### 14-3-1
Review of the NFPA Product Development Process by Andy Wandell, Division Director, Marketing & Sales. No Attachment

### 14-3-2
Review of the Process of Standards Council Decision Making by Maureen Brodoff, Vice President and General Counsel. No Attachment

### 14-3-3
Act on the issuance of proposed Tentative Interim Amendment (TIA) to Section 17.2.1.4(f) of the 2013 edition of NFPA 13, *Standard for the Installation of Sprinkler Systems*, (TIA No. 1124).

#### 14-3-3-a
Text of proposed TIA No. 1124. See Attachment 14-3-3-a

#### 14-3-3-b
Ballot results of TIA No. 1124. PASSED CC ballot on both correlation and emergency nature. PASSED TC ballot on both technical merit and emergency nature. See Attachment 14-3-3-b

#### 14-3-3-c
No public comments were received. No Attachment

### 14-3-4
Act on the issuance of proposed Tentative Interim Amendment (TIA) to Sections 8.3.1.1. 8.3.1.2 and A.8.3.1.1 of the 2014 edition of NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, (TIA No. 1123).

#### 14-3-4-a
Text of proposed TIA No. 1123. See Attachment 14-3-4-a

#### 14-3-4-b
Ballot results of TIA No. 1123. FAILED TC ballot on both technical merit and emergency nature. See Attachment 14-3-4-b

#### 14-3-4-c
No public comments were received. No Attachment

### 14-3-5
Act on the issuance of proposed Tentative Interim Amendment (TIA) to Table 12.6.2 of the proposed 2015 edition of NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages*, (TIA No. 1126).

**STAFF NOTE:** NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages*, is expected to be an Annual 2014 consent document. The NITMAM Closing Date for Annual 2014 documents is February 7, 2014. If issued by the Standards Council, this TIA will be issued concurrently with the 2015 edition of NFPA 30A.

#### 14-3-5-a
Text of proposed TIA No. 1126. See Attachment 14-3-5-a

#### 14-3-5-b
Ballot results of TIA No. 1126. PASSED TC ballot on both technical merit and emergency nature. See Attachment 14-3-5-b

#### 14-3-5-c
No public comments were received. No Attachment

### 14-3-6

**STAFF NOTE:** NFPA 30B, *Code for Manufacture and Storage of Aerosol Products*, is expected to be an Annual 2014 consent document. The NITMAM Closing Date for Annual 2014 documents is February 7, 2014. If issued by the
| 14-3-6-a | Text of proposed TIA No. 1127. See Attachment 14-3-6-a |
| 14-3-6-b | Ballot results of TIA No. 1127. **PASSED** TC ballot on both technical merit and emergency nature. See Attachment 14-3-6-b |
| 14-3-6-c | No public comments were received. No Attachment |

**14-3-7**  
Act on the issuance of proposed Tentative Interim Amendment (TIA) to Table 15.8.4.2 of the 2013 edition of NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas*, (TIA No. 1122).

| 14-3-7-a | Text of proposed TIA No. 1122. See Attachment 14-3-7-a |
| 14-3-7-b | Ballot results of TIA No. 1122. **PASSED** TC ballot on both technical merit and emergency nature. See Attachment 14-3-7-b |
| 14-3-7-c | No public comments were received. No Attachment |

**14-3-8**  
Act on the issuance of proposed Tentative Interim Amendment (TIA) to Table 820.154(a) of the 2014 edition of NFPA 70®, *National Electrical Code®*, (TIA No. 1120).

| 14-3-8-a | Text of proposed TIA No. 1120. See Attachment 14-3-8-a |
| 14-3-8-b | Ballot results of TIA No. 1120. **PASSED** the CC ballot on both correlation and emergency nature. **PASSED** the Panel ballot on both technical merit and emergency nature. See Attachment 14-3-8-b |
| 14-3-8-c | No public comments were received. No Attachment |

**14-3-9**  
Act on the issuance of proposed Tentative Interim Amendment (TIA) to Sections 11.5.1.1.2 through 11.5.1.1.4 and A.11.5.1.1.2 through A.11.5.1.1.3 of the 2012 and Proposed 2015 editions of NFPA 99, *Health Care Facilities*, (TIA No. 1125).

**STAFF NOTE:** Please note that TIA No. 1125 on NFPA 99, *Health Care Facilities Code*, is being proposed for the 2012 and the 2015 editions. In the *Regulations Governing the Development of NFPA Standards* (Regs) at Section 5.9, TIAs shall apply to the document existing at the time of issuance, except in the case of a document undergoing revisions where a TIA can apply to the existing and proposed editions. NFPA 99 is expected to be an A2014 document. If this TIA on the 2012 edition is issued by the Standards Council, the proposed TIA for the 2015 edition will be placed on a future Council agenda for consideration of issuance concurrently with the 2015 edition of NFPA 99.

| 14-3-9-a | Text of proposed TIA No. 1125. See Attachment 14-3-9-a |
| 14-3-9-b | Ballot results of TIA No. 1125. **PASSED** the CC ballot on correlation and emergency nature. **PASSED** the TC ballot on both technical merit and emergency nature. See Attachment 14-3-9-b |
| 14-3-9-c | No public comments were received. No Attachment |

**14-3-10**  
Act on the issuance of proposed Tentative Interim Amendment (TIA) to Sections 8.2.2.2.4 through 8.2.2.2.6 of the 2012 edition of NFPA 664, *Standard for the Prevention of Fire and Explosions in Wood Processing and Woodworking Facilities* (TIA No. 1119).

| 14-3-10-a | Text of proposed TIA No. 1119. See Attachment 14-3-10-a |
| 14-3-10-b | Ballot results of TIA No. 1119. **PASSED** the CC ballot on both correlation and emergency nature. **PASSED** the TC ballot on both technical merit and emergency nature. See Attachment 14-3-10-b |
| 14-3-10-c | No public comments were received. No Attachment |

**14-3-11**  
Act on the issuance of proposed Tentative Interim Amendment (TIA) to Sections 10.4.3.3 and 10.4.3.4 of the 2014 edition of NFPA 780, *Standard for the Installation of Lightning Protection*, (TIA No. 1121).
| 14-3-11-a | Text of proposed TIA No. 1121. See Attachment 14-3-11-a |
| 14-3-11-b | Ballot results of TIA No. 1121. **FAILED** TC ballot on both technical merit and emergency nature. See Attachment 14-3-11-b |
| 14-3-11-c | No public comments were received. No Attachment |

**14-3-12**

Act on the issuance of proposed Tentative Interim Amendment (TIA) to Sections 4.1.11 and 4.1.2 of the 2013 edition of NFPA 81, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*, (TIA No. 1111R).

| 14-3-12-a | Text of proposed TIA No. 1111R. See Attachment 14-3-12-a |
| 14-3-12-b | Ballot results of TIA No. 1111R. **PASSED** CC ballot on both correlation and emergency nature. **PASSED** TC ballot on both technical merit and emergency nature. See Attachment 14-3-12-b |
| 14-3-12-c | No public comments were received. No Attachment |

**14-3-13**


| 14-3-13-a | Text of proposed TIA No. 1112R. See Attachment 14-3-13-a |
| 14-3-13-b | Ballot results of TIA No. 1112R. **PASSED** CC ballot on both correlation and emergency nature. **PASSED** TC ballot on both technical merit and emergency nature. See Attachment 14-3-13-b |
| 14-3-13-c | No public comments were received. No Attachment |

**14-3-14**

The Fall 2013 Revision Cycle Consent Standards were letter balloted by the Council with an issuance date of November 12, 2013 and an effective date of December 2, 2013:

- NFPA 69, *Standard on Explosion Prevention Systems*
- NFPA 82, *Standard on Incinerators and Waste and Linen Handling Systems and Equipment*
- NFPA 730, *Guide for Premises Security*
- NFPA 921, *Guide for Fire and Explosion Investigations*
- NFPA 1005, *Standard for Professional Qualifications for Marine Fire Fighting for Land-Based Fire Fighters*
- NFPA 1194, *Standard for Recreational Vehicle Parks and Campgrounds*
- NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety*
- NFPA 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents*
- NFPA 1963, *Standard for Fire Hose Connections*
- NFPA 1975, *Standard on Station/Work Uniforms for Emergency Services*

The Fall 2013 Revision Cycle Consent Standard that did not receive public comment was letter balloted by the Council with an issuance date of January 14, 2014 and an effective date of February 3, 2014:

- NFPA 1965, *Standard for Fire Hose Appliances*

The Fall 2014 Revision Cycle Consent Standards that did not receive public comments were letter balloted by the Council with an issuance date of January 14, 2014 and an effective date of February 3, 2014:

- NFPA 601, *Standard for Security Services in Fire Loss Prevention*
<table>
<thead>
<tr>
<th>No action necessary. No Attachment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>14-3-15 APPEAL</strong> Consider the two appeals from Christos Sideropoulos of FoamFatale Greece Limited requesting that the Council review the procedures that were followed regarding his submitted PIs and Comments and to review the Second Draft Meeting Committee Statement on self-expanding foam systems for Public Comment No. 20 to NFPA 11, <em>Standard for Low-, Medium-, and High-Expansion Foam</em>. See Attachment 14-3-15 <a href="#">SA 14-3-15</a></td>
</tr>
<tr>
<td><strong>14-3-15-a</strong> Correspondence sent to the Technical Committee on Foam regarding Mr. Sideropoulos’ material. See Attachment 14-3-15-a</td>
</tr>
<tr>
<td><strong>14-3-15-b</strong> Comment received from Fay Purvis, Chair of the Technical Committee on Foam, regarding the appeals of Christos Sideropoulos. <a href="#">SA 14-3-15-b</a> ADDITION</td>
</tr>
<tr>
<td><strong>14-3-16</strong> Consider the request of the Committee on Loss Prevention Procedures and Practices that NFPA establish a standard for professional practices for Facility Fire Safety Planning and Fire Safety Directors. <strong>PROPOSED SCOPE</strong>: This document will cover the development of facility emergency action plans, and the duties, requirements for, and training/education required of building fire safety directors. See Attachment 14-3-16</td>
</tr>
<tr>
<td><strong>14-3-17</strong> Consider the request of Anthony Apfelbeck of Altamonte Springs that NFPA establish a standard for the use of consumer fireworks by the public. <strong>PROPOSED SCOPE</strong>: This document will provide regulations for the use of consumer fireworks by the public. See Attachment 14-3-17</td>
</tr>
<tr>
<td><strong>14-3-18</strong> Consider the request of Jim Crawford of Vision 20/20 Project that NFPA establish a standard that helps departments follow the process steps for a Community Risk Reduction plan. <strong>PROPOSED SCOPE</strong>: This document will provide guidance to fire prevention offices and fire jurisdictions on how to develop a community risk reduction plan. See Attachment 14-3-18</td>
</tr>
<tr>
<td><strong>14-3-19</strong> At the July 2013 meeting, the Council reviewed the request of Barry Badders, Chair of the Fire Test Committee that NFPA consider the establishment of a new test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source. After review of all the material before it, the Council voted to publish a notice to solicit public comments on the need for the project, information on resources on the subject matter, those interested in participating, if established, and other organizations actively involved with the subject. The comment period has passed and twenty comments were received; thirteen responses were in favor of the project, six were opposed and one provided suggestions. See Attachment 14-3-19</td>
</tr>
<tr>
<td><strong>14-3-19-a</strong> Additional documentation on the proposed new project on test methods to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source. <a href="#">SA 14-3-19-a</a></td>
</tr>
<tr>
<td><strong>14-3-19-b</strong> Committee List of the Fire Tests Committee <a href="#">SA 14-3-19-b</a> ADDITION</td>
</tr>
</tbody>
</table>
| **14-3-20** At the October 2013 meeting, the Council reviewed the request of the Forest and Rural Fire Protection Committee to reorganize the Project into two new committees, Wildland Fire Management and Wildland and Rural Fire Protection. After review of all the material before it, the Council voted to publish a notice to
solicit comments from the public regarding the reorganization. The comment period has passed. One public comment and eleven applications were received. Three applications were received for the proposed Wildland Fire Management Committee and eight applications were received for the proposed Wildland and Rural Fire Protection Committee. See Attachment 14-3-20

14-3-20-a Comment received on the reorganization of the Forest and Rural Fire Protection Committee. SA 14-3-20-a ADDITION

14-3-21 At the August 2011 agenda review meeting, the Council Chair administratively removed the request of the Wildland Fire Fighting Protective Clothing and Equipment Committee that NFPA consider the establishment of a new document on the selection, care and maintenance (SCAM) of wildland fire fighting clothing and equipment. At that meeting, the Council requested that the Committee consider including this SCAM document on wildland fire fighting clothing and equipment as part of a chapter in NFPA 1977, Standard on Protective Clothing and Equipment for Wildland Fire Fighting.

The Fire and Emergency Services Protective Clothing and Equipment Correlating Committee met and has decided that it would be the Technical Committee’s decision to add SCAM documents as chapters of the document and will be made on a case by case basis by the Technical Committee developing the document.

The Wildland Fire Fighting Protective Clothing and Equipment Committee has voted to not include this SCAM document as a chapter of NFPA 1977 but as an individual document, if approved by the Council.

**PROPOSED SCOPE:** This standard shall specify the minimum selection, care, and maintenance requirements of wildland fire fighting incidents that include garments, helmets, gloves, footwear, and interface components that are compliant with NFPA 1977, Standard on Protective Clothing and Equipment for Wildland Fire Fighting.

