

# NFPA® 290

## Standard for Fire Testing of Passive Protection Materials for Use on LP-Gas Containers

### 2009 Edition



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

## **IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA DOCUMENTS**

### **NOTICE AND DISCLAIMER OF LIABILITY CONCERNING THE USE OF NFPA DOCUMENTS**

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

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

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

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

## **ADDITIONAL NOTICES AND DISCLAIMERS**

### **Updating of NFPA Documents**

Users of NFPA codes, standards, recommended practices, and guides should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of Tentative Interim Amendments. An official NFPA document at any point in time consists of the current edition of the document together with any Tentative Interim Amendments and any Errata then in effect. In order to determine whether a given document is the current edition and whether it has been amended through the issuance of Tentative Interim Amendments or corrected through the issuance of Errata, consult appropriate NFPA publications such as the National Fire Codes® Subscription Service, visit the NFPA website at [www.nfpa.org](http://www.nfpa.org), or contact the NFPA at the address listed below.

### **Interpretations of NFPA Documents**

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

### **Patents**

The NFPA does not take any position with respect to the validity of any patent rights asserted in connection with any items which are mentioned in or are the subject of NFPA codes, standards, recommended practices, and guides, and the NFPA disclaims liability for the infringement of any patent resulting from the use of or reliance on these documents. Users of these documents are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

NFPA adheres to applicable policies of the American National Standards Institute with respect to patents. For further information contact the NFPA at the address listed below.

### **Law and Regulations**

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

### **Copyrights**

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

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

### **For Further Information**

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

For more information about NFPA, visit the NFPA website at [www.nfpa.org](http://www.nfpa.org).

Copyright © 2008 National Fire Protection Association®. All Rights Reserved.

**NFPA® 290**

**Standard for**

**Fire Testing of Passive Protection Materials  
for Use on LP-Gas Containers**

**2009 Edition**

This edition of NFPA 290, *Standard for Fire Testing of Passive Protection Materials for Use on LP-Gas Containers*, was prepared by the Technical Committee on Fire Tests. It was issued by the Standards Council on May 30, 2008, with an effective date of July 18, 2008, and supersedes all previous editions.

This edition of NFPA 290 was approved as an American National Standard on July 18, 2008.

**Origin and Development of NFPA 290**

Although the 2003 edition was the first edition of NFPA 290, *Fire Testing of Passive Protection Materials for Use on LP-Gas Containers*, a test procedure for torch fire and hose stream testing of thermal insulating systems for LP-Gas containers has been included as an annex to NFPA 58, *Liquefied Petroleum Gas Code*, since the 1986 edition of that code. That test method was developed by the Technical Committee on Fire Tests at the request of the Technical Committee on Liquefied Petroleum Gases as a result of numerous BLEVE incidents that had occurred in previous years. In the mid-1990s, the test procedure saw greater use, particularly outside the United States, and the two technical committees agreed that it should be developed and maintained as a fire test standard under the scope of the Fire Test Committee rather than as an annex to NFPA 58.

The 2003 edition of NFPA 290 represented a refinement of the test procedure that previously appeared as an appendix to NFPA 58, and it reorganized the procedure as a stand-alone fire test standard using mandatory language in accordance with the *Manual of Style for NFPA Technical Committee Documents*.

The 2009 edition contains revisions to clarify its scope and purpose, and a revised definition of the term “passive fire protection material.”

## Technical Committee on Fire Tests

**William E. Fitch, Chair**  
Phyrefish Enterprises, Inc., FL [SE]

**Farid Alfawakhiri,** American Iron and Steel Institute, IL [M]  
Rep. American Iron and Steel Institute  
**Barry L. Badders, Jr.,** Southwest Research Institute, TX [RT]  
**Jesse J. Beitel,** Hughes Associates, Inc., MD [SE]  
**April L. Berkol,** Starwood Hotels & Resorts Worldwide, Inc., NY [U]  
Rep. American Hotel & Lodging Association  
**Robert G. Bill, Jr.,** FM Global, MA [I]  
**John A. Blair,** The DuPont Company, DE [M]  
Rep. Society of the Plastics Industry, Inc.  
**Gordon H. Damant,** Inter-City Testing & Consulting Corp. of California, CA [SE]  
**Thomas W. Fritz,** Armstrong World Industries, Inc., PA [M]  
**Gordon E. Hartzell,** Hartzell Consulting, Inc., TX [SE]  
**Marcelo M. Hirschler,** GBH International, CA [SE]  
**William E. Koffel,** Koffel Associates, Inc., MD [SE]

