressure regulator shall be furnished wherever the supply pressure exceeds the system operating or design parameters or wherever the supply pressure is subject to fluctuations.

8.2.6.2 Vents shall be designed to prevent the entry of water and insects without restricting the flow capacity of the vent.

8.2.6.3 Regulators, relief valves, and gas pressure switches shall not be required to be vented to an approved location in the following situations:

- (1) Where a listed regulator–vent limiter combination is used
- (2) Where a regulator system is listed for use without vent piping
- (3) Where a regulator incorporates a leak limiting system that prevents or restricts the escape of gas into a space large enough and with sufficient natural ventilation so that the escaping gas does not present a hazard
- (4) Where a fuel pressure switch employs a vent limiter rated for the service intended

8.2.6.4 Vents from appliances operating at different fuel pressure control levels shall not be manifolded together.

8.2.6.5 Vents from appliances served from different fuel pressure reducing stations shall not be manifolded together.

8.2.6.6 Vents from systems using different fuel sources shall not be manifolded together.

8.2.6.7 Vent lines from multiple regulators and pressure switches of single or multiple appliances, where manifolded together, shall be piped in such a manner that any gas being vented from one ruptured diaphragm does not backload the other devices.

8.2.6.8 The cross-sectional area of the manifold line shall not be less than the greater of the following:

- (1) The cross-sectional area of the largest vent plus 50 percent of the sum of the cross-sectional areas of the additional vent lines
- (2) The sum of the cross-sectional areas of the two largest vent lines

8.2.6.9 A vent between safety shutoff valves, where installed, shall meet the following conditions:

- (1) Shall not be combined with other vents
- (2) Shall terminate to the exterior

8.2.6.10 Overpressure Protection.

8.2.6.10.1 Overpressure protection shall be provided in either of the following cases:

- (1) When the gas supply pressure exceeds the pressure rating of any downstream component
- (2) When the failure of a single upstream line regulator or service pressure regulator results in a supply pressure exceeding the pressure rating of any downstream component

8.2.6.10.2 Overpressure protection shall be provided by any one of the following:

- (1) A monitoring regulator installed in series with the service or line pressure regulator in accordance with NFPA 54
- (2) A full-capacity pressure relief valve
- (3) An overpressure cutoff device, such as a slam-shut valve or a high-pressure switch in combination with a compliant shutoff valve

8.2.6.11 Safety Shutoff Valves.

8.2.6.11.1 Each main and pilot fuel gas burner system shall be separately equipped with at least two safety fuel gas shutoff valves in series that automatically shut off the fuel to the burner system in each of the following events:

- (1) Interruption of electrical power
- (2) Activation of any interlocking safety devices
- (3) Activation of the combustion safeguard
- (4) Failure of the operational controls
- (5) Activation of manual shutdown stations

8.2.6.11.2 Each safety shutoff valve shall automatically shut off the fuel to the burner system after interruption of the holding medium (such as electric current or fluid pressure) by one of the interlocking safety devices, combustion safeguards, or operational controls.

8.2.6.11.3 Where multiple fire props share a common interior space, the safety shutdown of one fire prop shall result in the safety shutdown of all fire props in that space, as shown in Figure 8.2.6.11.3.

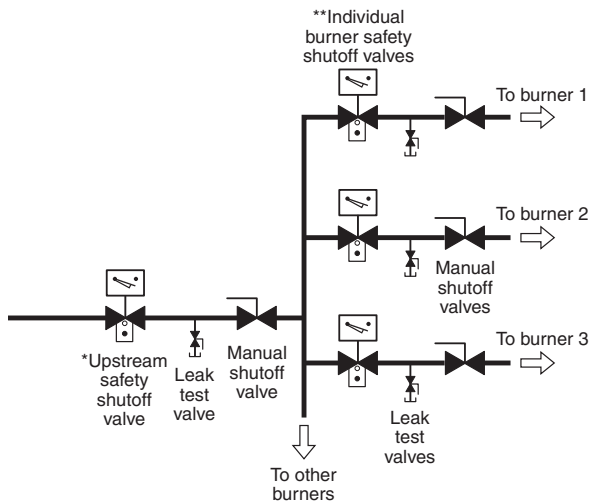
8.2.6.11.4 Safety shutoff valves shall not be used as modulating control valves unless they are designed as both safety shutoff and modulation valves and tested for concurrent use.