See Attachment 14-3-21

14-3-22 Consider the request of the Liquefied Natural Gas Technical Committee (TC) to not proceed with the development of a document on offshore LNG facilities. At the March, 2011 Council Meeting, the Council approved the Committee’s request to develop this document, with the stipulation that they solicit fire service expertise. (See Minute Item 11-3-18). See Attachment 14-3-22 SA 14-3-22

14-3-22-a Poll of the Liquefied Natural Gas Committee regarding the request to withdraw the new project on offshore LNG facilities. SA 14-3-22-a ADDITION

14-3-23 Consider the request of the Professional Qualifications Correlating Committee to withdraw the current draft of NFPA 1072, Standard on Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Professional Qualifications from the Fall 2016 revision cycle. This draft was approved to enter cycle by the Council at its October 2012 meeting. (See Minute Item 12-10-17) See Attachment 14-3-23

14-3-24 Consider requests from NFPA Committees to change revision cycles for the following documents:

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<tr>
<td>18</td>
<td>2011</td>
<td>F2015</td>
<td>F2015 to F2016</td>
<td>One Time Move</td>
<td>4 to 5 year cycle</td>
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<tr>
<td>18A</td>
<td>2011</td>
<td>F2015</td>
<td>F2015 to F2016</td>
<td>One Time Move</td>
<td>4 to 5 year cycle</td>
</tr>
<tr>
<td>56</td>
<td>2014</td>
<td>A2016</td>
<td>A2016 to F2016</td>
<td>One Time Move</td>
<td>3 to 3 ½ year cycle</td>
</tr>
<tr>
<td>652</td>
<td>Proposed</td>
<td>F2014</td>
<td>F2014 SD to A2015 SD</td>
<td>One Time Move</td>
<td>3 to 3 ½ year cycle</td>
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<tr>
<td>1550 2010</td>
<td>2016</td>
<td>A2016 to F2016</td>
<td>One Time Move</td>
<td>5 to 5 ½ year cycle</td>
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</tr>
<tr>
<td>1953 Proposed</td>
<td>F2014</td>
<td>F2014 SD to A2015 SD</td>
<td>One Time Move</td>
<td>5 to 5 ½ year cycle</td>
<td></td>
</tr>
</tbody>
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See Attachment 14-3-24. **SA 14-3-24**

**14-3-25**  Report of the Awards Task Group (K. Bell, Chair).  No Attachment

**14-3-26**  Report of the Policy and Procedures Task Group (J. Milke, Chair)  No Attachment

**14-3-27**  Report of the Membership Task Group (M. Snyder, Chair)

14-3-27-a  Act on pending applications for Committee Members.  No Attachment

14-3-27-b  Review the interest categories of the Fire and Emergency Service Organization and Deployment-Career Committee  No Attachment  **ADDITION**

**14-3-28**  Review the dates and locations of upcoming Council Meetings, as follows:

- August 11-14, 2014
  - Quincy, MA
- October 28-29, 2014
  - TBD

**14-3-29**  Hear a report on the Minutes of the October 2013 meeting.  No Attachment

**14-3-30**  Consider the request of the Special Operations Protective Clothing and Equipment Committee and the Fire and Emergency Services Protective Clothing and Equipment Correlating Committee to enter a new document, NFPA 1858, *Standard on Selection, Care, and Maintenance of Life Safety Rope and Equipment for Emergency Services*, into the Fall 2017 revision cycle.  The Council voted to proceed with the establishment of this proposed new document in July, 2008.  **SA 14-3-30**  **ADDITION**
Item 14-3-16
DATE: December 9, 2013

TO: National Fire Protection Association (NFPA) Standards Council
Linda Fuller, Manager: Codes and Standards Administration
National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169-7471

FROM: Joseph A. Cocciardi, PhD, MS, CSP, CIH, REHS, RS
Chair, Loss Prevention Procedures and Practices Committee

Attached please find a request for a new document/standard on professional practices for Facility Fire Safety Planning and Fire Safety Directors. Facility Fire Safety Plan submission is now commonplace, at facilities and this position required at specific types of occupancies throughout the country.

PURPOSE:

Protection of persons and property against the hazards of fire is a management responsibility. The requirements of this standard are intended to aide management in a) the development of facility emergency action plans which provide this protection and b) the definition of requirements, duties and training/education for individuals who implement the plans prior to and in conjunction with facility or municipal fire and emergency response services.

Indeed many jurisdictions such as the City of New York, now require these services in specific types of occupancies and both train and accredit/license these Fire Safety Directors. Additional jurisdictions require these individuals maintain on-site services when fire protection or notification systems are impaired. These individuals also develop and implement Emergency Action Plans, where they are required by federal, state or local statute.

---

1 The City of New York requires Fire Safety Directors in office occupancies where there are 100 people above or below street level or all buildings with 500 or more occupants. These individuals develop and implement fire safety plans, staff fire control centers, and direct evacuations and provide liaison with fire departments. They implement fire prevention plans and document activities. Cities such as Chicago and Los Angeles have similar requirements, which elaborate on the minimal U.S. Department of Labor; OSHA Emergency Action Planning requirements (29CFR1910.38).
Finally, multiple building and occupancy codes require personnel be trained to operate fire safety and emergency action plans in specific occupancies. An original requirement is published by the U.S. Department of Labor: Occupational Safety and Health Administration (OSHA), for occupancies where an Emergency Action Plan (EAP) is required. All of the above would be covered by this proposed standard.

Subsequently, this correspondence requests the authorization of a standard on the development of plans; and the qualification and duties of personnel who operate in the capacity of facility fire safety directors.

This document and action was discussed and agreed upon by the Loss Prevention Procedures and Practices Committee, who feel:

a) These actions and activities are not currently covered by NFPA 600 (Industrial Fire Brigades) or NFPA 601 (Security Services for Fire Loss Prevention); and
b) The committee feels there is a demonstrated need for this document; and

c) The current committee feels they have the expertise to develop this document.
New Project Initiation Form
(To be completed by proponent of new project/document)

Additional pages may be attached if necessary.

a. Explain the Scope of the new project/document:

This new document would act as the consensus national standards for the development of facility Emergency Action Plans, and the duties, requirements for, and training/education required of building fire safety directors. These actions are effected and individuals provide life safety and property conservation action prior to and in conjunction with facility fire brigades and municipal fire departments, at specific types of occupancies.

b. Provide an explanation and any evidence of the need for the new project/document:

Requirements for Emergency Action Plans and Fire Safety Directors have been in place for an extended timeframe. The federal government has had regulatory requirements in place for the development of Emergency Action Plans at specific occupancies, and many municipalities (e.g. the cities of New York, Chicago, and Los Angeles) have similar requirements. These municipalities also proffer fitness for duty requirements for such individuals, however, a consensus national standard or best practice in this field does not exist.

These plans and individuals operate at various occupancies, including high rise structures, hotels, motels, and public occupancies, as well as other locations.

c. Identify intended users of the new project/document:

Users for this new document would be varied and extensive:

- Facilities, required by the various codes and rules to provide emergency action plans and personnel to implement them [USERS].
- Enforcers (e.g. Municipalities, states, federal government) who have these basic requirements in place, and qualify, license or certify the competency of the plans and fitness of personnel [ENFORCERS].
- Individuals providing these planning functions from various facility fire prevention and safety offices and individuals self-evaluating these services and plans [CONSULTANTS/SME].

d. Identify individuals, groups and organizations that should review and provide input on the need for the proposed new project/document; and provide contact information for these groups:

The Loss Prevention Procedures and Practices Committee has identified the need for this document, and believes they have the expertise to formulate (with others) the standard. The Chair/Staff Liaison can be contacted for additional information.

e. Identify individuals, groups and organizations that will be or could be affected, either directly or indirectly, by the proposed new project/document, and what benefit they will receive by having this new document available:

<table>
<thead>
<tr>
<th>GROUP</th>
<th>EFFECT</th>
<th>BENEFIT</th>
</tr>
</thead>
</table>
| 1. Enforcers | Provision of a National Consensus Standard/Best Practice on the development of Emergency Action Plans/Establishment of Fire Control Centers and the duties, requirements for certification, and training/education of Fire Safety Directors who enforce these Emergency Action Plans. | • Provides a benchmark for these services/individuals in the fire safety field.  
• Allows for adoption (by reference or referendum) of the standard into municipal or other standards and enforcement processes. |
<table>
<thead>
<tr>
<th>2. Users</th>
<th>Provision of a National Consensus Standard/Best Practice on the development of Emergency Action Plans/Establishment of Fire Control Centers and the duties, requirements for certification, and training/education of Fire Safety Directors who enforce these Emergency Action Plans.</th>
<th>• Provides defendability for plans and personnel who comply with and conform to this standard on a national level due to the consensus standards making process and the inclusion of present practices in these areas.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Consultants/Experts</td>
<td>Provision of a National Consensus Standard/Best Practice on the development of Emergency Action Plans/Establishment of Fire Control Centers and the duties, requirements for certification, and training/education of Fire Safety Directors who enforce these Emergency Action Plans.</td>
<td>• Identifies currently acceptable best practices for the development of EAP and the duties, requirements, and training/education of Fire Safety Directors who enforce and implement plans as specified as specified facilities. • Eliminates excessive or inconsistent practices for these sites.</td>
</tr>
</tbody>
</table>

f. Identify other related documents and projects on the subject both within NFPA and external to NFPA:

The Loss Prevention Procedures and Practices committee presently authors standards on facility fire brigades and security services in fire loss prevention. Fire Brigades and security services are peripheral, however, to facility fire safety planning/emergency action planning. Facility Fire Brigades operate at fire events to control fires; while security services restrict access and/or allow access by emergency services, to facilitate the fire response process. Emergency Action Plans the Fire Safety Directors who implement them, complete property conservation and life safety planning, then implement these processes during fire events for these private locations. Various examples of users exist, including:

- The New York City requirements for plans and certified fire safety directors (NYC Local Law 6) in hotel, motel, high rise and public occupancies.
- Various locations within the State of California (e.g. County of Los Angeles; City of Los Angeles), who requires common business emergency planning, identification of an on-site person to implement the plans, and evaluations of plans and persons by municipal fire departments.
- Multiple Locations, such as the City of Seattle, WA and the City of Columbus, OH; have similar rules and regulations.

g. Identify the technical expertise and interest necessary to develop the project/document, and if the committee membership currently contains this expertise and interest:

The Loss Prevention Procedures and Practices committee currently contains expertise in this area, and has concurred with this project. If approved as a project, users and enforcers, as well as subject matter experts in this area, may be added to round out the committee. Individuals from locations such as the above cities, counties or federal agencies referenced may be ideal for this purpose.

h. Provide an estimate on the amount of time needed to develop the new project/document:

Timeframes typical to the standards development process would be necessary for this project.

It is estimated that a timeframe of approximately one (1) year would be required, which would include an initial meeting for standard development as well as follow-up timeframes for comment/adoption by the Committee and a recommendation for adoption by the Standards Council.

i. Comment on the availability of data and other information that exists or would be needed to substantiate the technical requirements and other provisions of the proposed new project/document:

Substantive documents and materials exist for this project, however, materials are local. The U.S. Department of Labor: Occupational Safety and Health Administration (OSHA) has been enforcing the EAP standard for approximately 30 years, and has experience in this area (although the OSHA standard is considered outdated at this time).

Documents from the municipalities noted above are plentiful, although a commonality does not exist.

Testing services for fire safety directors is provided by various organizations, in particular in the New York City area (e.g. a search of the certified fire safety director training site for New York City identifies www.nyc.gov/html/fdny) 15 such training and certification entities recognized by FDNY, and they range from Local 94 of the International Union of Operating Engineers (www.local94.com), through the John Jay College for Criminal Justice Studies, Fire Science Institute (www.jjay.cuny.edu/fsi).

Please send your request to:
NFPA Codes and Standards Administration
1 Batterymarch Park
Quincy, MA 02169
Stds_admin@nfpa.org
Rev. 10/09

<table>
<thead>
<tr>
<th>Signature:</th>
<th>Name: Joseph A. Cocciardi, PhD, MS, CSP, CIH, REHS, RS (please print)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affiliation:Chair; NFPA Committee on Loss Prevention Procedures and Practices</td>
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</tbody>
</table>
Item 14-3-17
New Project Initiation Form
(To be completed by proponent of new project/document)
Additional pages may be attached if necessary.

a. Explain the Scope of the new project/document:

The scope of the document would provide regulations for the use of consumer fireworks by the public.

b. Provide an explanation and any evidence of the need for the new project/document:

Currently, 46 states plus the District of Columbia allow the use of at least some form of consumer fireworks. NFPA promulgates a standard that permits the sale of consumer fireworks when the NFPA 1124 standard is adopted by the AHJ. Once a sale is permitted, the AHJ is left without guidance as to how a use of these devices should be regulated and how to deal with complaints received regarding the use of such devices. Even with blatantly unsafe use of consumer fireworks, the AHJ is unable to take action and correct the hazard. Unless there is a specific state law or rule providing guidance, AHJs are left with no regulatory provision in the NFPA standards that they can adopt locally or reference to determine the use is reasonable. This lack of a standard or code to regulate use actually encourages the unsafe use of consumer fireworks devices. An NFPA standard providing AHJs with some reasonable regulatory guidance would greatly assist in reducing injuries and property loss due to consumer fireworks.

The fireworks injury and property loss problem in the US is well documented. According to the NFPA website:

In 2011, 9,600 fireworks-related injuries were treated in U.S. hospital emergency rooms.

The trend in fireworks-related injuries has been mostly in the range of 8,500 to 9,800 since 1997, except for spikes in 2000, primarily due to celebrations around the advent of a new millennium, and in 2004, and a sharp drop in 2008. Injuries were higher in 1985-1995 than in 1997 and later years.

One-quarter (26%) of the victims of fireworks injuries in 2011 were under age 15. In an atypical year, the highest rates of injuries per million population applied to a wide range of ages, including children aged 5 to 19 and adults aged 25 to 44. Males accounted for two-thirds (68%) of fireworks injuries.

Three of five (61%) fireworks injuries in 2011 were to extremities – hand or finger (46%), leg (11%), and arm, shoulder, or wrist (4%). Most of the rest (34% of total) were to parts of the head, including the eye (17% of total).

In 2011, eight out of nine (89%) emergency room fireworks injuries involved fireworks that Federal regulations permit consumers to use. Sparklers, fountains, and novelties alone accounted for one-third (34%) of emergency room fireworks injuries.

In 2011, an estimated 17,800 reported fires were started by fireworks. These fires resulted in an estimated 40 civilian injuries and $32 million in direct property damage, with no reported fire deaths.

During 2007-2011, 91% of the average of 19,700 fires associated with fireworks per year occurred outside any structure or vehicle. The largest numbers of these outdoor fires associated with fireworks involved grass fires (6,800 per year), brush fires (4,500), dumpster fires (1,700), unclassified or unknown-type natural or vegetation fires (1,300) and other outside trash, rubbish, or waste fires (1,200).

In 2007-2011, four people per year were killed in fires started by fireworks, while data from death certificates show that five people per year were killed directly by fireworks. These estimates may overlap, because fireworks can directly kill someone while also starting a fatal fire.