**James R. Lawson,** U.S. National Institute of Standards and Technology, MD [RT]  
**Rodney A. McPhee,** Canadian Wood Council, Canada [M]  
**Frederick W. Mowrer,** University of Maryland, MD [SE]  
**Deggary N. Priest,** Intertek Testing Services NA, Inc., TX [RT]  
**David T. Sheppard,** U.S. Department of Justice, MD [RT]  
**Dwayne E. Sloan,** Underwriters Laboratories Inc., NC [RT]  
Rep. Underwriters Laboratories Inc.  
**Kuma Sumathipala,** American Forest & Paper Association, DC [M]  
Rep. American Forest & Paper Association  
**T. Hugh Talley,** Hugh Talley Company, TN [M]  
Rep. Upholstered Furniture Action Council  
**Rick Thornberry,** The Code Consortium, Inc., CA [SE]  
**William A. Webb,** Schirmer Engineering Corporation, IL [I]  
**Robert A. Wessel,** Gypsum Association, DC [M]

### Alternates

**Scott W. Adams,** Park City Fire Service District, UT [E]  
(Voting Alt. to IFMA Rep.)  
**Robert M. Berhinig,** Underwriters Laboratories Inc., IL [RT]  
(Alt. to D. E. Sloan)  
**Richard J. Davis,** FM Global, MA [I]  
(Alt. to R. G. Bill, Jr.)  
**Sam W. Francis,** American Forest & Paper Association, PA [M]  
(Alt. to K. Sumathipala)  
**Richard G. Gann, Ph.D.,** U.S. National Institute of Standards and Technology, MD [RT]  
(Alt. to J. R. Lawson)  
**Paul A. Hough,** Armstrong World Industries, Inc., PA [M]  
(Alt. to T. W. Fritz)

**Marc L. Janssens,** Southwest Research Institute, TX [RT]  
(Alt. to B. L. Badders, Jr.)  
**James K. Lathrop,** Koffel Associates, Inc., CT [SE]  
(Alt. to W. E. Koffel)  
**James A. Milke,** University of Maryland, MD [SE]  
(Alt. to F. W. Mowrer)  
**Arthur J. Parker,** Hughes Associates, Inc., MD [SE]  
(Alt. to J. J. Beitel)  
**Ineke Van Zeeland,** Canadian Wood Council, Canada [M]  
(Alt. to R. A. McPhee)  
**Robert J. Wills,** American Iron and Steel Institute, AL [M]  
(Alt. to F. Alfawakhiri)  
**Joe Ziolkowski,** American Furniture Manufacturers Association, NC [M]  
(Alt. to T. H. Talley)

### Nonvoting

**Robert H. Barker,** American Fiber Manufacturers Association, VA [M]

**Rohit Khanna,** U.S. Consumer Product Safety Commission, MD [C]

**Gregory E. Harrington,** NFPA Staff Liaison

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

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

**Committee Scope:** This Committee shall have primary responsibility for documents on fire testing procedures, for reviewing existing fire test standards and recommending appropriate action to NFPA, for recommending the application of and advising on the interpretation of acceptable test standards for fire problems of concern to NFPA technical committees and members, and for acting in a liaison capacity between NFPA and the committees of other organizations writing fire test standards. This Committee does not cover fire tests that are used to evaluate extinguishing agents, devices, or systems.