8.2.6.11.5 Safety shutoff valves shall not be open-close cycled at a rate that exceeds that specified by its manufacturer.

8.2.6.11.6 Valve components shall be of a material selected for compatibility with the fuel handled and for ambient conditions.

8.2.6.11.7 Safety shutoff valves in systems containing particulate matter or highly corrosive fuel gas shall be operated at time intervals in accordance with the manufacturer's instructions in order to maintain the safety shutoff valves in operating condition.

8.2.6.11.8 Valves shall not be subjected to supply pressures in excess of the manufacturer's ratings.



*Interlocked with preignition prepurge to comply with 8.8.2.2 of NFPA 86

**Interlocked with upstream safety shutoff valve to comply with 8.8.1.3 of NFPA 86

FIGURE 8.2.6.11.3 Multiple Burner System Valve Train Diagram.

8.2.6.11.9 The safety shutoff valves shall close in 1 second or less upon being de-energized.

8.2.6.11.10 Each main and pilot fuel gas burner system shall be separately equipped with either of the following:

- (1) Two safety shutoff valves wired in parallel and piped in series
- (2) A pilot train with an input greater than 20,000 Btu/h (6 kW) up to and including 400,000 Btu/h (120 kW) equipped with two safety shut-off valves piped in series and wired in parallel and certified in accordance with ANSI Z21.21/CSA 6.5, *Automatic valves for gas appliances*, or one safety shut-off valve certified in accordance with ANSI Z21.21/CSA 6.5 and marked C/I

8.3 Fuel Types.

8.3.1 Liquefied versions of flammable gas and flammable liquids shall not be piped into or utilized inside a structure or training prop and therefore shall not be used for interior live fire training. *(For the use of combustible liquids inside of a training structure, refer to Chapter 14.)*

8.3.2 Fuel vapor at pressures exceeding 20 psig (138 kPag) shall not be piped into any training structure.

8.3.3 Flammable liquids, as defined in NFPA 30, shall not be used in interior live fire training systems.

8.4 Main Gas Burners and Pilot Burners.

8.4.1 Burners shall be used only with the fuels for which they are designed.

8.4.2 All pressures required for operation of the combustion system shall be maintained within the design ranges throughout the firing cycle.

8.4.3 Burners shall have the ignition source sized and located in a position that provides ignition of the pilot within the design trial-for-ignition period.

8.4.4* The pilot ignition source shall be applied at the design location with the designed intensity to ignite the flame pilot burner air-fuel mixture.

8.4.5 Pilot burners shall be mounted to prevent unintentional changes in location and in direction with respect to the main flame burners.

8.4.6* No substitute for flame pilot burners shall be utilized to ignite main burners.

8.4.7 All main burners shall be ignited directly from a confirmed and monitored pilot flame.

8.4.7.1 Pilot burners shall be positioned and fixed as close as practical to ensure pilot flame impinges on the first points of gas release of the related main burner element(s) to ensure positive ignition.

8.4.8 The live fire system shall include either an intermittent pilot or an interrupted pilot.

8.4.9 Manually lighting flammable gas fires in interior training spaces or altering a manufacturer's appliance shall not be permitted.

8.4.9.1 Intermittent Pilot Burners.

8.4.9.1.1 Intermittent pilot flames shall be interlocked to control fuel delivery valves to prevent fuel from flowing without a confirmed pilot flame being present.

8.4.9.1.2 Pilot flames shall be continuously monitored for the duration of the demand for flame on the main burner(s).

8.4.9.1.2.1 Upon loss of pilot flame, all related burner gas supply valves shall automatically close.

8.4.9.2 Interrupted Pilot Burners.

8.4.9.2.1 Interrupted pilot flames shall be interlocked to control fuel delivery valves to prevent fuel from flowing without a confirmed pilot flame being present during the main flame establishment period.

8.4.9.2.2 Main flames shall be continuously monitored for the duration of the demand for flame on the main burner(s).

8.4.9.2.3 Upon loss of main flame confirmation, all related burner gas supply valves shall automatically close.

8.5 Control System.

8.5.1 Electrical System — Safety Devices.

8.5.1.1 All wiring and equipment shall be in accordance with *NFPA 70*, or other applicable standards as recognized by the AHJ.

8.5.1.2 Control panels shall be designed and manufactured in compliance with UL 508A, *Standard for Industrial Control Panels*, or other applicable standards as recognized by the AHJ.