Using 2000-2010 data, the risk of fire death relative to hours of usage is higher for fireworks than for cigarettes. On Independence Day in a typical year, fireworks account for two out of five of all reported fires, more than any other cause of fire.
c. Identify intended users of the new project/document:

Local and State AHJs

Consumers

d. Identify individuals, groups and organizations that should review and provide input on the need for the proposed new project/document; and provide contact information for these groups:

International Fire Marshals Association
**Executive Secretary**
Steven Sawyer
NFPA
1 Batterymarch Park
Quincy, MA 02169-7471
Tel: +1 617 984-7423
Fax: +1 617 984-7056

NFPA Regional Fire Code Development Committees
**Staff Liaison**
Steven Sawyer
NFPA
1 Batterymarch Park
Quincy, MA 02169-7471
Tel: +1 617 984-7423
Fax: +1 617 984-7056

International Association of Fire Chiefs Fire and Life Safety Section
**IAFC Staff Liaison**
Richard Miller, Section Liaison
703-537-4846
rmiller@iafc.org

National Association of State Fire Marshals
**National Association of State Fire Marshals:**
Mailing
P.O. Box 671
Cheyenne, WY 82003
Tel: 202-737-1226
info@firemarshals.org
govtaffairs@firemarshals.org

American Pyrotechnics Association
7910 Woodmont Avenue
Suite 1220
Bethesda, MD 20814
Phone: (301) 907-8181
Fax: (301) 907-9148
gsmith@americanpyro.com

U.S. Consumer Product Safety Commission
4330 East West Highway
Bethesda, MD 20814

e. Identify individuals, groups and organizations that will be or could be affected, either directly or indirectly, by the proposed new project/document, and what benefit they will receive by having this new document available:

Group: AHJs
Benefit: 46 states plus the District of Columbia allow the use of at least some form of consumer fireworks. NFPA even promulgates a standard that permits the sale of consumer fireworks when the standard is adopted by the AHJ, NFPA 1124. Once a sale is permitted, the AHJ is left without guidance as to how a use of these devices should be regulated and how to deal with complaints received regarding the use of such devices. Unless there is a specific state law or rule providing guidance, AHJs are left with no regulatory provision in the NFPA standards that they can adopt locally or reference to determine the use is reasonable.

Group: Consumers

Benefit: 46 states plus the District of Columbia allow the use of at least some form of consumer fireworks. While it appropriate to discourage consumers not to utilize consumer fireworks, the reality is that they will and legally can in 46 states. A document that provides reasonable life safety and property protection standards that the consumer can utilize will assist in reducing injuries and property loss.

f. Identify other related documents and projects on the subject both within NFPA and external to NFPA:

NFPA 1124: Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles

NFPA 1: Fire Code

g. Identify the technical expertise and interest necessary to develop the project/document, and if the committee membership currently contains this expertise and interest:

AHJs and Consumer Fireworks Manufactures

Yes, the technical expertise is currently contained on the Technical Committee on Pyrotechnics. However, the TC on Pyrotechnics should be expanded to add additional expertise from AHJs. The NFPA 1 Fire Code Committee also contains significant expertise that could assist in the development of this project/document.

h. Provide an estimate on the amount of time needed to develop the new project/document:

Three years.

i. Comment on the availability of data and other information that exists or would be needed to substantiate the technical requirements and other provisions of the proposed new project/document:

Consumer Products Safety Commission and NFPA have extensive data on fireworks injuries and property loss. In addition, the NFIRS system contains extensive data on fire causes and losses.

Please send your request to:
NFPA
Codes and Standards Administration
1 Batterymarch Park
Quincy, MA 02169
Stds_admin@nfpa.org
Rev. 10/09

Signature: __________________________

Name: Anthony C. Apfelbeck
(please print)

Affiliation: City of Altamonte Springs

February 25, 2014
Supplemental Agenda March 3-4, 2014
Page 672 of 1111
Item 14-3-18
Steve, I’m sending this to you to support development of some type of standard or guide that helps departments follow the process steps of Community Risk Reduction. We have developed a good deal of experience with the concepts – and currently offer one day workshops and are creating an online training program to promote CRR concepts for the U.S. Fire Service. Our project in this area is being led by the Institution of Fire Engineers, U.S. Branch and the National Fallen Firefighter’s Foundation, but in fact the group supporting these CRR concepts includes more than 100 fire service leaders from across the nation. This submittal is being done on their behalf, as well as the Vision 20/20 Project.

If you have any questions, please don’t hesitate to contact me.

Thanks,
Jim

Jim Crawford
Vision 20/20 Project Manager
583 51st Street
Washougal, WA 98671-5104
(503) 939-0473 cell
crawfordj54@comcast.net
www.strategicfire.org
**New Project Initiation Form**  
*(To be completed by proponent of new project/document)*

**Additional pages may be attached if necessary.**

<table>
<thead>
<tr>
<th>a. Explain the Scope of the new project/document: A standard or guide for community risk reduction (CRR) for the fire service. The document proposed would be a “how to” steps of CRR. NFPA’s process is ideal for beginning and maintaining fresh thinking on a topic that is not necessarily new (i.e. CRR) but has varying versions across the nation. A national consensus based model is needed.</th>
</tr>
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<tr>
<td>b. Provide an explanation and any evidence of the need for the new project/document:</td>
</tr>
<tr>
<td>These programs have worked well in other nations – including the UK and Canada. There is a growing interest in them in the U.S. For example, the strategic planning platform for the IAFC has been changed to recognize the need for the fire service to embrace an integrated approach to community risk reduction. That same concept has been taught for years at the national fire academy, and more recently embraced by the National Fallen Firefighters Foundation, the Institution of Fire Engineers and a growing cadre of supporters in the fire service nationally. Through the Vision 20/20 Project, more than 100 advocates from among the fire service leadership of the nation have been identified to support a national advocacy strategy for embracing the community risk reduction concepts. Further, the International City Managers Association has also embraced these concepts, and has partnered with the Vision 20/20 Project to provide field trainings and webinars for ICMA membership on what CRR is – and how it is changing the fire service of the U.S. The new NFPA 1730 document requires the fire prevention organization perform a CRR. Annex text provides guidance but reference to a specific guide or standard would be beneficial. NFPA 1710 and other NFPA standards make reference to CRR.</td>
</tr>
<tr>
<td>With so many jurisdictions cutting back or even declaring bankruptcy, a new business model for fire protection is needed. Many are promoting CRR as a new methodology for managing call volume and using integrated mitigation and prevention tools for public safety. We believe the level of need and of interest is very high.</td>
</tr>
<tr>
<td>c. Identify intended users of the new project/document:</td>
</tr>
<tr>
<td>The intended users of the document would include all fire prevention offices and fire jurisdictions.</td>
</tr>
<tr>
<td>d. Identify individuals, groups and organizations that should review and provide input on the need for the proposed new project/document; and provide contact information for these groups:</td>
</tr>
<tr>
<td>The International Association of Fire Chiefs; the International Association of Firefighters; the National Volunteer Fire Council; the International City Managers Association; the National League of Cities: the Center for Public Safety Excellence; The International Fire Marshal’s Association; the National Association of State Fire Marshal’s; the Vision 20/20 Project.</td>
</tr>
<tr>
<td>e. Identify individuals, groups and organizations that will be or could be affected, either directly or indirectly, by the proposed new project/document, and what benefit they will receive by having this new document available:</td>
</tr>
<tr>
<td>Every jurisdiction.</td>
</tr>
<tr>
<td>f. Identify other related documents and projects on the subject both within NFPA and external to NFPA:</td>
</tr>
<tr>
<td>Training material for CRR process steps is available from the National Fire Academy, and the Vision 20/20 Project. These materials have been vetted in part by the Centers for Disease Control and Washington State University. NFPA 1730.</td>
</tr>
</tbody>
</table>
g. Identify the technical expertise and interest necessary to develop the project/document, and if the committee membership currently contains this expertise and interest:

The Center for Public Safety Excellence; the Vision 20/20 Project; the International Association of Fire Chiefs; the National Fire Academy; IFMA; NASFM; 1730 TC.

h. Provide an estimate on the amount of time needed to develop the new project/document:

The right committee and good leadership could produce a document in a year, based on previous work and an aggressive schedule of virtual and physical meetings.

i. Comment on the availability of data and other information that exists or would be needed to substantiate the technical requirements and other provisions of the proposed new project/document: See f above.

Please send your request to:
NFPA
Codes and Standards Administration
1 Batterymarch Park
Quincy, MA 02169
Stds_admin@nfpa.org
Rev. 10/09

Signature:

Name: Jim Crawford
Affiliation: Project Manager, Vision 20/20

(please print)
Subject: Public Comment - New test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source

It is our understanding based on the NFPA web announcement in the November newsletter that the NFPA Fire Test Committee is seeking public comment before January 20, 2014. On behalf of Bernhardt Furniture Company, we want to thank you for the opportunity to comment on the proposal for a “New test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source”

However open flame testing is already prevalent in some areas via California technical bulletin 133. We are very familiar with California TB-133, which currently may be specified for public occupancies with higher hazard and/or limited egress (hospitals, prisons, etc.) conditions.
Typically, TB-133 products are not specified in general environments.
TB-133 is a large open flame, full-scale test that requires significant design, cost, and comfort considerations.

TB-133 affects design in that seat pan to arm and seat pan to back relationships and shapes/contours have to be considered to meet the test. Designers must work around these geometric limitations. Designers are also limited in the fabrics available to meet TB-133. Certain fabrics may require specific treatments such as back coating with FRs to meet the test; others cannot be used regardless of treatments. Natural fabrics are particularly difficult to use in TB-133 products. It is also common for many of the polymeric materials (trim pieces, structural elements, etc.) to be treated with additional FR compounds in order to meet the TB-133 requirements.

TB-133 affects comfort and longevity of the products, those Fire Retardant chemicals, used at levels up to 40% the weight of the foam, can adversely affect foam properties. Additionally, barriers can impact comfort. In some cases, double barriers are necessary and have an adverse effect on comfort, ergonomics and appearance of the product. FR compounds may also be used in barrier materials to pass the TB133 open flame test.

Surveys of manufacturers have indicated that TB-133 costs 10% to 100% more than the same design that does not require TB-133 compliance. Typically, the lower cost products will have the greatest percentage upcharge to meet TB-
In terms of price impact, it would not be unusual for the price of a chair to increase by $50 or more for the TB-133 option; larger items such as lounge seating could increase $300 or more and sofas may increase by $700 or more. The cost of the barrier is only a small portion of the cost increase, and barriers alone may not be sufficient in meeting the requirements; the fabric, foam and other materials in the chair may also require FR additives. Special thread is often needed. Much of the cost impact is due to additional labor and overhead. This would push the cost of open flame resistant furniture out of the reach of the very people who would benefit from it.

Bernhardt Furniture has worked very closely with BEARHFTI and other industrial stakeholders in the creation and execution of California Technical Bulletin 117-2013 smolder standard. We do not see any benefits in having an open flame standard that can only be achieved with added chemicals of concern. The amount of these chemicals added to be able to withstand open flames have already been linked proven to be more dangerous to human life than the flames themselves.

Thank you for your consideration

Eddie Pitts
Corporate Environmental Manager
Bernhardt Furniture Company
828 759 6348
eddiepitts@bernhardt.com
Dec. 23, 2013

Standards Council – Fire Test Committee
National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169

Subject: Public Comment - New test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source

The Business and Institutional Furniture Manufacturers Association (BIFMA) is the not-for-profit trade association for business and institutional furniture manufacturers. Since 1973, BIFMA has been the voice of the commercial furniture industry and currently has over 250 member companies.

Our industry’s service to our customers – providing healthy, comfortable, and productive workspaces – rests on an infrastructure of engineering and materials standards. These standards, founded on centuries of craft and enhanced by ever-advancing science, embody the best of our knowledge on safety, ergonomics, and sustainability.

It is our understanding, based on the NFPA web announcement in the November newsletter, that the NFPA Fire Test Committee is seeking public comment before January 20, 2014. On behalf of the BIFMA Flammability Subcommittee, we want to thank you for the opportunity to comment on the proposal for a “New test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source”. Members of BIFMA are very familiar with flaming ignition tests. Both from the early TB-117 method (now TB-117-2013 smolder) and from the TB-133 test method, which are met with the use of flame retardant (FR) chemicals and/or barrier materials for upholstered furniture.

Members of the BIFMA Flammability Subcommittee gathered comments for your consideration:

1. BIFMA has supported the recently updated California TB-117-2013 smolder standard for home furniture. BIFMA agrees with small scale, smolder testing as most appropriate for fire-safe upholstered furniture. BIFMA suggests that the NFPA consider following the new TB-117-2013 standard. This standard will allow BIFMA members to considerably reduce the use of flame retardant chemicals of concern in their products while maintaining fire safety.

2. Based on input from our customers and some regulators (including the Federal Government and California), BIFMA furniture manufacturers actively seek to move away from Chemicals of Concern as referenced in the ANSI/BIFMA e3-2012 Furniture Sustainability Standard (Annex B) and our industry position paper of March 27, 2012. If the NFPA promotes an open-flame standard for upholstered furniture, then it would adversely impact our industry’s intent to move away from the use of Fire Retardant chemicals of concern. We believe the risks associated with the use of these chemicals is greater than the hazard associated with the fire risk from furniture without fire retardants. An open-flame standard would cause needless expense in the design and manufacturing of our products given the nearly non-existent incidence of fire in the workplace today. Unfortunately, such a standard would increase the amount of flame retardant chemicals in our furniture.

3. Office and Institutional environments are historically very safe with respect to fire concerns. Generally speaking, in the office and institutional environment occupants are not permitted to smoke, are awake, familiar with their surroundings and are in facilities with smoke detection systems.
and/or sprinklers. NFPA statistics do not show significant concern with injuries due to initial combustion of upholstered furniture in the office setting. While already low, there continues to be favorable trending in the number of fire incidents in these environments.

4. In addition to our environmental concerns of flame retardant chemicals, our industry understands the performance and cost implications of open-flame regulations. For example, if NFPA considers an open flame test that is similar to the stringent Cal TB-133 test, the following comments may be relevant:

- Open-flame requirements can limit furniture design. For example, seat pan to arm and seat pan to back relationships and shapes/contours have to be considered. Designers must work around these geometric limitations. Designers are also limited in the fabrics available to meet open-flame tests. Certain fabrics may require specific treatments such as backcoating with fire retardant chemicals to meet the test; others cannot be used regardless of treatments. Natural fabrics are particularly difficult to use in flame retardant chairs. It is also common for many of the polymeric materials (trim pieces, structural elements, etc.) to be treated with additional flame retardant compounds in order to meet the open-flame requirements.

- Open-flame requirements affect comfort and longevity of the products in that Fire Retardant chemicals, used at levels up to 40% the weight of the foam, can adversely affect foam properties. Additionally, barriers can impact comfort. In some cases, double barriers are necessary and have an adverse effect on comfort, ergonomics and appearance of the chair. FR compounds may also be used in barrier materials to pass an open flame test.