## Contents

|                                                                        |               |                                                |               |
|------------------------------------------------------------------------|---------------|------------------------------------------------|---------------|
| <b>Chapter 1 Administration</b> .....                                  | <b>290– 4</b> | <b>Chapter 6 Test Location</b> .....           | <b>290– 5</b> |
| 1.1 Scope .....                                                        | 290– 4        | 6.1 Environmental Effects .....                | 290– 5        |
| 1.2 Purpose .....                                                      | 290– 4        | 6.2 Air Temperature .....                      | 290– 6        |
| 1.3 Application .....                                                  | 290– 4        | 6.3 Wind Limitations .....                     | 290– 6        |
| 1.4 Units and Formulas .....                                           | 290– 4        | 6.4 Adverse Weather .....                      | 290– 6        |
| <b>Chapter 2 Referenced Publications</b> .....                         | <b>290– 4</b> | <b>Chapter 7 Conduct of Tests</b> .....        | <b>290– 6</b> |
| 2.1 General .....                                                      | 290– 4        | 7.1 Test Assembly .....                        | 290– 6        |
| 2.2 NFPA Publications. (Reserved) .....                                | 290– 4        | 7.2 Calibration Test .....                     | 290– 6        |
| 2.3 Other Publications .....                                           | 290– 4        | 7.3 Conduct of Torch Test .....                | 290– 6        |
| 2.4 References for Extracts in Mandatory<br>Sections. (Reserved) ..... | 290– 4        | 7.4 Hose Stream Test .....                     | 290– 6        |
| <b>Chapter 3 Definitions</b> .....                                     | <b>290– 4</b> | 7.5 Conditions of Acceptance .....             | 290– 7        |
| 3.1 General .....                                                      | 290– 4        | 7.6 Environmental Conditions .....             | 290– 7        |
| 3.2 NFPA Official Definitions .....                                    | 290– 4        | 7.7 Measurements .....                         | 290– 7        |
| 3.3 General Definitions .....                                          | 290– 5        | 7.8 Observations .....                         | 290– 7        |
| <b>Chapter 4 Test Specimens</b> .....                                  | <b>290– 5</b> | 7.9 Photographs .....                          | 290– 7        |
| 4.1 Construction of Test Specimen .....                                | 290– 5        | 7.10 Video .....                               | 290– 7        |
| 4.2 Construction of Rear Box .....                                     | 290– 5        | <b>Chapter 8 Presentation of Results</b> ..... | <b>290– 7</b> |
| 4.3 Passive Fire Protection (PFP) Material .....                       | 290– 5        | 8.1 Test Report .....                          | 290– 7        |
| <b>Chapter 5 Torch Fire</b> .....                                      | <b>290– 5</b> | <b>Annex A Explanatory Material</b> .....      | <b>290– 7</b> |
| 5.1 Torch Fire Nozzle .....                                            | 290– 5        | <b>Annex B Informational References</b> .....  | <b>290– 8</b> |
| 5.2 Torch Fire Exposure .....                                          | 290– 5        | <b>Index</b> .....                             | <b>290– 9</b> |
| 5.3 Fuel .....                                                         | 290– 5        |                                                |               |

## NFPA 290

### Standard for

## Fire Testing of Passive Protection Materials for Use on LP-Gas Containers

### 2009 Edition

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

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

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.

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

## Chapter 1 Administration

**1.1\* Scope.** The test described in this procedure shall be used to determine the fire resistance of passive fire protection (PFP) materials applied to the exterior of LP-Gas containers.

**1.2 Purpose.** This test is designed to evaluate the fire resistance of passive fire protection (PFP) materials in a torch fire environment created by the rupture of a nearby storage vessel.

**1.2.1\*** This test procedure subjects an insulated steel plate, simulating an LP-Gas storage vessel, to a torch fire exposure for 50 minutes. After 20 minutes of the torch fire exposure, the insulated steel plate is subjected simultaneously to the torch fire exposure and a hose stream for 10 minutes.

### 1.3 Application.

**1.3.1** This procedure shall be a test of materials and not a test of assemblies. If necessary, additional testing shall be performed to determine the effectiveness of the material protecting a particular assembly or fabrication.

**1.3.2\*** Although the test has been designed to reproduce conditions similar to those found in fires resulting from realistic releases of hydrocarbons, this test does not guarantee a specific degree of protection from the myriad of possible fires involving LP-Gas storage vessels or containers.

**1.3.3** The test involves hazardous materials and operations.

**1.3.3.1** The procedure does not address all of the safety problems associated with its use.

**1.3.3.2** It shall be the responsibility of the user of the procedure to establish the safety and health practices and determine the applicability of regulatory limitations before use.

**1.3.3.3** It shall be the responsibility of the supplier to inform the testing laboratory of any dangerous properties of the material to be tested, fumes given off during testing, and the residues after testing.

**1.3.4** Although the test specified has been designed to simulate some of the conditions that occur in an actual LP-Gas fueled torch fire, it does not reproduce them all exactly.

**1.3.4.1** The results of this test do not guarantee safety but can be used as elements of a fire hazard or fire risk assessment for structures or plants.

**1.3.4.2** The fire hazard or fire risk assessment shall also take into account all the other factors that are pertinent to an assessment of the fire hazard for a particular end use.

**1.3.5** This test does not offer an assessment of other properties of the passive fire protection material such as weathering, aging, shock resistance, impact or explosion resistance, flame spread, or smoke production.

### 1.4 Units and Formulas.

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

**1.4.2 Primary Values.** The SI value for a measurement and the equivalent inch-pound value given in parentheses shall each be acceptable for use as primary units for satisfying the requirements of this standard.

## 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. (Reserved)

### 2.3 Other Publications.

**2.3.1 ANSI/UL Publications.** Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 385, *Standard for Safety Play Pipes for Water Supply Testing in Fire Protection Service*, 2006.