8.5.1.3 Combustion safeguards, flame detectors, and safety shutoff valves shall be listed for combustion safety service or approved by a nationally recognized testing laboratory (NRTL) if a listed device is not commercially available for use in the design environment.

8.5.1.4 Safety devices shall be selected, applied, and installed in accordance with this standard and the manufacturer's instructions.

8.5.1.5 Safety devices shall be located or guarded to protect them from physical damage.

8.5.1.6 Safety devices shall not be bypassed electrically or mechanically.

8.5.1.7 Where a system includes a "built-in" test mechanism that bypasses any safety device, it shall be interlocked to prevent operation of the system while the device is in the test mode, unless listed for that purpose.

8.5.2 Emergency Stops.

8.5.2.1 At least one manual emergency (e-stop) switch shall be provided at one entry point to each burn room, in order to initiate a safety shutdown.

8.5.2.2 Each e-stop switch shall be connected into the control system as a safety interlock.

8.5.2.3 A safety shutdown of the burner system shall require manual intervention of an operator to re-establish normal operation of the system.

8.5.2.4 Where wireless controls are used in place of hard-wired e-stop switches for safety shutdown functions, wireless control signal failure shall be supervised and a signal failure shall initiate a safety shutdown.

8.5.3 Burner Management System (BMS).

8.5.3.1 Gas-fueled live fire training systems shall include a listed commercial flame safeguard system or a programmable controller used in accordance with Section 8.4 of NFPA 86.

8.5.3.2 The activation of any safety interlock in the BMS shall result in a safety shutdown of the associated burner(s).

8.5.3.3 Safety interlocks shall meet one or more of the following criteria:

- (1) Be hardwired without relays in series and ahead of the controlled device
- (2) Be connected to an input of a programmable controller logic system complying with Section 8.4 of NFPA 86
- (3) Be connected to a relay that represents a single safety interlock that is configured to initiate safety shutdown in the event of power loss
- (4) Be connected to a listed safety relay that represents one or more safety interlocks and initiates safety shutdown upon power loss

8.5.4 Safe Start Check. The control system must be designed to constantly monitor all safety systems for satisfactory operation.

8.5.5 System Operation and Safety Shutdowns.

8.5.5.1 Safety devices shall not be removed or rendered ineffective.

8.5.5.2 High Fuel Gas Pressure Sensor — Safety Shutdown. The system shall contain a system fuel high-pressure sensor that meets the following criteria:

- (1) Interlocked into the trainer control system
- (2) Located downstream of the system pressure-reducing regulator(s)
- (3) Have a set point below the lowest rated operating pressure of any gas component positioned downstream of the final pressure control

- (4) Have a trip that causes all of the system burner(s) to shut down and the event to be indicated to the trainer control system

8.5.5.3 Combustion Air.

8.5.5.3.1 The fuel-burning system design shall provide a supply of clean combustion air mechanically delivered in amounts prescribed by the appliance manufacturer across the full range of burner operation.

8.5.5.3.2 Products of combustion, steam, simulated smoke, and other contaminants shall not be mixed with or introduced into the combustion air supply.

8.5.5.3.3 Where combustion air is provided mechanically, combustion airflow or pressure shall be proven and interlocked with the safety shutoff valves so that fuel gas cannot be admitted prior to establishment of combustion air and so that the gas is shut off in the event of combustion air failure.

8.5.5.3.4 Where a combustion air adjustment is provided, adjustment shall include a locking method to prevent an unintentional change in setting.

8.5.5.4 Exhaust Ventilation System.

8.5.5.4.1 An exhaust ventilation system capable of removing heat, smoke, and unburned gas shall be installed for each burn room in the live fire training structure.

8.5.5.4.2 The exhaust fan shall be rated for continuous high-temperature operation and shall be listed.

8.5.5.4.3 The exhaust ventilation system shall be sized, when operating at high speed, to provide a minimum of one air change per minute in the related live fire training space(s).

8.5.5.4.3.1 The exhaust ventilation system shall be commanded to run at high speed during all e-stop events to meet the minimum requirement of one air change per minute in the related live fire training space(s).

8.5.5.4.3.2 The exhaust ventilation system shall continue to run at high speed until the initiating e-stop event is cleared.