- Confidential surveys of manufacturers have indicated that open-flame requirements cost up to 100% more than the same design that does not require open-flame compliance. Typically, the lower cost products will have the greatest percentage upcharge to meet an open-flame requirement. In terms of price impact, it would not be unusual for the price of an office chair to increase by $50 or more for an open-flame requirement. If NFPA develops a standard for seating requiring an open-flame test, and the standard were to become widely accepted in the United States, then the office and institutional furniture industry could experience cost increases of over $200,000,000. (The residential industry would be in addition to this figure).

We appreciate your consideration of our comments. Should you proceed with development of an upholstered furniture flammability standard, we would appreciate being at the table as a stakeholder to offer additional input on our industry’s experiences in this area and our concerns about the unintended consequences of fire retardants.

Please contact me with any questions.

Sincerely,

David Panning
Director of Technical Services
NFPA Member 2768895
January 14, 2014

TO: National Fire Protection Association – Standards Council

RE: New test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source

We are opposed to the proposal that the Fire Test Committee develop such a new test method, for the following reasons:

(1) Smoldering ignition from cigarettes rather than small open flame ignition is responsible for the majority of fire deaths from fires originating in upholstered furniture. This is true despite the introduction of Reduced Ignition Propensity (RIP) cigarettes.

(2) The State of California changed their small open flame standard to a smolder standard to increase fire safety and decrease the use of harmful flame retardant chemicals in furniture.

(3) A standard requiring resistance to open flames is likely to be met with halogenated and/or phosphate flame retardant chemicals either known to be toxic or lacking adequate toxicological information to assure safety.

(4) Claims by industry regarding the effectiveness of flame retardant chemicals in increasing fire safety have been based on a NIST study conducted by one of the signatories to this letter, Dr. Babrauskas. These claims distorted and misinterpreted the NIST study, which in fact does not support the effectiveness of flame retardant treatments if used at commercially common levels.

(5) UK studies show that their use flame retardant chemicals, often at a high level, in fabric, barriers and/or foam to meet open flame/barrier standards protects against only a limited range of open flame fires; and that improvements in UK fire loss statistics are most likely due to unrelated factors such as reduction in cigarette sales.

(6) Flame retardant chemicals can increase toxic gases and acute fire toxicity. Production of carbon monoxide, soot, smoke, and irritant gases should be evaluated when flame retardants are used to meet open flame standards to determine whether increases in fire effluent toxicity may offset other possible fire safety benefits.

(7) Halogenated flame retardant chemicals and their combustion byproducts may be associated with elevated rates of cancer occurring among firefighters.

(8) Halogenated and phosphate flame retardant chemicals cause serious health harm to humans and the environment.

(9) The source of the request for this new test method may have a conflict of interest.

Please see below detailed explanations relating to each of the above reasons.

(1) Smoldering ignition from cigarettes rather than small open flame ignition is responsible for the majority of fire deaths from fires originating in upholstered furniture. This is true despite the introduction of Reduced Ignition Propensity (RIP) cigarettes.

The proposed scope of the project states that only 10% of deaths from fires originating in upholstered furniture come from small open flame sources. Since NFPA tabulates there are 500 fire deaths per annum originating in upholstered furniture,¹ this means that the proposed action consists of trying to reduce a
total of 50 deaths per annum. While NFPA is a fire safety advocacy organization, we do not believe it should be advocating fire safety measures that are disproportionately costly to society, in the context of the alleged benefits provided. California’s TB 117-1975 proved ineffective in reducing deaths due to small open flames. This sensibly leads to the conclusion that a much more expensive technology would be needed if the 50 per-annum number were to be reduced significantly. We are not aware of any technology that can do this economically, and without introducing chemicals harmful to firefighters, the general population, or the environment.

We also wish to question the recent claim by NFPA’s Dr. John Hall that additional lives could be saved when furniture items that were not the first ignited, but that contributed to the severity of the fire, are taken into account.\(^2\) There are two important points to be made in this regard:

(a) The statistical basis for this claim is unreliable. The data come from a new field in NFIRS 5.0\(^3\) “Item contributing most to flame spread.” As with all NFIRS input data, the questions are answered solely by responding firefighters. But the question here is an engineering question and would be difficult for qualified engineers to answer properly, unless they were to do comparative testing or fire modeling. Even much simpler NFIRS input data are answered in an unreliable manner by the fire departments filing the NFIRS report. In one study where CPSC\(^4\) examined the accuracy of NFIRS data, they found a 50% error in reporting. FEMA themselves have published two studies demonstrating the unreliable nature of NFIRS data.\(^5,6\)

(b) To resist “contributing to fire spread,” furniture would have to be made to an institutional standard, e.g. TB133 level of protection. Not only would this hugely increase costs, but it would lead to the addition of harmful chemicals to most furniture, since most TB133-compliant furniture meets the requirement by using flame retardant chemicals in fabric, barriers, and/or foam.

(2) The State of California changed their small open flame standard to a smolder standard to increase fire safety and decrease the use of harmful flame retardant chemicals in furniture.

In 2013, the State of California withdrew the 1975 regulation requiring small-open flame testing of furniture foams, when it became apparent that the dominant hazard is smoking materials, not open flames, and that an open-flame resistance regulation can result in manufacturers adding flame retardant chemicals to furniture. The State of California published a document nearly 500 pages long documenting the appropriateness of that decision, and we refer NFPA to this documentation.\(^7\)

(3) A standard requiring resistance to small open flames is likely to be met with halogenated and/or phosphate flame retardant chemicals either known to be toxic or lacking adequate toxicological information to assure safety.

Marketplace experience has shown that when furniture foams are required to meet open-flame requirements, they are treated with FR chemicals. If barriers are used, there is a wide variety of patented solutions, but nonetheless, a significant number of these products (which are more effective from the fire resistance point of view) are treated with flame retardant chemicals in fabric, barriers, and/or foam. Standards or regulations which include an open-flame test are likely to lead to the use of flame retardant chemicals, at least part of the time.
(4) Claims by industry regarding the effectiveness of flame retardant chemicals in increasing fire safety have been based on a NIST study conducted by one of the signatories to this letter, Dr. Babrauskas. These claims distorted and misinterpreted the NIST study, which in fact does not support the effectiveness of flame retardant treatments at commercially common levels.

This is a gross distortion of the research work that was actually conducted at NIST. A detailed explanation is provided in the Appendix.

(5) UK studies show that their use of flame retardant chemicals, often at a high level, in fabric, barriers, and/or foam to meet open flame/barrier’ standards protects against only a limited range of open flame fires; and that improvements in UK fire loss statistics are most likely due to unrelated factors such as reduction in cigarette sales.

UK flammability standards for residential furniture requires resistance to a large open flame source, called ‘crib 5,’ which is equivalent to about 2 sheets of burning newspaper. However, passing the crib 5 test does not guarantee that furniture will resist ignition from a larger open flame. In a recent experiment, 4 sheets of newspaper easily ignited an UK sofa. Even with an open flame source of the same size as crib 5, furniture could still ignite if the source was placed in a different location than in the test conditions, or if an air current was present. These results suggest that the UK FFR open flame regulations may be effective against only a subset of open flame fires. Perturbations in the conditions affecting ignition, such as air currents, blankets, papers, books, etc. on the sofa, are present in a majority of homes.

Careful evaluation of a 2009 report on the UK FFR suggests that the benefits of the regulation were overestimated. In fact, analysis indicates that other societal factors which predated the starting date of the UK regulations, along with a sharp drop in cigarette sales accounts for improvement seen in the UK fire loss statistics. In contrast to the questionable benefit of this regulation, the impacts of the flame retardant chemicals used to meet it are definite. TCPP, TDCPP and decaBDE contaminate UK house dust, exposing the population to these flame retardants that are either known to be harmful or lack adequate toxicological information.

(6) Flame retardant chemicals can increase toxic gases and acute fire toxicity.

Most fire deaths and most fire injuries result from the inhalation of carbon monoxide, irritant gases, soot and other fire effluents. The incorporation of halogenated flame retardants can increase the yield of these and other toxic combustion by-products. Production of carbon monoxide, soot, smoke, and irritant gases should be evaluated when flame retardants are used to meet open flame standards to determine whether increases in fire effluent toxicity may offset other fire safety benefits.

Halogenated flame retardants act by replacing the most reactive hydrogen and hydroxyl free radicals in a flame with chlorine or bromine free radicals. In this process, the irritant acid gases HCl and HBr (hydrochloric or hydrobromic acid, respectively) are created. The hydroxyl radical is required for the conversion of carbon monoxide (CO) to carbon dioxide (CO\textsubscript{2}). In the presence of brominated or chlorinated flame retardants, this reaction is prevented, resulting in more carbon monoxide under some combustion conditions. Thus, the same flame retardant action that reduces heat release can also result in higher yields of carbon monoxide. In addition, the flame-quenching action of bromine and
chlorine radicals prevents the oxidation of other hydrocarbons to carbon dioxide (CO$_2$ and water), which can significantly increase the yield of soot and smoke.$^{20,21}$

(7) **Halogenated flame retardant chemicals and their combustion byproducts may be associated with elevated rates of cancer occurring among firefighters.**

When halogenated flame retardants burn they produce toxic dioxins and other toxic byproducts.$^{22}$ Firefighters have higher rates of cancers associated with dioxin exposure: multiple myeloma, non-Hodgkin’s lymphoma, prostate and testicular cancers.$^{23}$ In our opinion, firefighter health should necessarily be a topmost priority to NFPA.

(8) **Halogenated and phosphate flame retardant chemicals cause serious health harm to humans and the environment.**

Exposure to these chemicals is associated with numerous adverse health effects in animals and humans, including endocrine disruption, immunotoxicity, reproductive toxicity, effects on fetal/child development, and cancer.$^{24,25,26}$ The reviews cited contain additional references, and the peer-reviewed papers on this subject number in the thousands, too numerous to adequately discuss here. Flame retardants currently used in furniture, for example, are linked with cancer, damage to the nervous and reproductive systems, obesity, and anxiety.$^{27,28,29}$

(9) **The source of the request for this new test method may have a conflict of interest.**

Mr. Barry Badders, who requested this new standard, works for Southwest Research Institute in the Fire Technology Department. His department receives research funding from the North American Flame Retardant Alliance, whose mission is to promote the use of flame retardants. That department is headed by Dr. Matthew Blais, who is a consultant to the flame retardant manufacturers and has published papers of questionable accuracy$^{30}$ in support of the use of flame retardants.

**Summary and Conclusions**

The State of California has revised its furniture flammability regulations since the previous small-flame test requirements led to the use of toxic flame retardant chemicals in furniture foam, yet gave no demonstrable fire safety benefit. Now, NFPA appears to be moving towards reversing this with a new test that is likely to be similarly met with flame retardants, yet have, at best, limited fire safety benefits.

According to a 2008 CPSC analysis, there are about 30 fire deaths a year due to small-flame ignitions of furniture which might be “addressable” by a small open-flame fire standard. In an unsuccessful attempt to reduce this number, over 313 million Americans have been exposed to flame retardant chemicals which can cause cancer, endocrine disruption, and reproductive and neurodevelopmental impairments. Firefighters are increasingly concerned about elevated rates of cancer in their profession, and dioxins and furans produced from these flame retardants are believed to contribute to their high cancer incidence.

By contrast, CPSC concluded that there are 10 times as many fire deaths due to smoldering ignitions, which would be “addressable” by a smolder standard met without flame retardants. The CPSC study was based on reasonably reliable data on furniture as the first item ignited. But NFPA is now advancing the speculative concept of “contributing most to fire spread” in NFIRS 5.0. Even the unsubstantiated number
of 610 fire deaths based on “fire spread” will be a very small number if a “solution” is adopted that result in our entire population being exposed to chemicals adversely affecting their health. NFPA can play a positive role with regards to furniture flammability by focusing on reducing cigarette ignitions, which still accounts for the highest fraction of furniture fire deaths. Improving requirements for cigarette ignition resistance can be achieved without flame retardant chemicals with adverse health effects. Conversely, a new open-flame standard such as suggested by the NFPA will invite the increased use of flame retardants with a great potential to harm our population and ecosystems without a proven significant fire safety benefit. California has realized this, and so should NFPA.

In view of the above concerns, we strongly urge NFPA not to proceed with the suggested project to develop a flaming-ignition standard for upholstered furniture.

Respectfully yours,

Vytenis Babrauskas, Ph.D.
Fire Science and Technology Inc.

Donald Lucas, Ph.D.
Lawrence Berkeley Laboratory

David B. Rich, Ph.D.
Reax Engineering, Inc.

Arlene Blum, Ph.D.
Green Science Policy Institute
References

30. “Doubts cast on new research touted by fire-retardant lobby” Chicago Tribune 12/30/2012

APPENDIX – Industry misuse of the 1988 NIST report

In 1988, the National Institute of Standards and Technology (NIST, formerly called NBS) published a large-scale study on plastic commodities comparing the fire behavior of non-FR and FR items. This study was widely cited by makers of halogenated FR chemicals as supporting their views that (a) FR chemicals provide a fire safety benefit when added to consumer products such as upholstered furniture foams; and (b) their use reduces, instead of increasing, the evolution of toxic chemicals. These types of presentations are technically incorrect and misleading and imply conclusions that are unsound and unjustified.

To appreciate the problems with the FR chemical makers’ presentations, several points must be understood:

1. The test items procured for the large-scale NIST tests were not chosen to represent products sold for consumer use. Instead, the project was formulated to examine FR treatments for various product categories that are commercially available, but are of the highest FR performance. For example, upholstery cushions were loaded with an organic chlorinated phosphate FR, an organic brominated FR, and alumina trihydrate. The loading of the FR chemicals was so high that the foam reached a density of 64 kg m$^{-3}$. By contrast, residential grade upholstered furniture foams generally have a density in the range of 16 – 29 kg m$^{-3}$. Foams of 64 kg m$^{-3}$ are used in certain institutional and governmental applications, but do not represent products that consumers purchase.

2. The ‘FR room’ consisted 100% of fully FR-treated products; the non-FR room consisted, of course, of normal products without FR treatments. Creating a test room where 100% of the fuel load was FR-treated allowed some interesting observations to be made about the behavior of such environments, and was intended as an updated revisitation of the 1973 Hillenbrand study. It should be noted that the Hillenbrand study was conducted for NASA, and was intended to examine how NASA-quality materials would perform when an entire room was constructed of such materials. The NIST tests confirmed what Hillenbrand had found in 1973—that if only NASA-quality materials are used in a room, there is no possibility for a fire to develop there. However, while this may be important to NASA, it is not applicable to domestic or commercial occupancy environments. In the latter, even if some FR combustibles are present, fire will have the potential to burn due to the inevitable presence of non-FR goods which burn well, and such combustibles include even ordinary paper, books, and clothing.