### 2.3.2 Other Publications.

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

### 2.4 References for Extracts in Mandatory Sections. (Reserved)

## 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 Shall.** Indicates a mandatory requirement.



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

**3.2.3 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 Fire Resistance.** An indication of the length of time for which a structure will continue to resist the effect of a standard fire test before reaching thermal failure.

**3.3.2\* Passive Fire Protection (PFP) Material.** A material that is applied to a substrate and designed to protect it from the thermal effects of a fire.

**3.3.2.1 Passive Fire Protection — Coating Material.** A material that is applied to a substrate and is designed to protect it from thermal effects.

**3.3.2.2 Passive Fire Protection — Panel Material.** A material in the form of a panel or sheet, including pre-formed components, which are designed to stand alone prior to application to a steel substrate.

**3.3.3 Rear Box.** A mild steel box, open at the front and back, which is designed to be attached to the rear of the test specimen to shield it from environmental influences.

**3.3.4 Test Specimen.** A steel plate, thermally protected with an insulation material, exposed to the simulated gas impingement jet or torch fire.

**3.3.5 Torch Fire.** An ignited discharge of propane vapors under pressure.

## Chapter 4 Test Specimens

### 4.1 Construction of Test Specimen.

**4.1.1** Two test specimens shall be required to conduct this test.

**4.1.2** One test specimen shall be an uninsulated steel plate used for calibration of the propane torch fire exposure.

**4.1.3** A second test specimen shall be thermally protected with the insulation material at the thickness, density, and installation techniques being evaluated.

**4.1.4** The test specimen dimensions shall not be less than 1.2 m × 1.2 m (4 ft × 4 ft) by nominal 16 mm (5/8 in.) thick.

**4.1.5** The test specimens shall be constructed using a steel plate with thermal properties equivalent to ASME pressure vessel steel.

**4.1.6** Multiple insulated test specimens shall be permitted to be evaluated in a single test program, provided the test specimens are tested consecutively.

**4.1.7** The test specimen shall be mounted on a steel-plate holder such that the exposed face of the test specimen is not shielded in any way by the test specimen fixture.

**4.1.8** The steel-plate holder shall be constructed in such a manner that the only heat transfer to the backside of the plate

is by heat conduction through the plate and not by any other heat paths.

**4.1.9** The test specimen shall be mounted vertically.

**4.1.10** The rear box shall be installed to the unexposed face of the test specimen in a manner such that all joints are gastight.

### 4.2 Construction of Rear Box.

**4.2.1** All tests require fitting the rear box to the unexposed side of the test specimen to shield the unexposed face from environmental influences.

**4.2.2** The rear box shall be constructed from mild steel a minimum of 10 mm (3/8 in.) thick.

**4.2.3** The rear box shall be open at the front and back and flanged at the front to allow fitting to the rear of the test specimen with no significant air gaps.

**4.2.4** The internal dimensions of the rear box shall match the dimensions of the test specimen and be a minimum of 1 m (3 ft) deep.

### 4.3 Passive Fire Protection (PFP) Material.

**4.3.1** Documentation of the method of preparation of the test specimen and the application details of the PFP material shall be provided to the test laboratory in advance of the test.

**4.3.2** The test laboratory shall include this information in the test report.

## Chapter 5 Torch Fire

**5.1 Torch Fire Nozzle.** The propane vapor shall be issued from a nozzle capable of meeting the requirements of this test standard.

### 5.2 Torch Fire Exposure.

**5.2.1** The flame temperature from the torch fire shall be 1200°C ± 60°C (2200°F ± 140°F) for the duration of the test.

**5.2.2** The velocity of the torch fire at the exposed face of the test specimen shall be 64 km/hr ± 16 km/hr (40 mph ± 10 mph) for the duration of the test.

**5.2.3** The tip of the discharge nozzle shall be aimed horizontally perpendicular and centered such that the apex of the flame shall be directed to impinge on the geometric center of the test specimen.

**5.2.4** The tip of the discharge nozzle shall be positioned at a distance from the exposed face of the test specimen to achieve the temperature and velocity requirements specified in 5.2.1 and 5.2.2.

### 5.3 Fuel.

**5.3.1** The fuel shall be a propane fuel delivered as a vapor, without a liquid fraction, at a steady flow rate such that the requirements of 5.2.1 and 5.2.2 are met.

**5.3.2** There shall be a means of controlling and monitoring the fuel flow of the propane fuel during the torch test.

## Chapter 6 Test Location

**6.1 Environmental Effects.** The test shall be carried out in a test location such that environmental effects are minimized.