8.5.5.4.4 The ventilation system shall be interlocked with the fire generation control system so that a failure of the ventilation system shall inhibit the operation of the main burners of the related burn props in the space that the ventilation system serves.

8.5.5.4.4.1 During burn evolutions, the ventilation system shall not be required to operate at high speed.

8.5.5.4.5 The exhaust ventilation system shall be monitored for operation using an airflow sensor or other method of ensuring that a failure of the exhaust ventilation system is sensed by the fire generation control system.

8.5.5.4.6 The exhaust ventilation system airflow sensor shall not be capable of being bypassed or overridden to yield a false indication of positive airflow.

8.5.5.4.7* Provision for a quantity of makeup air shall be admitted to burn rooms to provide the air volume required for the safety exhaust ventilation system to operate at rated maximum airflow when all doors and windows to the burn room are fully closed.

8.5.5.4.8 The exhaust ventilation extraction point for the burn room shall be at or near the uppermost horizontal surface of the burn space.

8.5.5.4.8.1 The extraction opening shall be permitted to be in the ceiling surface or at the highest point of a vertical burn room wall.

8.5.5.4.9 Exhaust ventilation fans shall be located in areas where they can be inspected and maintained.

8.5.5.4.10 Exhaust ventilation fans shall have local power disconnects provided in accordance with *NFPA 70*.

8.5.5.5 Exhaust Ventilation Ductwork.

8.5.5.5.1 If exhaust ventilation ductwork is provided as part of the exhaust ventilation system design, the provisions in 8.5.5.5.2 through 8.5.5.5.6 shall be followed.

8.5.5.5.2 Ductwork shall be constructed entirely of corrosion-resistant metal capable of meeting the intended installation and conditions of service.

8.5.5.5.3 The installation shall be protected where subject to physical damage.

8.5.5.5.4 All ductwork shall be made tight throughout and shall have no openings other than those required for the operation and maintenance of the system.

8.5.5.5.5 All ductwork shall be braced where required and shall be supported by corrosion-resistant metal hangers or brackets.

8.5.5.5.6 Exhaust fans, exhaust ducts, or both shall not discharge near openings or other air intakes where effluents can be entrained and directed to locations creating a hazard.

8.5.5.6 Temperature Monitoring System.

8.5.5.6.1 One or more interlocked temperature monitoring devices that measure the temperatures within the live fire training environment shall be installed in each burn room.

8.5.5.6.2 A measuring device shall be mounted at a level of 5 ft (1.5 m) above finished floor (AFF), at a location between the gas-fueled appliance and first point of ventilation and where trainees are expected to frequent.

8.5.5.6.3 A high-temperature shutdown shall occur when temperature reaches the lower of 500°F (260°C) or 50°F (10°C) below the temperature limits of all PPE, to avoid injuries and equipment damage.

8.5.5.6.4 Upon activation of a high-temperature shutdown, all burners in the related space shall be automatically shut down, and forced, full-volume mechanical ventilation of the related training space shall be initiated automatically by the control system.

8.5.5.6.5 The ventilation operation shall continue until the measured temperature on the interlocked temperature monitoring system(s) falls below the set point.

8.5.5.7 Combustible Gas Detection System.

8.5.5.7.1 Combustible gas detection shall be provided in training and equipment spaces where the possibility exists for the accumulation of unburnt gases either released during the operation of a gas-fueled live fire training system or leaked within the unventilated confines of an equipment area.

8.5.5.7.2 The gas detection system shall be interlocked to the control system to cause a system safety shutdown and activate an alarm when the level exceeds 25 percent of the lower explosive limit (LEL).

8.5.5.7.3 Forced, mechanical ventilation of the training space shall be initiated automatically by the control system when the safety shutdown occurs at the 25 percent LEL and continue until the measured LEL on all interlocked gas detection system falls below 10 percent.

8.5.5.7.4 Combustible gas detection installed within training and equipment spaces shall be designed to be continuously monitored during all live fire training activities.

8.5.5.7.5 Failure of the gas detection system shall inhibit the operation of live fire initiation within the related area of coverage of the failed gas detection system.

8.5.5.7.6* For live fire training structures with more than one room that includes a gas-fueled live fire training system, the gas detection systems shall be interlocked between any training rooms where the communication of gas could occur.

8.5.5.7.7 When interlocked, the gas detection system in remote rooms shall have the ability to cause a safety shutdown for all related gas-fueled live fire training systems.