3. The 1988 NIST study did not examine any human or environmental health issues of the chemicals themselves, in the absence of fire. Nor did the study examine firefighter health issues associated with burning of FR-containing chemicals. Both of these issues have become important recently as information about environmental toxicity and elevated cancer deaths in firefighters has been emerging. Thus, in no way can the NIST study be considered a study on the ‘toxicity’ from FR-treated products in general. Instead, it was a study solely focused on the acute toxicity of common combustion products. But with the knowledge available today, it is clear this is not the whole problem and that both environmental and firefighter health
issues\textsuperscript{34,35} (which comprise chronic, not acute exposures) must be considered and that these can be of paramount importance.\textsuperscript{36}

NIST, in fact, had published a study\textsuperscript{37} a few years prior to the 1988 report which documented in detail the fact that the level of FR chemicals added to consumer-grade residential furniture foams (TB117 formulations) gives no improvement in the fire behavior of such furniture. In view of this, it is especially troubling that the industry has persistently touted the supposed value of FR chemicals in TB117 foams and claimed that the 1988 study justified this claim.

To make this all this very clear, the factually supportable conclusions are the following:

(a) Use of FR chemicals can provide major improvements to fire behavior of plastics. However, the loadings need to be high, and while this is the case for certain military, government, industrial, and other classes of products, it is not so for FR chemicals added to consumer goods.

(b) The effectiveness of halogenated FR chemicals depends both on the loading of the chemical and on the volume of fire confronted. Plastics with modest FR loadings can perform well in some small-flame tests, but do not show a similar behavior when large flames are involved.

(c) Room-fire type tests configured with all-FR products can reflect certain environments in NASA and other specialized applications, but results from such tests cannot legitimately be applied to normal buildings or homes.

(d) Social responsibility demands that environmental and health concerns be adequately addressed for any chemicals promoted for their claimed fire safety benefits.

References


\textsuperscript{32} Hillenbrand, L. J., and Wray, J. A., A Full-Scale Fire Program to Evaluate New Furnishings and Textile Materials Developed by the National Aeronautics and Space Administration (Contract NASW-1948), Battelle Columbus Laboratories, Columbus OH (1973).


To: NFPA Standards Council

I strongly support the development by NFPA of a fire test to assess the flaming ignition performance of upholstered furniture composites and/or components.

The decision by the State of California to eliminate the flaming ignition component from the CA TB 117 test method as of this year (2014) means that no standard test method exists at present for assessing the performance of upholstered furniture components and/or composites to open flame ignition.

It has been shown that open flame testing of upholstered furniture is essential to provide fire safety, in view of the significant number of fire fatalities associated with the ignition of upholstered furniture. It has also been shown that ignition of an item of furniture by a small open flame source (match, candle or lighter) typically results in much more rapid ignition than with a cigarette, unless the furniture is constructed with materials with high fire performance (either inherently or via the incorporation of additives) or is provided with protective barrier fabric materials.

Furniture containing components that have not been assessed for open flame ignition performance, once they reach flaming ignition, are likely to progress to rapid fire growth and reach flashover within minutes and be completely consumed shortly thereafter. Once a flashover condition is reached, fire and smoke are pushed to other rooms by expanding gas pressure and heat and spread rapidly throughout the residence, endangering the lives and health of all occupants, increasing the probability of injuries and fatalities and typically leading to major structural damage.

It is essential that a standard test be developed that can assess the effects of open flame ignition so that fire safety can be improved for all American households.

It is my opinion that, once this standard test is developed, it will be able to be used extensively and fill a vacuum that exists today.

Sincerely,

John D. DeHaan, Ph.D.
I am pleased to offer comments on the proposed new project on Furniture Flammability.

In Table 11 (Ahern, NFPA, August, 2011) for home structure fires (2009) that began with upholstered furniture, the largest single source was smoking materials (27%) followed by operating equipment (24%), and candle, lighter, or match (20%). Some 73% of fires are not accounted for by smoking materials. In Table 12 for deaths, 49% involved smoking materials while 51% did not. Clearly, cigarettes are not “the way most fires start in the home.” That may have been true 20 years ago, but is not true today. Thus available standards should not ignore ignition sources beyond cigarettes and smoking materials in general.

In discussions about furniture foam there has been a lot of “Chemophobia” about the use of “toxic” flame retardants. Barrier technologies exist as do new bound-in non-halogen flame retardants, which will not leach or migrate.

To simply replace current foam with untested non-FR foam undoubtedly raises the heat release rates of upholstery foam considerably. We tested recently a non-FR control polyurethane foam which had a Peak Rate of Heat Release (Cone Calorimeter) of 1670, a CAL 117 compliant foam was 1154, a BS5852 compliant foam was 953, and two different CAL 133 compliant foams were 913 and 502, respectively. The CAL 117 compliant foam showed a 30% reduction in PHRR versus the control. To say it another way, replacement of the CAL 117 foam by the control foam results in a 45% increase in PHRR.

At a CPSC hearing some time ago which I attended CPSC said that a national open flame test for upholstered residential furniture would save 140 lives a year.

The new project is essential. A flaming ignition test or set of tests is clearly needed.

I have substantial experience in flame retardant polyurethane foams by a variety of methodologies and would be happy to participate.

Gordon L. Nelson, Ph.D.
University Professor of Chemistry
Florida Institute of Technology
321-674-8480
I fully support the promulgation of the open flame ignition source test of home furnishings. Flexible polyurethane foams are particularly hazardous in home fires and furniture items containing these foams should be tested to the most rigorous standards in order to ensure public safety. A smolder only standard as proposed by CAL TB117-2013 does not meet this standard and an association like NFPA is a logical proponent for this standard.

Matthew S. Blais, Ph.D.
Director, Fire Technology Research Laboratory
Southwest Research Institute
(210) 522-3524
Maynard, Mary

Subject: NFPA Fire Test on Upholstered Furniture Open Flame Ignition

To: NFPA Standards Council


I strongly support the development by NFPA of a fire test to assess the flaming ignition performance of upholstered furniture composites and/or components.

The decision by the state of California to eliminate the flaming ignition component from the CA TB 117 test method as of this year (2014) means that no standard test method exists in the US at present for assessing the performance of upholstered furniture components and/or composites to open flame ignition.

It has been shown that open flame testing of upholstered furniture is essential to provide fire safety, in view of the significant number of fire fatalities associated with the ignition of upholstered furniture. It has also been shown that ignition of an item of furniture by a small open flame source (match, candle or lighter) typically results in much more rapid ignition than with a cigarette, unless the furniture is constructed with materials with high fire performance (either inherently or via the incorporation of additives) or is provided with protective barrier fabric materials.

Furniture containing components that have not been assessed for open flame ignition performance, once they reach flaming ignition, are likely to progress to rapid fire growth and reach flashover within minutes and be completely consumed shortly thereafter. Once a flashover condition is reached, fire and smoke are pushed to other rooms by expanding gas pressure and heat and spread rapidly throughout the residence, endangering the lives and health of all occupants, increasing the probability of injuries and fatalities and typically leading to major structural damage.

It is essential that a standard test be developed that can assess the effects of open flame ignition so that fire safety can be improved.

It is my opinion that, once this standard test is developed, it will be able to be used extensively and fill a vacuum that exists today.

I attach a recent article I wrote discussing the issue, which contains multiple references, including references to NFPA fire statistics supporting the need for such a test.

Yours sincerely

Marcelo M Hirschler
January 16, 2014

To: Codes and Standards Administration
National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169


The National Association of State Fire Marshals welcomes the NFPA Standards Council's invitation to comment on the proposal that NFPA undertake a project to develop a test method to evaluate fire ignition/resistance of upholstered furniture subject to a flaming ignition source. The National Association of State Fire Marshals was the original petitioner to the Consumer Product Safety Commission (CPSC) for a mandatory standard to address upholstered furniture flammability. NASFM members are the senior fire prevention officials in the U.S. states and the District of Columbia. NASFM recognized the need for mandatory upholstered furniture standards over 20 years ago, and has continued to participate in efforts to urge the CPSC to publish furniture flammability standards that would reduce the deaths and injuries that occur due to upholstered furniture fires. Upholstered furniture remains the product under CPSC's jurisdiction that has annually resulted in the greatest number of fire deaths by item first ignited.

Although CPSC embarked on a project to address upholstered furniture fires when it was first established as an agency in 1973 (and the current rulemaking prompted by the NASFM petition began in 1994), to date it has not come to any conclusion or taken any formal regulatory action. The agency's most recent action in Spring 2008 was to issue a Notice of Proposed Rulemaking (NPR) for furniture flammability that addresses only ignition by smoldering sources, such as cigarettes. The NPR appears to reverse prior CPSC recommendations that ignition of furniture by both smoldering and flaming ignition sources be addressed; even though more recently the CPSC appears to be considering a broader scope for its rulemaking, the 2008 NPR is the only formal proposed rule that has been put forward by CPSC. NASFM has frequently expressed dismay over CPSC's inaction, and has long expressed strong support for a meaningful standard that would address both smoldering and open-flame ignition of the furniture. In 2013, the State of California (which in 2005 led the way in the development of a large open flame standard for residential mattresses that served as the model for the CPSC’s 16 CFR 1633 regulation) changed its residential upholstered furniture flammability regulation from a small open flame standard to a smolder-only
standard. Thus, currently there is no other technical or regulatory effort that is addressing ignition of residential upholstered furniture by open flame sources.

NASFM believes that NFPA is in an excellent position to help address upholstered furniture fires. NFPA’s focus on developing a test method for open-flame ignition will provide a significant contribution to addressing the problem of upholstered fire safety, as well as significantly enhance protection of the public from the destructive effects of upholstered furniture fires.

According to NFPA, ("Home Fires that Began with Upholstered Furniture," Marty Ahrens, National Fire Protection Association, August 2011), in 1993, the 5-year rolling average number of civilian deaths that began with upholstered furniture fires was 650. In 2009 (the most recent year for available data reported) the average number of deaths reported was 450. Historical NFPA and CPSC fire statistics indicate that, since 1980, the total number of fire deaths resulting from incidents in which furniture was the first item ignited is about 24,000, and exceeds 30,000 deaths since CPSC first started looking at furniture fire safety in 1973. Over a period of about forty years, the annual number of upholstered furniture fire deaths has decreased, from well over 1,000 per year to the current number of about 450 per year. The decline in upholstered furniture related fire deaths probably results from social factors, such as an increased use of smoke alarms and decreased smoking. But it was the intent of Congress when it passed the Consumer Product Safety Act in 1972 that the CPSC reduce addressable deaths and injuries through regulatory action, not through the process of standing by and observing slow social changes.

NASFM does not have the resources, nor does it maintain the technical staff needed, to develop fire test methods. However, since 1997 NASFM has maintained a Science Advisory Committee (SAC); this committee, made up of internationally recognized fire and product safety experts, provides technical guidance and advice to the NASFM Board of Directors. For more than 15 years the SAC has continuously advised the NASFM Board that a mandatory national standard for upholstered furniture should be developed; that both smoldering and open-flame ignition sources need to be included in any effective furniture fire standard; and that significant improvements in fire resistance can be achieved in upholstered furniture without reliance on flame retardant chemicals that may pose environmental or other health threats.

In the past, ignition and flame spread have been prevented primarily through the use of chemical treatments to reduce ignition propensity and prevent flame spread. Some of these chemicals have since been identified as health hazards, and there have been a number of actions to reduce or eliminate their use. It is important to note that not all flame retardants are hazardous, but the term has developed a bad reputation, whether applied accurately or not. In the decades that have passed while CPSC procrastinated on developing a meaningful fire standard for upholstered furniture, methods of achieving improved fire safety have changed substantially. Today’s technology makes it possible to reduce ignition propensity and prevent flame spread without creating health hazards. In fact, CPSC and the US mattress industry have done just this with the introduction of the full-scale mattress flammability standard (16 CFR 1633), which became effective in July 2007; significant fire threats to the mattress are addressed in a meaningful way through a rigorous test method that addresses mattress fire resistance from a large open-flame ignition source.
The scenarios of ignition and flame spread to the point of flashover are significantly different for smoldering and open-flame sources. Smoldering ignition takes a long time (often hours) to develop to the point of flashover, and the likelihood of detection of smoldering fires is much higher than for open-flame ignition. Open-flame ignition of upholstered furniture, on the other hand, can lead to flashover in as little as 3 – 4 minutes, results in much more destructive damage, and frequently leaves less evidence of fire cause. Open flame involvement of upholstered furniture itself is a major contributor to residential fires, according to NFPA’s own statistics. Given that upholstered furniture represents the largest fuel load in most homes, and that flashover of the furniture is the critical event, preventing full involvement of the furniture in the fire will save significant numbers of lives. NASFM strongly believes that a meaningful upholstered furniture standard, based on a realistic and reliable test method that includes both smoldering and open-flame ignition, is both feasible and is necessary. When referring to “open-flame ignition,” NASFM believes it is important for NFPA to address a larger flame source than a typical “small” open flame (i.e., a match or lighter flame). This approach would cover a wider variety of causes of ignition, such as a flaming wastebasket or a blanket draped on the furniture, and would also provide resistance to fires caused by small open flame sources.

Without doubt, there are many complexities that need to be addressed in developing a flammability test for upholstered furniture, but NASFM believes those complexities have more to do with issues of conformance and enforcement than with the technical issues of the standard itself. NASFM also believes that the key to compliance with a performance standard may be through the use of fire barriers in the furniture construction. Furniture makers know how to apply barriers to shield the filling material from ignition, thus reducing the time to flashover or eliminating flashover altogether. In fact, the furniture industry has been using fire barriers in the design of contract and institutional furniture for more than 25 years. Barriers have the advantage of enabling resistance of the furniture to large open flame sources, and the science and availability of barriers have been improved over the past decade through the implementation of the federal open flame mattress flammability standard, 16 CFR 1633. NASFM believes that basic principles of barrier application, through "best practices" approaches, can be met by furniture manufacturers just as mattress makers have done, and that this effort will significantly reduce fire involvement of upholstered furniture, and the societal impact of furniture-related fires.