**6.2 Air Temperature.** The ambient air temperature at the start of the test shall be between  $-10^{\circ}\text{C}$  and  $41^{\circ}\text{C}$  ( $14^{\circ}\text{F}$  and  $105^{\circ}\text{F}$ ).

**6.3 Wind Limitations.** The wind conditions for tests conducted outdoors shall be less than 16 km/hr (10 mph) for the duration of the test.

**6.4 Adverse Weather.** Tests shall not be conducted outdoors during periods of rain or fog or other adverse weather conditions that could affect the outcome of the test.

## Chapter 7 Conduct of Tests

### 7.1 Test Assembly.

**7.1.1** The test specimen shall be adequately restrained in the test specimen fixture throughout the torch and hose stream tests.

**7.1.2** The test duration shall be a minimum of 50 minutes.

### 7.2 Calibration Test.

**7.2.1** Prior to evaluating the performance of the thermal insulation system, the torch impingement shall be calibrated as described in 7.2.2 through 7.2.7.

**7.2.2** An uninsulated steel plate, as described in Section 4.1, shall be installed in the steel-plate holder.

**7.2.3\*** The unexposed face of the uninsulated steel plate shall be instrumented with not fewer than nine thermocouples.

**7.2.4** The thermocouples attached to the unexposed face of the test specimen shall be divided into nine equal squares with a thermocouple affixed to the center of each square.

**7.2.5** Before exposure to the torch fire, none of the thermocouple readings on the unexposed side of the steel plate shall indicate a plate temperature in excess of  $38^{\circ}\text{C}$  ( $100^{\circ}\text{F}$ ) or less than  $0^{\circ}\text{C}$  ( $32^{\circ}\text{F}$ ).

**7.2.6** Temperature measurements shall be monitored during the course of the calibration test and recorded at intervals not exceeding 30 seconds.

**7.2.7** A calibration test shall be deemed successful when two of the nine thermocouples record unexposed face temperatures of  $427^{\circ}\text{C}$  ( $800^{\circ}\text{F}$ ) within 4 minutes  $\pm$  0.5 minute from the start of the test.

### 7.3 Conduct of Torch Test.

**7.3.1** A thermal insulation system shall be tested in the torch environment described in Section 7.2 in the manner described in 7.3.1.1 through 7.3.1.8.

**7.3.1.1** The thermal insulation system shall be applied to the exposed side of a steel plate identical to that used during the calibration test described in Section 7.2.

**7.3.1.2** The unexposed side of the steel plate shall be instrumented with a minimum of nine thermocouples placed as described in 7.2.3 to record the thermal response of the steel plate.

**7.3.1.3** Before exposure to the torch fire, none of the thermocouple readings on the unexposed side of the insulated steel plate shall indicate a plate temperature in excess of  $38^{\circ}\text{C}$  ( $100^{\circ}\text{F}$ ) or less than  $0^{\circ}\text{C}$  ( $32^{\circ}\text{F}$ ).

**7.3.1.4** The entire surface of the thermal insulation system shall be exposed to the torch fire environment.

**7.3.1.5** The test specimen shall be exposed to the torch fire environment described in Section 7.2.

**7.3.1.6** The insulated test specimen shall be exposed to the torch fire for 50 minutes.

**7.3.1.7** Twenty minutes into the torch test, a hose stream test shall be conducted concurrently, as described in Section 7.4, for 10 minutes.

**7.3.1.8** Subsequent to the application of the hose stream, the torch test shall continue until any thermocouple on the unexposed face of the steel plate indicates a plate temperature in excess of  $427^{\circ}\text{C}$  ( $800^{\circ}\text{F}$ ) or until a total test time of 50 minutes has elapsed.

### 7.4 Hose Stream Test.

**7.4.1** During the torch test, the insulated test specimen shall be exposed to a hose stream test.

**7.4.2** After 20 minutes of exposure to the torch test, the test specimen shall be exposed to a hose stream test.

**7.4.3** The hose stream test shall be conducted concurrently with the torch test for a period of 10 minutes.

**7.4.4** The hose stream shall be delivered through a 64 mm (2 in.) diameter hose discharging through a National Standard play pipe as specified in ANSI/UL 385, *Standard for Safety Play Pipes for Water Supply Testing in Fire Protection Service*.

**7.4.4.1** The play pipe shall have an overall length of 762 mm (30 in.) and shall be equipped with a 28 mm ( $1\frac{1}{8}$  in.) diameter discharge tip of the standard-taper, smooth bore pattern without shoulder at the orifice.