8.5.5.7.8 Combustible gas detection shall be executed either by a direct monitoring gas detection system fixed gas sensor head installed within the live fire training room or by a drawn sample extraction gas detection system.

8.5.5.7.9 Direct Monitoring Combustible Gas Detection.

8.5.5.7.9.1 Direct monitoring systems shall include all of the following characteristics:

- (1) Be rated to operate within the high levels of humidity and moisture experienced under live fire training conditions
- (2) Include a spray shield and moisture prevention device
- (3) Be mounted in a location that will have temperatures within the normal operating range of the gas detector
- (4) Allow gas samples to be taken between burn room entrance and the burner at a height where the fuel gas is expected to be present
- (5) Continuously respond and react to the dynamic changes in unburned gas levels within the live fire training space
- (6) Be designed to have a sensor that is nonpoisonable

8.5.5.7.9.2 Drawn Sample Extraction Gas Detection. Sample extraction gas detection systems shall include all of the following characteristics:

- (1) Be rated to operate within the high levels of humidity and moisture experienced under live fire training conditions
- (2) Include a moisture prevention device
- (3) Utilize a pump to continuously draw samples of the live fire training environment
- (4) Allow draw samples to be taken in proximity to the equipment, between burn room entrance and the burner at a height where the fuel gas is expected to be present
- (5) Provide filtering to prohibit the solid contaminants from the sampled space from entering the sampling lines
- (6) Provide monitoring devices to detect flow rate deviations caused by disconnected sampling lines, clogged sampling lines, dirty filters, and sample pump failures
- (7) Continuously respond and react to the dynamic changes in unburned gas levels within the training space

8.5.5.7.9.3 Combustible Gas Sensing Locations.

(A)* The gas sensor/sample inlets shall be mounted in the airflow path between the live fire training system and ventilation outlets where they are most likely to detect the gas concentration.

(B)* The gas sensor/sample inlets shall be mounted in an area where it is accessible to routine maintenance and inspection.

(C) Protection for the gas sensor/sample inlet shall be provided in an area where it will be subjected to physical abuse, which would damage or impede the performance of the sensing system.

8.5.5.8 Operator Interface.

8.5.5.8.1 Operator Present Capability.

8.5.5.8.1.1 An operator present *deadman* feature shall be included in the control system for every fire prop.

8.5.5.8.1.2 Failure to maintain the operator present condition shall cause the related fire(s) to be immediately stopped.

8.5.5.8.1.3 The operator present feature shall not be disabled or bypassed.

8.6* System Operations and Maintenance Training.

8.6.1 Personnel who operate, maintain, or supervise the system shall be thoroughly instructed and trained in their respective job functions under the direction of a qualified person(s).

8.6.2 Personnel who operate, maintain, or supervise the system shall be required to demonstrate an understanding of the equipment, its operation, and practice of safe operating procedures in their respective job functions.

8.6.3 Personnel who operate, maintain, or supervise the system shall receive regularly scheduled refresher training and shall demonstrate understanding of the equipment, its operation, and practice of safe operating procedures in their respective job functions.

8.6.4 The training program shall cover start-up, shutdown, and lockout procedures in detail.

8.6.5 The training program shall be kept current with changes in equipment and operating procedures, and training materials shall be available for reference.

8.6.6 Operating instructions that include all of the following shall be provided by the live fire system manufacturer:

- (1) Schematic piping and wiring diagrams
- (2) Start-up procedures
- (3) Shutdown procedures
- (4) Emergency procedures, including those occasioned by loss of fuel gas, loss of electric power, ventilation malfunction, combustible gas levels, temperature levels, or interruption of other utilities
- (5) Maintenance procedures, including gas detection calibration, ventilation maintenance, interlock performance testing, and gas train pressure testing

8.7 Commissioning.

8.7.1 Commissioning shall be required for all new installations or for any changes that affect the safety system.

8.7.2 All components shall be installed and connected in accordance with the system design.

8.7.3 During commissioning, all piping that conveys flammable gases shall be inspected for leaks.

8.7.4 The gas-fueled live fire training system shall not be released for operation before the installation and testing of the required safety systems have been successfully completed.

8.7.5 Burner management systems shall be tested and verified for compliance with the design criteria when the burner management systems are installed, replaced, repaired, or updated.