NASFM strongly urges NFPA to accept the proposal to develop an open flame fire test for residential upholstered furniture, and to use its recognized technical resources to develop realistic test protocols to address the common ignition sources that often result in dangerous and destructive upholstered furniture fires. NFPA may well be the only organization willing to and capable of taking on this crucial task. There is much previous work that NFPA can draw on, and NASFM particularly urges NFPA to include and review the work of the National Institute of Standards and Technology (NIST) and of Underwriters Laboratories (UL). In addition, although CPSC has not taken regulatory action to date, NASFM feels that it is important that NFPA include CPSC in the activity, to the extent possible, and work to secure the agency's willingness to adopt or defer to NFPA's work product as a national mandatory regulation.

NASFM will support this effort in any way it can, and would like to participate, as long as funding is made available by NFPA to enable that participation. Mr. Gordon Damant, former Chief of the California Bureau of Home Furnishings and Thermal Insulation Laboratory, longtime member of
the NASFM Science Advisory Committee, and a member of the NFPA Committee on Fire Tests, can make a significant contribution to the NFPA effort, and NASFM would be pleased to put forward his name as a participant.
January 14, 2014

Codes and Standards Administration, NFPA
1 Batterymarch Park
Quincy, MA 02169-7471

To whom it may concern:

Albemarle is a leading global developer, manufacturer and marketer of highly engineered specialty chemicals for a wide range of markets including petroleum refining, consumer electronics, plastics, crop protection, construction, automotive, pharmaceuticals, food safety and custom chemistry services. As a world leader in flame retardant chemistry, we provide customers with products that help them meet fire safety standards in transportation, electronics and construction applications. We appreciate the opportunity to provide comment on the establishment of a new test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source.

We support the establishment of a new test method to evaluate fire/ignition resistance of upholstered furniture and/or its components subject to a flaming ignition source. In particular there is need for a test that can provide adequate evaluation of the risk arising from exposure of domestic furniture to open flame ignition sources. The importance of addressing the flammability hazard represented by home furnishings cannot be overstated. The open flame testing of upholstered furniture is essential to assuring fire safety, particularly in view of the significant number of fatalities associated with the ignition of upholstered furniture. Further, the aged, the very young and those with physical disabilities are at highest risk of death from home fires. The removal of a flaming ignition test requirement for domestic furniture by the state of California has created a serious gap in fire safety standards.

We at Albemarle feel the NFPA has an important opportunity to address upholstered furniture ignition from candles, matches, lighters and other sources. Thank you for your efforts to improve overall fire safety and for this opportunity to comment.

Sincerely,

Steven W. LeVan
Div. Vice President, Advocacy
Albemarle Corporation
451 Florida St.
Baton Rouge, LA 70801
Christian Dubay, PE, January 20, 2014

NFPA
1 Batterymarch Park
Quincy, MA, 02169
Via Email: cdubay@nfpa.org

RE: Development of a NFPA standard for evaluating resistance of upholstered furniture to a flaming ignition source

Dear Mr. Dubay,

Chemtura Corporation fully supports the establishment of an NFPA standard for the evaluation of the resistance of upholstered furniture to external/open flaming ignition sources. The need for this standard is underscored by the continuing devastating effect of furniture-related fires which the NFPA has clearly documented and reported in a number of publications. Although the data may be imperfect given the challenge of collecting information on the causes of fires, it is clear that furniture-related fires result in substantial numbers of deaths and injuries, not to mention substantial property and environmental damage.

Furniture which has not been designed for open flame ignition performance will contribute to rapid fire growth and lead to flashover conditions within minutes. Fire professionals know that once flashover is reached, fire, heat and smoke rush out of the room of origin throughout the residence, threatening the lives of all occupants in the structure and dramatically increasing the structural damage.

The need for an external/open flaming ignition test for furniture has become increasingly important as US living spaces are filled with highly combustible goods in the presence of well-recognized ignition sources including matches, candles, lighters, high intensity lighting, space heaters, etc. The side-by-side comparison room burns Underwriters Laboratories has conducted dramatically demonstrates what fire fighters and others know to be the case: the modern home fire grows faster and burns hotter than those of several decades ago (see [https://www.ul.com/room_fire/room_fire.html](https://www.ul.com/room_fire/room_fire.html)).

The NFPA understands the devastating impact fire injuries and death has on people and families as well as the destruction fires cause to property. It is essential for public safety to establish standards and regulations to prevent unprotected, readily ignitable, high heat content items from being brought into homes, offices, hotels, and retail establishments and the like where numerous ignition sources are present. The recent decision by California’s Bureau of Electronic, Appliance Repair, Home Furnishings and Thermal Insulation to eliminate any consideration of open flame ignition requirements for furniture or its components has left a huge void in fire safety for California and the country. NFPA must take action to fill that void.

Given NFPA’s history of leading the way in fire safety, its development of an external/open flame ignition test for furniture is an essential step in continuing to lead in the effort to reduce if not eliminate accidental fire injuries and deaths.

Sincerely

[Signature]

Great Lakes Solutions
West Lafayette Indiana
This is a response to the NFPA Standards Council request for input on the development of a standard for ignition resistance of upholstered furniture subjected to a flaming ignition source.

Summary: An accurate and appropriate test for assessing the flaming behavior of residential upholstered furniture would, if implemented, lead to a significant reduction in fire losses. Such a test must include consideration of the magnitude, spatial extent, and duration of the ignition source, and the furniture surface to which it is applied. There are other measurement options beside ignition resistance. The development of such a test will take longer than suggested in the request for input.

Richard G. Gann
9409 Eagleton Lane
Montgomery Village, MD 20886
301-869-5261
rggann44@verizon.net
**Response to the Standards Council of the National Fire Protection Association (NFPA) request for input on the development of a standard for ignition resistance of upholstered furniture subjected to a flaming ignition source**

The U.S. national fire data indicate that fire/ignition resistance of upholstered furniture results in significant fire loss. NFPA analysis of NFIRS data shows that upholstered furniture is the leading item involved in home fire deaths. However, the profile of furniture involvement in fire losses is far broader than indicated by the current request for input.

Ahrens analysis\(^1\) indicates the following annual losses from fires where the furniture was the first item ignited between 2005 and 2009:

<table>
<thead>
<tr>
<th>Ignition Source</th>
<th>Fires</th>
<th>Deaths</th>
<th>Injuries</th>
<th>Property Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonflaming</td>
<td>4000</td>
<td>370</td>
<td>540</td>
<td>$280 M</td>
</tr>
<tr>
<td>Flaming</td>
<td>2340</td>
<td>110</td>
<td>320</td>
<td>$124 M</td>
</tr>
<tr>
<td>Unknown/unclassified</td>
<td>420</td>
<td>20</td>
<td>20</td>
<td>$ 21 M</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6760</td>
<td>500</td>
<td>880</td>
<td><strong>$442 M</strong></td>
</tr>
</tbody>
</table>

In this table, I have combined the more specific ignition sources in the NFPA report into these two categories. Cigarettes are the prevalent nonflaming ignition source (and the only ignition source in current U.S. standards), but the other nonflaming sources (e.g., space heaters) can be significantly more powerful. Furthermore, the current test methods address ignition of the upholstered cushions. Heating and electrical ignitions might well occur on other surfaces of the furniture, including the exterior surfaces. The relative prevalence of furniture surfaces on which flaming ignition occurs is less clear, but it appears reasonable that most of the ignitions might well have been at sites other than the seat cushion.

Hall *et al.* analyzed the losses from furniture fires between 2006 and 2010 in which the furniture was not the first item ignited but was a primary contributor to fire spread.\(^2\)* They estimated that this group of fires accounted for an additional 2,200 fires, 130 civilian deaths, 276 civilian injuries, and $138 million in property loss. These numbers are comparable to those in row 2 of the above table. The authors did not break these numbers down by ignition source. However, if there were already a fire, then it is reasonable to assume that (a) these were flaming ignitions and (b) the power of the ignition source was well above that of a match or candle.

These data indicate that accurately supplementing the current standard tests for upholstered furniture flammability would lead to significant reductions in fire losses.

- Non-flaming ignition: The tests for cigarette ignition resistance of furniture *composites* are probably sufficient. A reliable correlation between performance of furniture *components* in bench-scale tests and tests of actual furniture has not been established.

  In the current tests for cigarette smoldering, the test substrate is supported on a wooden base. Recent research at the National Institute of Standards and Technology (NIST) indicates that this underestimates the *extent* of smoldering relative to a test geometry in

\(^*\) There are only small differences between the two five-year compilations in the two analyses.
which there is air access to the bottom of the padding material. Residential upholstered furniture rarely has a nonpermeable plate under the seat cushions.

Ignitions by heating and electrical equipment lead to nearly as many fires and nearly as much property loss as do cigarette ignitions. The contributions to injuries and deaths are much lower. These non-flaming ignition sources apply far more heat to the upholstered furniture and are more likely to apply this heat to the exterior surfaces rather than the cushions.

- Flaming ignition: The small flame formerly used in California TB117 might replicate a match, cigarette lighter, or small candle. In fatal fires, these small flames were not necessarily applied to the cushions. Moreover, furniture ignition by an existing fire appears to lead to as many deaths as all direct flaming ignitions combined. These ignition sources are far more intense than the conventional small flame and likely threaten the furniture at sites where the composition is unlike that of the seat cushion.

The current proposal is for the NFPA Fire Test Committee (of which I am a member) to develop a single test for flaming ignition resistance of upholstered furniture. The fire incidence data show that improved ignition resistance would lead to reduced fire losses. However, re-creating the small flame test from TB 117 or even the more severe Level 5 small crib fire in BS 5852 is not necessarily an effective solution. From the above discussion, there are a range of ignition energies and a variety of dissimilar ignition sites. There must be a rational combination of flame intensity/duration and site/substrate composition to result in a test that reduces fire losses significantly.

There are additional considerations to be factored into the development and implementation of such a test.

- In any given year, there are over 10,000 upholstery fabrics available. Combined with multiple padding materials, assorted additional inner layers, and diverse furniture designs, it would be impossible to test all combinations before new fabrics had entered the ever-changing market. Moreover, the cost of such testing would be immense, perhaps unbearable. A validated protocol is needed for reducing the number of combinations to be tested.

- There is also merit to designing furniture for post-ignition fire performance similar to that of mattresses in 16 CFR 1633. This standard has technically-based limits on the early heat release and on the peak heat release rate. A furniture standard based on NFPA xxxx could be a basis. The same grouping concept as for bench-scale testing would be necessary, since there is not enough laboratory capacity to test all the possible combinations of components and design features.

- Should a bench-scale test be proposed, especially if the test specimens are component materials, the test results need to be demonstrated as predictive of the fire behavior of full-scale furniture composites.

- A key factor in the success of the implementation of the 16 CFR 1633 standard was the development of guidance by the mattress industry for manufacturers (and their suppliers) to meet the test requirements. A comparable effort is needed if the furniture industry is to manufacture compliant products with manageable cost and customer satisfaction.
The development of such a test will require:

- Laboratory data to indicate the type of test that would be effective and viable. The NIST Fire Research Division is already performing experiments to identify the dominant phenomena that amplify a small fire into a high hazard furniture fire, including characterizing the roles of the furniture components. Additional, coordinated efforts would speed establishment of the needed knowledge.

- Selection (ideally by the Fire Test Committee, manufacturers, and potential regulators) of the type of test to be developed.

- Construction of a prototype design and procedure, operation of the prototype for a range of furniture composition, assessment of the accuracy of the test results, and determination of any acute sensitivities of the output to test conditions.

- Preparation of a draft standard for balloting.

Completing these stages for the mattress standard (16 CFR 1633), a less complex subject than upholstered furniture, took xx years.

Is all the expertise on the Committee?
Appendix A. Request for Comments

The National Fire Protection Association (NFPA) Standards Council requested input on the following subject. Comments are to be submitted by e-mail to stds_admin@nfpa.org by January 20, 2014.

New test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source

At its July 2013 meeting, the Standards Council reviewed the request of Barry Badders, Chair of the Fire Test Committee, that NFPA consider the establishment of a new test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source. After review of all the material before it, the Council voted to publish a notice to solicit public comments on the need for the project, information on resources on the subject matter, those interested in participating, if established, and other organizations actively involved with the subject. The following justifications for the new project has been submitted:

a. Explain the Scope of the new project/document:
This document would provide a test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source.

b. Provide an explanation and any evidence of the need for the new project/document:
The State of California publishes Technical Bulletin 117, Requirements, Test Procedure and Apparatus for Testing the Flame Retardance of Resilient Filling Materials Used in Upholstered Furniture, which previously included a test method for evaluating fire resistance of upholstered furniture when exposed to an open flame ignition source. The California Bureau of Home Furnishings and Thermal Insulation has proposed the removal of the small open flame test requirement. Organizations have argued that requiring an open flame test will result in the continued use of fire retardant chemicals that can cause health problems.

NFPA currently publishes two upholstered furniture test methods, NFPA 260, Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture and NFPA 261, Standard Method of Test for Determining Resistance of Mock-Up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes. Both of these standards use cigarettes as an ignition source, representing smoldering ignition. NFPA’s research proves that smoldering ignition only represents 45% of the fire deaths associated with upholstered furniture. None of the leading U.S. SDOs for fire testing currently publish a test method to evaluate upholstered furniture subject to open flame ignition sources, leaving a gap in the industry.

NFPA conducted an analysis1 of national statistics regarding upholstered furniture related fire losses. The analysis found that upholstered furniture is the leading item involved in home fire deaths, accounting for 24% of all home fire deaths in recent years. Of those deaths, 45% is attributed to cigarette ignition, 10% is attributed to small open flame ignition and 21% can be attributed to flaming ignition from another burning item. The other 24% are ignitions that are an unknown mix of smoldering and flaming, such as arching or overheating from operating equipment.

1 William M. Pitts, Summary and Conclusions of a Workshop on “Quantifying the Contribution of Flaming Residential Upholstered Furniture to Fire Losses in the United States,” NIST Technical Note 1757, National Institute of Standards and Technology, Gaithersburg, MD, 2012.

c. Identify intended users of the new project/document: Upholstered furniture manufacturers, testing laboratories

d. Identify individuals, groups and organizations that should review and provide input on the need for the proposed new project/document; and provide contact information for these groups:

e. Identify individuals, groups and organizations that will be or could be affected, either directly or indirectly, by the proposed new project/document, and what benefit they will receive by having this new document available:

The NFPA 101/NFPA 5000 technical committees on Interior Finish and Residential Occupancies and the NFPA 1 technical committee could reference this new standard as a requirement for upholstered furniture in residential occupancies. Both the TCs on Interior Finish and Residential Occupancies have reviewed this proposal. Neither TC opposed the development of this document.

f. Identify other related documents and projects on the subject both within NFPA and external to NFPA:

- NFPA 260, Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture
- NFPA 261, Standard Method of Test for Determining Resistance of Mock-Up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes
- ASTM Committee E-5, Fire Tests
- BS 5852, Methods of Test for Assessment of the Ignitability of Upholstered Seating by Smouldering and Flaming Ignition Sources

g. Identify the technical expertise and interest necessary to develop the project/document, and if the committee membership currently contains this expertise and interest:

The committee membership currently contains the expertise to develop this new standard. The technical committee informally voted during their last committee meeting (April 2013) to support this project.

h. Provide an estimate on the amount of time needed to develop the new project/document: Two to three years.

i. Comment on the availability of data and other information that exists or would be needed to substantiate the technical requirements and other provisions of the proposed new project/document:

The committee could build on the many years of test data gleaned under the California test program. Manufacturers of upholstered furniture would be asked to share their research or data on use of alternate methods to pass a flaming ignition test without the use of FR chemicals.
References


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January 17, 2014

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Reference: NFPA request for comment on a possible open flame test for upholstered furniture materials.