**7.4.4.2** The play pipe shall be fitted with a 64 mm (2 in.) inside diameter by 152 mm (6 in.) long nipple mounted between the hose and the base of the play pipe.

**7.4.4.3** The pressure tap for measuring the water pressure at the base of the nozzle shall be normal to the surface of the nipple, centered in its length.

**7.4.4.4** The pressure tap shall not protrude into the water stream.

**7.4.4.5** The water pressure shall be measured with a pressure gauge [as a minimum 0 kPa to 345 kPa (0 psig to 50 psig)] graduated in no more than 13.8 kPa (2 psig) increments.

**7.4.5** The water pressure at the base of the nozzle and for the duration of the hose stream test shall be 207 kPa (30 psig).

**7.4.5.1** The estimated delivery rate of water shall be 776 L/min (205 gpm) or 7760 L (2050 gal) over the 10-minute hose stream test.

**7.4.6 Nozzle Distance.** The nozzle orifice shall be located 6 m (20 ft) from and on a line normal to the center of the exposed surface of the test specimen.

**7.4.6.1** If the nozzle cannot be located normal to the surface of the test specimen, the nozzle shall be on a line deviating not to exceed 30 degrees from the line normal to the center of the test specimen.

**7.4.6.2** When so located, the distance from the center of the test specimen shall be less than 6 m (20 ft) by an amount equal to 0.3 m (1 ft) for each 10 degrees of deviation from the normal.



**7.4.7** The hose stream shall be directed first at the middle of the test specimen and then at all parts of the exposed surface, making changes in direction slowly.

**7.5 Conditions of Acceptance.** None of the thermocouples on the unexposed side of the steel plate shall indicate a temperature in excess of 427°C (800°F) for a period of 50 minutes.

**7.6 Environmental Conditions.**

**7.6.1** Environmental conditions shall be measured immediately before the test, and any significant changes during the test shall be noted.

**7.6.2** The ambient temperature shall be measured. For tests conducted outdoors, wind speed and direction shall also be measured. Observations shall also be made of the weather, to indicate whether it is sunny or cloudy or whether there is any precipitation.

**7.7 Measurements.** A steady flow rate of propane vapor shall be required.

**7.7.1** When the torch fire first impinges on the test specimen, a timer shall be started and the flow rate, temperatures, and pressures shall be monitored.

**7.7.2** Readings of the instruments shall be taken at least once every 30 seconds.

**7.7.3** The tests shall continue until either the time or temperature selected prior to the test is reached.

**7.8 Observations.**

**7.8.1** Observations of significant details of the behavior and appearance of the test specimen during the test and after the torch fire is extinguished shall be recorded.

**7.8.2** Information on deformation, spalling, cracking, and burning of the PFP material and continuance of flaming shall be noted.

**7.9 Photographs.**

**7.9.1** Photographs of the test specimen shall be taken prior to and as soon as is practicable after the torch test has been extinguished.

**7.9.2** The photographs described in 7.9.1 shall be included in the test report.

**7.10 Video.** A video record shall be made of the test.

- (b) Record of the fuel pressure and temperature at least every 30 seconds throughout the test, where these are used to calculate mass flow rate, and the method of control and calculation.
- (c) Record of fuel mass flow rate at least every 30 seconds throughout the test and total mass of fuel used.
- (d) For reacting materials, the thickness of unreacted or partially reacted material left at the end of the test and the char thickness at the positions where the initial thickness was measured. The condition of the char and the strength of bonding to the underlying material shall be recorded.
- (e) For materials restrained/supported by a reinforcing mesh, the condition of the mesh at the end of the test.
- (6) The test result, in the following format:
  - (a) The behavior and appearance of the test specimen during and after the test and photographs, as detailed in Section 7.8 and Section 7.9.
  - (b) Temperature/time plots and tables of temperatures at least every 30 seconds for each thermocouple.
  - (c) Record of the maximum temperature and the time it occurs for each thermocouple.
  - (d) Statement as to the material's performance with respect to the conditions of acceptance.

## Annex A Explanatory Material

*Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.*

**A.1.1** Thermal protection insulating systems are allowed for use on LP-Gas containers as a means of "Special Protection" in NFPA 58, *Liquefied Petroleum Gas Code*, and NFPA 59, *Utility LP-Gas Plant Code*. These standards have required that these materials undergo thermal performance testing as a precondition for acceptance. The intent of this testing procedure is to identify insulation systems that retard or prevent the release of the container's contents in a fire environment of 50 minutes' duration and that will resist a concurrent hose stream of 10 minutes' duration.