8.7.6 Documentation shall be provided to the end user or to the approval authority that confirms that all related safety devices and safety logic are functional.

8.7.7 Any changes to the original design made during commissioning shall be reflected in the as-built documentation.

8.7.8 Set points of all safety interlock settings shall be documented.

8.7.9 Records of inspection, testing, and maintenance activities shall be provided to the owner.

8.8 Approvals.

8.8.1 Gas-fueled live fire training systems shall be listed or labeled by a third-party NRTL to ensure compliance with the requirements of this standard.

8.8.2 All safety critical components of the gas-fueled live fire training system shall be rated and labeled for the intended use.

8.8.3 The local electrical codes as appropriate and specified by the AHJ shall be adhered to in regards to the design and installation of the gas-fueled live fire training system.

8.9 Maintenance and Testing.

8.9.1 A regularly scheduled maintenance program shall be implemented based on the manufacturer's recommendations and include visual, operational, servicing, and calibration.

8.9.2 Maintenance inspections shall be conducted daily during use.

8.9.2.1 Maintenance service and calibration shall be conducted annually.

8.9.3 Safety devices shall be maintained in accordance with the manufacturer's instructions.

8.9.4 It shall be the responsibility of the system manufacturer to provide instructions for inspection, testing, and maintenance.

8.9.5 It shall be the responsibility of the user to establish, schedule, and enforce the frequency and extent of the inspection, testing, and maintenance program, as well as the corrective action to be taken.

8.9.6 All safety interlocks shall be tested for function annually.

8.9.7 The set point of temperature, pressure, or flow devices used as safety interlocks shall be verified annually.

8.9.8 Safety device testing shall be documented annually.

8.9.9 Gas pressure relief devices shall be visually inspected annually to ensure that they are unobstructed and properly labeled.

8.9.10 Testing frequency shall be annually.

8.10* Auxiliary Equipment.

8.10.1 The smoke generation system (if applicable) shall be interlocked into the safety network, and in the event of an e-stop or emergency shutdown, the production of smoke shall stop and any smoke duct fans shall shut off.

8.10.2 The sound system (if integrated into the live fire training system) shall be interlocked into the safety network, and in the event of an e-stop or emergency shutdown, all sound(s) shall stop.

8.10.3 The data logging system (if applicable) shall be interlocked into the safety network, and in the event of an e-stop or emergency shutdown, the data logging system shall continue operating or begin recording if not already.

8.10.4 The video recording system (if applicable) shall be interlocked into the safety network, and in the event of an e-stop or emergency shutdown, the video recording system shall continue operating or begin recording if not already operating.

Chapter 9 Gas-Fueled Live Fire Training Systems — Exterior

9.1 General.

9.1.1* A gas-fueled live fire training system shall include at a minimum, a gas-fueled training appliance and fire prop that generates and controls repeatable flames for training fire fighters on suppression techniques.

9.1.2 Burners, along with associated valves, regulators, safety controls, and other auxiliary components, shall be selected for the intended application, type, pressure of the fuel gases to be used, and the temperatures to which they are subjected.

9.1.3 Fire props and mock-ups shall maintain structural integrity while being used for training in accordance with NFPA 1403.

9.1.3.1 After extended use, mock-ups shall be able to be maintained or replaced without the replacement of the fire prop.

9.1.4 Mock-ups shall maintain structural integrity while being used for training in accordance with NFPA 1403.

9.1.4.1 After extended use, mock-ups shall be able to be maintained or replaced without the replacement of the fire-generating appliance.

9.2 Gas Equipment.

9.2.1 Fuel Storage. Installation of LP-Gas storage and handling systems (if applicable) shall comply with NFPA 58 or other applicable standards as recognized by the AHJ.

9.2.2 Gas Piping and Fittings.

9.2.2.1 Piping from the point of delivery to the equipment isolation valve shall comply with NFPA 54 or other applicable standards as recognized by the AHJ.

9.2.2.2 Fuel gas piping materials shall be in accordance with NFPA 54 or other applicable standards as recognized by the AHJ.

9.2.2.3 Fuel gas piping shall be sized to provide flow rates and pressure to maintain a stable flame throughout the burner operating range.

9.2.3 Control of Contaminants.

9.2.3.1 A sediment trap shall be installed downstream of the appliance isolation valve and upstream of all other fuel gas system components.