I read with interest the NFPA article, “Hot Seat,” published in the September/October Journal. NFPA has requested public comments on whether to pursue development of an open flame test standard for upholstered furniture components and/or composites. My comments follow as a scientist practicing in the area, a home owner with upholstered furniture and having a deep concern for residential fire safety.

I strongly support the development of an open flame test standard for upholstered furniture by the NFPA Fire Test Committee. With the new California TB 117 test effective in 2014 there is no open flame test requirement in the States for ordinary residential furniture and the fire safety of upholstered furniture in the whole of the U.S. has been compromised. The development and subsequent adoption of an NFPA open flame test standard has the potential to significantly improve U.S. residential fire safety, saving lives and preventing property loss.

By way of my background, I have a Ph.D. in organic chemistry and worked for BASF Corporation in their Research and Development area for 25 years (now retired). Most all of that time was spent doing work in polyurethane R&D chemistry and much of that related to flammability issues in flexible PU foam development. I had been Chair of the Alliance for the Polyurethanes Industry’s (API but now CPI, Center for the Polyurethanes Industry) Combustibility Group for a number of years and spearheaded that group’s effort in understanding polyurethane foam and upholstered furniture flammability with respect to both cigarette smoldering and open flame ignition resistance. Under my guidance we worked with other industry and government groups to bring sound scientific principles to the table. I have met with staff at the California Bureau, CPSC, NIST, NFPA, PFA and AHFA over the at least the last 20 years on the subject of upholstered furniture flammability. I have kept an active dialog with most of these organizations on the subject. In addition to these national polyurethane based industry groups I chaired the global Fire Science Group of the International Isocyanate Institute (III) for six years while at BASF. This international group of fire scientists examines many aspects of polyurethane foam flammability. I continue to be active in these organizations as a consultant today.
For reasons enumerated below I believe a significantly higher margin of safety would be provided by both a cigarette smoldering and an open flame resistance standard. The open flame portion of a test method would evaluate the fire resistance of the covering fabric, padding materials as well as evaluation of any barrier materials.

**Recognition of Fire Loss Problems**

Residential fires are often catastrophic for those involved, especially when there are injuries or deaths of loved ones. NFPA is the acknowledged leader for fire loss statistics in the U.S. The report by the NFPA on residential upholstered furniture fires (M. Ahrens, 2012) revealed that in the years 2005-2009, there were an average of 7,040 home structure fires per year in the United States in which upholstered furniture was the first item ignited. These fires resulted in a yearly average of 500 civilian fire deaths, 890 civilian fire injuries and $442 million in property damage. The death rate from furniture fires over this period was 7.1%. While fires beginning with furniture were 2% of reported home fires, they accounted for one in five (19%) of home fire deaths. Therefore there is a relatively high risk of injury or death in fires where upholstered furniture was the first item ignited.

Smoking materials are still the leading cause of upholstered furniture fire incidents and losses. NFPA data on fire loss statistics are certainly crucial in evaluating the upholstered furniture fire risk in the States. In 2010 smoking related fires killed an estimated 610 people (NFPA, J. Hall, 2012). Small flame sources, such as candles, matches and lighters, were involved in 21% of furniture fires and 12% of deaths in the period between 2005 and 2009. This 12% of fire deaths cited above from small open flame is certainly significant, just ask the families of those who have lost loved ones. Additional fires involving portable or fixed space heaters, operating equipment, fireplace embers or ashes and electrical short circuits and malfunctions, are not included in the small-flame totals. Not all secondary ignitions of upholstered furniture could be prevented; however, a significant percentage, I believe, would be addressable by including an open flame component of a national standard, as had been brought forward by CPSC in past method drafts. John Hall concluded (NIST Workshop on “Quantifying the Contribution of Faming Residential Upholstered Furniture to Fire Loses in the U.S., September 2012) that based on his experience and discussions upholstered furniture as a second item ignited contributes to fire losses in a meaningful way. There are an estimated annual 190 fire deaths involving upholstered furniture that are not caused by initial ignition of furniture by cigarette smoldering. These include the other sources of ignition mentioned above. This is a significant number of deaths and could be addressed by a national regulatory or consensus (NFPA) standard which includes a robust open flame ignition resistance of furniture. Secondary ignition of upholstered furniture is not directly counted in the residential fires that claim lives every year in the U.S. It has been documented that upholstered furniture and mattresses account for the greatest fuel load in the living and sleeping areas of most homes. From whatever source, upholstered furniture will burn vigorously when ignited and typically reach flash over conditions within several minutes. This presents a high hazard to people in other than the rooms of fire origin where the majority of fire deaths occur. (An exception to this situation that we have in the States comes from the British experience with upholstered furniture compliant to their BS5852 standard.)

From the NIST Workshop in Sept. of 2012 (NIST Technical Note 1757) the participants summarized their major points which include, in part:
“Recent studies confirm the potential for rapid flaming fire growth on RUF [Residential Upholstered Furniture] to cause significant fire losses in residences.”

“Statistics show that fires are many times more likely to result in property loss, injury, and particularly fatalities than expected based simply on their percentage of all fires.”

“Statistics suggest that flaming ignition of RUF occurs in a number of ways that, in total, represent a significant but not dominant source of fire losses involving RUF.”

Synthetic upholstery fabrics involving RUF generally act as heat sinks when exposed to a smoldering cigarette by melting away from the heat. If polyester batting is used under the cover fabric, it too can act as a heat sink and in total the item will tend not to go to flaming or will go to flaming in a relatively long period of time (perhaps many minutes or more). The current CPSC proposal will test these materials and find relatively positive performance with a cigarette ignition source. On the other hand, these same fabrics and padding, largely resistant to cigarette smoldering, tend to catch fire rapidly when exposed to a small open flame.

**Laboratory Studies with an Open Flame Ignition Source for Upholstered Furniture**

A study was conducted by API/CPI in 2001 where mock-up scale test results (modified BS 5852 test frame, the “small test rig” described in BS 5852) were obtained on combinations of 40 commercial upholstery fabrics, three PU foam grades, three polyester batting materials and two FR interliners. This data was presented to CPSC in 2002 by myself. It is worthwhile to review some of this information here when considering open flame test development by NFPA.

**Introduction/Background/Materials:**

In these studies, composite specimens consisting of fabric and foam combinations used in commercially available upholstered furniture were prepared. The ignition source used in this study was a butane flame about the size of a burning match (BS 5852 Source 1 equivalent), placed at the intersection of the seat and back of the mock up for 20 sec. Mass loss/mass loss rate measurements during the tests provided quantification of the extent of burning of the specimens.

This project had three primary objectives: 1) develop certain flammability data on fabric-foam composite test specimens that are representative of materials used in U.S. residential upholstered furniture; 2) analyze and interpret the data and create a method for presenting the results in a simplified, but quantitative, manner that would permit easy interpretation and extrapolation to full scale furniture evaluations; and 3) develop a test procedure that could be the basis for a regulatory tool to evaluate upholstered furniture flammability resistance.

Fabric/foam combinations used in upholstered furniture were evaluated as composites, rather than testing an upholstery fabric over a standard PU foam or a foam under a standard fabric. For many of the products tested, evaluation of the flammability properties of the separate components did not adequately predict the fire performance of the composite item.

Polyurethane foam samples were chosen to illustrate the performance of conventional non-FR foam. Foam compliant to the California T.B. 117 [2000] standard illustrated the performance of the foam required in all upholstered furniture sold in California (and in much of the country). Foam compliant to
the BS 5852 standard (Crib 5 ignition source) was chosen to represent the best commercially available FR treated product available to manufacturers in the U.K.

The set of 32 fabrics was chosen as a cross section of U.S. commercially available upholstery fabrics. They represent various weights and fiber constructions, some with a latex or acrylic backing and some without. Eight FR-backcoated fabrics were included and were designed to pass the BS 5852 test for fabrics.

Polyester batting materials were chosen to represent typical adhesive, adhered (to foam); “slickened” batting (tends to be more highly combustible); and a batting designed to pass the BS 5852 batting test or the Cal TB 117 [2002] draft standard requirements (a less combustible batting). The great majority of upholstered furniture with polyurethane seat cushions is manufactured with a “slickened” polyester batt wrap under the cover fabric.

The two barriers/interliners were commercially available FR-interliners that have been used to pass more stringent flammability tests such as the California TB 133 test. They contain crossed linked melamine and aramid fibers.

**Representative Data and Discussion:**

Mass loss curves for two set of commercial upholstery fabrics in the small BS 5852 test rig configuration are shown below. While the mass loss is given in grams (of the test mock-up) the relative performance is of value. For the majority of fabrics in these data sets the rapid mass loss in the vicinity of 100 to 200 sec. is indicative of full fire involvement of the test mock up and, most likely, what would be seen in full scale furniture. These tests were of fabric over foam alone – no polyester batting or interliner. The curves towards the right side of the graphs indicate better performing fabrics; in the case of Fabric Set 2 a cotton/polyester weave and leather both took more than 5 minutes before they reached full fire involvement.

**Fabric Set 1**

**Fabric Set 2**

The fabrics had a range of weights, were blends of natural (e.g., cotton) and synthetic (e.g., polyester) fibers, had a range of measured air flows and, importantly, varying amounts of non-FR backcoating, normally a latex or acrylic base material. Largely because of this variability it was not possible to do an overall comparative summary in terms of best to worst performing fabrics or mock-up types but some generalizations were observed. More open weave fabrics tended to perform worse than tightly woven
(lower air flow) fabrics of similar construction. Fabrics with a heavier backcoating (non-FR) tended to perform worse than similar fabrics with no or a lighter amount of backcoating.

As a verbal summary of the more than 150 combinations of fabrics, foams, polyester battings and fire barrier interliners, there were specimens that did not ignite and burn to those that ignited easily and went to full fire involvement quickly. All mock-ups of the 8 fabrics with an FR backcoating and 4 “conventional” fabric mock-ups (including leather) did not ignite with the small match flame ignition source whether or not non-FR PU foam was used; or there was insignificant mass loss. Mock-ups with the interliner also had insignificant mass loss. The mass loss rate, in g/sec, was measured up to 4% of the specimen mass loss at which time the tests were ended.

The general ranking of mock-ups from these tests are listed from best to worst is as follows:

1. FR backcoated fabrics over non-FR foam
2. BS 5852 compliant foam
3. About equal to No. 2 was interliner + non-FR foam
5. BS 5852 compliant foam + slickened polyester batting
6. About equal to No. 5 was non-FR foam

In virtually all cases the presence of the commonly used slickened polyester batting caused the mock-ups to perform more poorly than without the material. Therefore this must be taken into account when setting flammability standards.

In a different set of tests in which 12 labs participated in a round robin. Seven combinations of materials were evaluated and are listed below.

<table>
<thead>
<tr>
<th>Series</th>
<th>Fabric¹</th>
<th>Foam²</th>
<th>Batting³</th>
<th>Interliner⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“Selected” fabric</td>
<td>Cal. 117 [2002]</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>“Selected” fabric</td>
<td>Cal. 117 [2002]</td>
<td>Conventional</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>“Selected” fabric</td>
<td>BS 5852, crib 5</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>FR back-coated</td>
<td>Non FR</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>7</td>
<td>Heavy polyolefin</td>
<td>New Cal. 117</td>
<td>Conventional</td>
<td>Commercial FR</td>
</tr>
</tbody>
</table>

As with the first study, all the tests were conducted using the BS 5852 small test rig and again the ignition source was a match type butane flame applied to the seat/back crevice of the mock-up. The “Selected” fabric was a 64/36 blend of rayon/polyester with no back coating (13.8 oz./linear yard). The FR backcoated fabric was made to be compliant to the BS 5852 fabric test requirements. The “Heavy
polyolefin” fabric was a blend of 72/28 of polyolefin/polyester (20.1 oz./linear yard). The FR interliner was a commercial grade made for upholstered furniture. The batting was a commercial “slickened” polyester. The mass loss of the specimens was recorded over a specific time segment during the tests.

The figure below gives the overall average of the small scale mass loss rates for all labs participating in the study.

There are several take-aways from these curves. First, Series 2 performed the worst – TB 117 [2002] foam with batting. As was the case in the first study, the polyester batting degraded mock-up performance. TB 117 [2000] foam and non-FR foam were not part of this study but were somewhat worse performing than the TB 117 [2002] compliant foam (private communication and lab experience). Curve 5 – BS 5852 Crib 5 compliant foam performed significantly better than the TB 117 foam runs. With Curve 3 we see that “unslickened” polyester batting (compliant to TB 117 [2002] performed about the same as with BS 5852 foam alone. This type of batting acted as a fire blocking layer itself. In Curve 4 with an FR interliner the fabric tended to burn off but left the foam largely untouched. This is consistent with CPSC, NIST and UL studies on barriers. However, there are economic considerations in using double upholstery for an interliner. There is no Curve 6 because that mock-up did not ignite with any detectable mass loss.

The anomaly in this set is with Curve 7 – the same construction as Curve 4 specimens but with the heavier fabric. In this case the fire load of the fabric itself eventually overcame the protection of the FR barrier = the foam eventually became fully involved in the fire. This was witnessed in the California Bureau labs with a full scale couch and the same heavy weight fabric. Therefore, if barrier technology is allowed in any standard care must be taken not to automatically approve the use of any barrier material.

As a next step in this extended study full scale upholstered chairs were manufactured with construction matching Series 2, 3, 4 and 7 mentioned in the Table earlier. The same match type butane open flame ignition source was used at the crevice of the seat/back. The results are shown below.
Curve 2 above shows the fast involvement of fire with TB 117 foam and slickened polyester batting. Curve 3 with the better performing unslickened polyester batting (a type of fire barrier) and significantly better performance than Curves 1 and 2 in the mock-up study hardly gave better performance here. Curve 7 with the FR interliner and heavy polyolefin fabric became fully involved in the fire in about 300 sec., significantly worse than in the small scale mock-up tests. The construction with the FR interliner, slickened polyester batting and a lighter weight fabric performed well until about 950 sec. into the test when it quickly went to a flash over condition.