This test method provides a replacement for the test as described in Annex H of NFPA 58 and referenced in NFPA 59.

**A.1.2.1** The torch exposure simulates the high temperature and erosive effects of a high-pressure jet of burning fuel vapor issuing from a nearby ruptured LP-Gas storage vessel. The hose stream simulates a fire fighter hose stream impingement on the insulated steel tank.

**A.1.3.2** This test is an evaluation based on a "torching" type fire exposure. Other fire exposures such as a pool fire are a potential concern. It is believed, however, that the "torching" test is a worst-case fire scenario because of the high-temperature exposure coupled with the erosive effects of the high-velocity flame.

**A.3.3.2 Passive Fire Protection (PFP) Material.** Passive fire protection materials can be in the form of coatings or in the form of panels or sheets, including preformed components, that are designed to stand alone prior to application to a substrate.

**A.7.2.3** Thermocouples can be attached to the steel plate via several methods. One such method is to weld the individual thermocouple leads directly to the steel plate, with the individual leads separated by 6 mm (¼ in.) or less. Another method is to "peen" the thermocouples in place. This entails

## Chapter 8 Presentation of Results

**8.1 Test Report.** A test report shall be produced and shall include the following information:

- (1) Name of the testing laboratory and the test date.
- (2) Names of the sponsor/customer, the manufacturer, and the product.
- (3) Documentation of how and when the test specimen was prepared, details of the application of the PFP material, and the name of the applicator company.
- (4) A description of the test specimen, including measurements of the thickness of passive fire protection material and the hardness, if measured. The mean, standard deviation, and range of measurements of thickness shall be given.
- (5) Record of test details, as follows:
  - (a) Ambient conditions.

drilling a small diameter indentation into the steel plate. This indentation is less than the diameter of the thermocouple bead. The thermocouple bead is placed in the indentation, and the surrounding metal is “peened” over the thermocouple bead to secure it in place.

## **Annex B Informational References**

**B.1 Referenced Publications.** The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the require-

ments of this document unless also listed in Chapter 2 for other reasons.

**B.1.1 NFPA Publications.** National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 58, *Liquefied Petroleum Gas Code*, 2008 edition.

NFPA 59, *Utility LP-Gas Plant Code*, 2008 edition.

**B.1.2 Other Publications. (Reserved)**

**B.2 Informational References. (Reserved)**

**B.3 References for Extracts in Informational Sections. (Reserved)**

## Index

Copyright © 2008 National Fire Protection Association. All Rights Reserved.

The copyright in this index is separate and distinct from the copyright in the document that it indexes. The licensing provisions set forth for the document are not applicable to this index. This index may not be reproduced in whole or in part by any means without the express written permission of NFPA.

- A-**  
**Adverse weather** ..... 6.4  
**Ambient temperature** ..... 6.2, 7.6.2  
**Application of standard** ..... 1.3, A.1.3.2
- C-**  
**Calibration test** ..... 7.2, A.7.2.3  
**Conditions of acceptance** ..... 7.5, 8.1(6)(d)
- D-**  
**Definitions** ..... Chap. 3  
**Documentation** ..... *see also* Test report  
    Application details of PFP material ..... 4.3.1, 8.1(3)  
    Photographs ..... 7.9, 8.1(6)(a)  
    Test specimen, preparation and description of ..... 4.3.1, 8.1(3),  
        8.1(4), 8.1(6)(a)  
    Video ..... 7.10
- E-**  
**Environmental conditions** ..... 7.6  
    Documentation of ..... 7.6.1, 8.1(5)(a)  
    Minimizing effects of ..... 6.1
- F-**  
**Fire resistance (definition)** ..... 3.3.1  
**Fuel, torch fire** ..... 5.3, 7.7, 8.1(5)(b), 8.1(5)(c)
- H-**  
**Hose stream test** ..... 7.4
- M-**  
**Measurement, units of** ..... 1.4
- N-**  
**Nozzle**  
    Hose stream test ..... 7.4.4.3, 7.4.5, 7.4.6  
    Torch fire ..... 5.1, 5.2.3, 5.2.4
- O-**  
**Observations** ..... 7.8
- P-**  
**Passive fire protection (PFP) materials**  
    Coating materials (definition) ..... 3.3.2.1
- Definition ..... 3.3.2, A.3.3.2  
    Panel materials (definition) ..... 3.3.2.2  
**Photographs** ..... 7.9, 8.1(6)(a)  
**Propane fuel** ..... *see* Fuel, torch fire  
**Purpose of standard** ..... 1.2
- R-**  
**Rear box** ..... 4.1.10, 4.2  
    Definition ..... 3.3.3  
**References** ..... Chap. 2, Annex B  
**Results, presentation of** ..... *see* Test report
- S-**  
**Scope of standard** ..... 1.1, A.1.1  
**Shall (definition)** ..... 3.2.1  
**Should (definition)** ..... 3.2.2  
**SI units** ..... 1.4  
**Standard (definition)** ..... 3.2.3
- T-**  
**Test assembly** ..... 7.1  
**Test location** ..... Chap. 6  
**Test report** ..... 4.3.2, 7.8.2, 7.9.2, Chap. 8  
**Tests, conduct of** ..... Chap. 7  
**Test specimens** ..... Chap. 4  
    Definition ..... 3.3.4  
    Observations ..... 7.8  
    Photographs ..... 7.9  
**Torch fire** ..... 1.2, Chap. 5, A.1.2.1, A.1.3.2  
    Calibration for torch test ..... 7.2, A.7.2.3  
    Conduct of torch test ..... 7.3  
    Definition ..... 3.3.5  
    Fuel ..... 5.3, 7.7, 8.1(5)(b), 8.1(5)(c)  
    Hose stream test during torch test ..... 7.4
- U-**  
**Units of measurement** ..... 1.4
- V-**  
**Video recording** ..... 7.10
- W-**  
**Weather conditions** ..... 6.2 to 6.4, 7.6.2  
**Wind limitations** ..... 6.3, 7.6.2