9.2.3.2 Sediment traps shall have a vertical leg with a minimum length of three pipe diameters [minimum of 3 in. (80 mm)] of the same size as the supply pipe.

9.2.3.3 A minimum of one gas filter or strainer shall be installed in the fuel gas piping and shall be located to protect the downstream gas components.

9.2.4 Appliance Isolation Valves.

9.2.4.1 Manually operated equipment isolation valves shall meet the following requirements:

- (1) They shall be provided for each appliance.
- (2) They shall be quarter-turn valves with stops.
- (3) Handles shall remain affixed to valves and shall be oriented with respect to the valve port to indicate the following:
 - (a) An open valve when the handle is parallel to the pipe
 - (b) A closed valve when the handle is perpendicular to the pipe
- (4) They shall be accessible.
- (5) They shall be able to be operated from full open to full close and return without the use of tools.

9.2.5 Fuel Pressure Regulators.

9.2.5.1 A fuel pressure regulator shall be furnished wherever the supply pressure exceeds the system operating or design parameters or wherever the supply pressure is subject to fluctuations.

9.2.5.2 Vents shall be designed to prevent the entry of water and insects without restricting the flow capacity of the vent.

9.2.5.3 Safety Shutoff Valves.

9.2.5.3.1 Each appliance shall be separately equipped with at least two safety fuel gas shutoff valves in series that automatically shut off the fuel to the burner system in each of the following events:

- (1) Interruption of electrical power
- (2) Activation of any interlocking safety devices
- (3) Activation of flame safeguard (if applicable)
- (4) Failure of the operational controls
- (5) Activation of manual shutdown stations

9.2.5.3.2 Each safety shutoff valve shall automatically shut off the fuel to the burner system after interruption of the holding medium (such as electric current or fluid pressure) by one of the interlocking safety devices, or operational controls.

9.2.5.3.3 Safety shutoff valves shall not be used as modulating control valves unless they are designed as both safety shutoff and modulation valves and tested for concurrent use.

9.2.5.3.4 Safety shutoff valves shall not be open-close cycled at a rate that exceeds that specified by its manufacturer.

9.2.5.3.5 Valve components shall be of a material selected for compatibility with the fuel handled and for ambient conditions.

9.2.5.3.6 Safety shutoff valves in systems containing particulate matter or highly corrosive fuel gas shall be operated at time intervals in accordance with the manufacturer's instructions in order to maintain the safety shutoff valves in operating condition.

9.2.5.3.7 Valves shall not be subjected to supply pressures in excess of the manufacturer's ratings.

9.2.5.3.8 The safety shutoff valves shall close in 1 second or less upon being de-energized.

9.2.5.3.9 Each main fuel gas burner system shall be separately equipped with two safety shutoff valves wired in parallel and piped in series.

9.2.6 Overpressure Protection.

9.2.6.1 Overpressure protection shall be provided in either of the following cases:

- (1) When the gas supply pressure exceeds the pressure rating of any downstream component
- (2) When the failure of a single upstream line regulator or service pressure regulator results in a supply pressure exceeding the pressure rating of any downstream component

9.2.6.2 Overpressure protection shall be provided by any one of the following:

- (1) A monitoring regulator installed in series with the service or line pressure regulator in accordance with NFPA 54
- (2) A full-capacity pressure relief valve
- (3) An overpressure cutoff device, such as a slam-shut valve or a high-pressure switch in combination with a compliant shutoff valve

9.2.6.3 Hydrostatic relief valves shall be installed on liquid LP-Gas lines as directed by NFPA 58.

9.3 Fuel Types. Liquefied versions of flammable gas shall be permitted for use in exterior live fire training systems. *(For the use of combustible and flammable liquids for exterior live fire training systems, refer to Chapter 13.)*

9.4 Main Gas Burners and Pilot Burners.

9.4.1 Burners shall be used only with the fuels for which they are designed.

9.4.2 All pressures required for operation of the combustion system shall be maintained within the design ranges throughout the firing cycle.

9.4.3 Burners shall have the ignition source sized and located in a position that provides ignition of the pilot or main flame within the design trial-for-ignition period.

9.4.4 The pilot ignition source (e.g., electric spark, hot wire, pilot burners) shall be applied at the design location with the designed intensity to ignite the flame pilot burner air-fuel mixture.

9.4.5 Pilot burners shall be mounted to prevent unintentional changes in location and in direction with respect to the main flame burners.