## *Sequence of Events Leading to Issuance of an NFPA Committee Document*

### **Step 1: Call for Proposals**

- Proposed new Document or new edition of an existing Document is entered into one of two yearly revision cycles, and a Call for Proposals is published.

### **Step 2: Report on Proposals (ROP)**

- Committee meets to act on Proposals, to develop its own Proposals, and to prepare its Report.
- Committee votes by written ballot on Proposals. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.
- Report on Proposals (ROP) is published for public review and comment.

### **Step 3: Report on Comments (ROC)**

- Committee meets to act on Public Comments to develop its own Comments, and to prepare its report.
- Committee votes by written ballot on Comments. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.
- Report on Comments (ROC) is published for public review.

### **Step 4: Technical Report Session**

- “*Notices of intent to make a motion*” are filed, are reviewed, and valid motions are certified for presentation at the Technical Report Session. (“Consent Documents” that have no certified motions bypass the Technical Report Session and proceed to the Standards Council for issuance.)
- NFPA membership meets each June at the Annual Meeting Technical Report Session and acts on Technical Committee Reports (ROP and ROC) for Documents with “certified amending motions.”
- Committee(s) vote on any amendments to Report approved at NFPA Annual Membership Meeting.

### **Step 5: Standards Council Issuance**

- Notification of intent to file an appeal to the Standards Council on Association action must be filed within 20 days of the NFPA Annual Membership Meeting.
- Standards Council decides, based on all evidence, whether or not to issue Document or to take other action, including hearing any appeals.

## *Committee Membership Classifications*

The following classifications apply to Technical Committee members and represent their principal interest in the activity of the committee.

- M     *Manufacturer:* A representative of a maker or marketer of a product, assembly, or system, or portion thereof, that is affected by the standard.
- U     *User:* A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.
- I/M   *Installer/Maintainer:* A representative of an entity that is in the business of installing or maintaining a product, assembly, or system affected by the standard.
- L     *Labor:* A labor representative or employee concerned with safety in the workplace.
- R/T   *Applied Research/Testing Laboratory:* A representative of an independent testing laboratory or independent applied research organization that promulgates and/or enforces standards.
- E     *Enforcing Authority:* A representative of an agency or an organization that promulgates and/or enforces standards.
- I     *Insurance:* A representative of an insurance company, broker, agent, bureau, or inspection agency.
- C     *Consumer:* A person who is, or represents, the ultimate purchaser of a product, system, or service affected by the standard, but who is not included in the *User* classification.
- SE    *Special Expert:* A person not representing any of the previous classifications, but who has a special expertise in the scope of the standard or portion thereof.

#### NOTES;

1. “Standard” connotes code, standard, recommended practice, or guide.
2. A representative includes an employee.
3. While these classifications will be used by the Standards Council to achieve a balance for Technical Committees, the Standards Council may determine that new classifications of members or unique interests need representation in order to foster the best possible committee deliberations on any project. In this connection, the Standards Council may make appointments as it deems appropriate in the public interest, such as the classification of “Utilities” in the National Electrical Code Committee.
4. Representatives of subsidiaries of any group are generally considered to have the same classification as the parent organization.