**Combustion Toxicity**

Work by Barbrauskas, et al., (NBS publication 749, 1988) looked, in part, at the relative smoke toxicity from burning plastic containing materials (several diverse plastics), including upholstered furniture. Both bench-scale and full-scale fire tests were run on the articles with and without flame retardants to determine if the flame retardants provided benefit from a combustion toxicology standpoint. The results between bench and full-scale tests were in approximate agreement. An important study conclusion was that the overall toxic hazard was reduced in articles with effective amounts of flame retardants on the basis of reducing the total amount of burning or material consumed. This included the toxicity test results from the upholstered furniture experiments. If a residential fire is prevented or develops more slowly because of flame retardants of any type, the amount of toxic CO given off will be limited. This is the most effective way to reduce fire toxicants.

**California TB 117 [2000] and TB 117 [2013] standard, Continuing need for Open Flame Test**

These points are brought up here to illustrate what seems to be a solely political decision by the State of California to eliminate the open flame portion of the TB 117 test that went into effect this past January 1. There are a number of interesting statements made by the California Bureau of Home Furnishings and Thermal Insulation Chief about 5 years ago in a letter to CPSC containing comments on the CPSC March 2008 notice of proposed rule-making (NPR) which basically would have required a cigarette smolder only requirement for fabric and foam (with the exception of an open flame test for flame resistant barrier materials). The letter, dated May 18, 2008 contained the following:

- “As we have indicated in our comments, the Bureau strongly believes that the CPSC’s latest proposed test method is a significant step backwards and will seriously compromise the
safety of the California consumers in regards to open flame fire hazard of upholstered furniture.”

- “Available fire statistics have shown that despite its weaknesses, this minimum California upholstered furniture flammability standard [TB 117 (2000)] has provided improvements in fire resistance for upholstered furniture components compliant with the standard. On average, upholstered furniture fire deaths and injuries in California have been well below national levels.”

- “Bedding and upholstered furniture were the materials first ignited in 38% of fatal child fires. Lighters and candles were the primary heat sources for these fires.”

- “According to the same report [U.S. Fire Administration report of multiple-fatality fires, November 2001] the leading form of material ignited in multiple fatality fires is upholstered sofa and chairs and the leading form of heat of ignition for such fires is open flame which includes candles and matches and lighters.”

- “While a small portion of existing upholstery fabrics may demonstrate some resistance to ignition from small open flames, the vast majority of fabrics and nearly all synthetic or mostly synthetic upholstery fabrics can easily ignite with a small open flame while the same fabrics can easily pass a cigarette smoldering test.”

- “Manufacturers must be given the choice of using fire resistant fillings [not necessarily with flame retardant chemicals] that are proven to be also safe in regards to hearth effects.”

- “In order to prevent fast developing fires once ignition has occurred, the Bureau believes that the filling contents of upholstered furniture must be either resistant to small open flame or it must be protected by an effective fire barrier. Manufacturers must be given the choice of either using fire resistant fillings that are proven to be also safe in regards to health effects or using fire barriers.”

- “The proposed draft TB 117, dated February 2002, offered improvements in the performance of fabrics, fiber battings, polyurethane foams and loose fillings and included a composite test to allow use of a wider choice of fabrics.”

- “…the Bureau believes that fire safe upholstered furniture can be constructed using existing and emerging fire resistant technologies and materials while avoiding the use of any FR chemicals or treatments that may pose health hazards to the consumer.”

- “For the majority of fabrics that do not pass an open flame fabric test, either a fire barrier (with non-FR filling) or a fire resistant filling that is environmentally safe can be used, meaning no FR treatment of cover fabrics is necessary.”

These statements are a very positive, clear cut and strong endorsement of an open flame portion of an upholstered furniture test. The statements even talk of “available fire statistics” that have shown improvements in fire resistance of upholstered furniture and that California fire losses are well below national levels! With regard to the use of flame retardants, the statements say that if flame retardants were used they would have to not pose health hazards to the consumer and be environmentally safe! The statements make sense, do not mandate the use of flame retardants but do provide a layering of fire safety protection for the people of California with some resistance to both smoldering and open flame ignition sources. It is hard to believe that the Bureau has done a complete turn around in this short amount of time with regard to open flame ignition protection. To completely abandon these lines of reasoning it must be assumed the decisions are totally political and not based on sound science!

An important point on PU foam compliant with the 2000 version of California TB 117 (FR foam) with its open flame requirement vs. non-FR PU foam is that the heat released from upholstered furniture made with FR foam is lower than from non-FR PU foam furniture. Dr. Marc Janssens from Southwest Research Institute has pointed out that the FR foam furniture in a recent study (“Reducing Uncertainty of Quantifying the Burning Rate of Upholstered Furniture,” for National Institute
of Justice (NIJ), July 2012): that “Peak HRR [Heat Release Rate] is strongly affected by the padding material. As an example, the peak HRR was significantly lower for mockups containing Ca TB 117 [2000] foam as opposed to those with non-fire retarded foam.” This means that once a piece of upholstered furniture is ignited (by whatever means) fire growth is slowed somewhat and the time to full fire involvement (time to flash over) is retarded and would allow at least some very important increased escape time from a building. In one case comparing non-FR foam to FR foam furniture the FR foam mockup slowed the onset of the free burning fire by more than doubling the time from ignition to peak HRR (pHRR) as reported by Dr. Matthew Blais, a co-author of the NIJ work at Southwest Research.

“The use of foam compliant to Cal TB 117 [2002] in this study would allow increased escape time to save lives. While the current TB 117 type PU foam does add safety value, an increased open flame resistance requirement would be a step in the right direction.” Dr. Blais also points out that, “The defense in depth approach [for upholstered furniture fire safety] of using both an FR fabric [compliant to NFPA 701] and Cal TB 117 [2000] foam hugely impacts the fire event.” “…with the large burner the protected couch failed to ignite while the unprotected couch reaches free burning in 180 sec. The unprotected couch would cause the room to reach flashover in 4 min.”

The National Association of State Fire Marshals (NASFM) issued a statement on furniture flammability on May 24, 2012, in response to allegations made by the Chicago Tribune article series on upholstered furniture fires and flammability. In part the statement reads, “NASFM has long been committed to the concept of “safety layering,” because there is no single “silver bullet” answer to addressing the fire problem. In this context, safety layering would dictate that ignition sources, such as cigarettes, candles, lighters and electrical sources; as well as fuel sources such as upholstered furniture and other flammable products in the home, including build materials must be addressed and protected or made safer whenever possible.”

**CPSC Furniture Flammability Approaches**

The National Association of State Fire Marshals first petitioned CSPC to regulate the flammability of upholstered furniture by addressing cigarette ignition and both small and large open flame ignition sources. As you know, CPSC denied the large open flame part of the petition, allowed the small open flame part and deferred action on the cigarette smoldering part (later adopted). Now, of course, CPSC has focused on its 2008 notice of proposed rule-making in which it calls for only cigarette smoldering resistance of all upholstery fabrics and interlines (barriers), as well as an open flame test for the interliners or barriers.

In a Memorandum from Shivani Mehta to Dale Ray, Project Manager at the time of the report dated May 9, 2012, Ms. Mehta stated that one of the conclusions from the report was that interliners (or barriers) seemed to be effective in reducing the fire sizes and the time to reach peak fire size was slower regardless of the fabric or foams used.

In a short paper presented by Ms. Mehta at the Fire and Materials Conference on January 29, 2013, she expressed concern about the prediction of bench scale cigarette smoldering results to full scale test results. She also addressed the concern that reduced ignition propensity (RIP) or so-called “fire safe” cigarettes may not yield the desired fire safety results that are claimed. Ms. Patricia Adair gave an extended presentation on June 26, 2013, at the ASTM E05 Fire test meeting at ASTM headquarters where she
reiterated the poor correlation of small scale to large scale reproducibility with cigarettes as the ignition source. In part it was suggested that:

- Testing of RIP cigarettes for percentage of FLBs (full length burns) per ASTM E2187-04 may not be predictive of RIP cigarette FLBs on soft furnishings.
- Percentage of FLBs per ASTM E2187-04 may not be predictive of smoldering on soft furnishings.
- It is premature to conclude that RIP cigarettes alone will greatly reduce the threat of unintentional cigarette-ignited fires involving soft furnishings.

It has also been stated (ASTM E05 Fire Test Meetings, December 2012 and June 2013) by Rik Khanna, current CPSC upholstered furniture flammability Project Manager, that small or bench-scale cigarette smoldering results do not correlate very well with full scale results.

From the draft Federal Register Notice, “Upholstered Furniture Fire Safety Technology Meeting and Request for Comments, to The Commission,” Todd A. Stevenson, Secretary, dated March 1, 2013: “For this test series, the bench-scale performance did not demonstrate an adequate prediction of real furniture flammability performance, especially in the smoldering ignition tests. The open-flame ignition bench-scale qualification tests for fire barriers, however, do appear to result in improvements in full-scale performance.”

In addition to these statements and result findings, I directed an interlaboratory study (ILS) for the API (now CPI) polyurethane industry group on cigarette smoldering in 2005 following the ASTM E691 practice, “Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method.” The primary objective of conducting the ILS was to develop data for a statistical evaluation of the May 2005 CPSC cigarette-ignition draft test protocol. This entailed calculation of the within-laboratory repeatability and between-laboratory reproducibility of the protocol. Specimens were limited to two types of polyurethane foam filling materials under the cotton velvet covering fabric called out in the draft method. The PU foams (1.3 pcf and 1.8 pcf densities) were both compliant to the TB 117 (2002) draft standard, in other words they had somewhat more flame resistance than foams used in TB 117 (2000) upholstered furniture. Bench-scale mock-ups were used and 11 different laboratories participated. There was considerable variability between laboratories. It was possible that results from a variety of laboratories could range from 0 to 12 percent mass loss. In practical terms, this meant that foam samples in one lab that passed the CPSC criteria may not have passed in a different lab. As a cautionary note to CPSC it seems clear that before they would adopt a new standard test method they should run an Interlaboratory Study to verify that within lab and between lab testing results are consistent within accepted fire test ranges.

Of course, as pointed out during the ASTM E05.15 Fire Test Meeting on June 19, 2013, CPSC continues to do “promising research on fire blocking barriers.” Because of these results and activities and the lack of a supportive ILS, I believe it is premature for CPSC to issue a final rule.

Another aspect of using so-called high loft fire barriers is that this may preclude use in some furniture constructions just because of the physical height of the barriers for some configurations.
BS 5852 Standard

The U.K. enacted a law in 1982 and updated it in 1988 to require upholstered furniture to meet certain flammability requirements set forth in the British Standard (BS) 5852 test standard. In this standard, which is regarded as the most stringent for general residential furniture use, a composite test of cover fabric and filling material is subjected to cigarette smoldering. The cover fabric is separately exposed to a small open flame when over non-FR foam. PU foam filling is tested under a 17g wood ‘crib’ which is a significantly higher heat source than the small open flame in TB 117 (2000). There is also an interliner exemption for non-compliant materials. Typically, the cover fabrics would be back coated with an FR chemical and the PU foams treated with a higher level of flame retardants than have been used in TB 117 (2000 or 2002).

To help evaluate the effectiveness of the standard the U.K. Department of Trade and Industry (responsible for furniture fire regulations) commissioned a study by the University of Surrey to evaluate fire losses pre- and post- the full 1988 standard. The results were significant (“Effectiveness of the Furniture and Furnishings (Fire Safety) Regulations 1988”). Before the mid-1980s there were about 3.0 fire deaths per million people (pmp). From 1990 to the 1997 study end date, the trend was down so that only about 1.4 deaths pmp. These fatality numbers represented only those lives lost where upholstered furniture was the first item to ignite. Of course there were still many older upholstered furniture pieces in people’s homes during this time.

It was stated by Dr. David Hawkridge of Mobeltest Quality Services, U.K., during an AFMA Upholstered Furniture Flammability Update meeting on March 7, 2000 that there was no evidence of any fatality where furniture complying with 1988 Regulations has been involved.” This was a huge advance in fire safety for the U.K.

Cal Technical Bulletin 117-2013

Comments on technical aspects of this draft standard:

Under Section 2, Barrier Materials Test – Only using a smoldering cigarette for the barrier (interliner) as the ignition source is definitely shortsighted. Any non-compliant cover fabric which should happen to ignite will provide a significantly greater heat source than the smoldering cigarette. To circumvent this type of problem/issue I strongly recommend that an open flame, as well as cigarette smoldering, ignition source be used in testing any barrier material.

The Bureau intends to further investigate barrier technologies. From the Initial Statement of Reasons document, it “will commence a two-year study on available and emerging fire barrier materials and other fire barrier material and other relevant technologies to examine their open flame fire resistant properties, to monitor and evaluate cost effectiveness, and determine their applicability in open flame testing of upholstered furniture.” As referenced by Arlene Blum and the AHFA there is no prediction that the public in California will prematurely dispose of their older upholstered furniture on the basis of wanting to get rid of flame retardant containing articles, despite the large amount of publicity on this issue. It is very unfortunate that the California Bureau has elected to push ahead with its revised TB 117 standard without first conducting the research that it and CPSC are conducting on barrier and other technologies. There
should **be no rush to adopt a standard that will cover upholstered furniture in so many millions of homes until sound science yields a result that would save significantly more lives than the currently debated approach that CPSC and California seem to be taking.**

- **Under Annex B, Ignition Source –** There is a choice of using the NIST Standard Reference Material (SRM) 1196 cigarette described as a “high ignition propensity” cigarette, similar to the Pall Mall cigarette from years past which is no longer available; or a cigarette which is described in Annex B. I strongly suggest that the SRM 1196 cigarette be used as the only smoldering ignition source in this standard. Having the tight control of the cigarettes for ignition gives needed assurance that the tests will deliver adequate and consistent results.

The very first sentence of the draft standard under Introduction states, “The intent of this standard is to produce upholstered furniture which is safer from the hazards associate with smoldering ignition.” And on p. 5 of the Initial Statement of Reasons document, under “Problem being addressed,” it is stated, “Also, interliner-barriers and resilient filling material can be smolder tested in a more stringent manner.”

I certainly read these two last statements to say that it is one of the intents to make this more rather than less stringent. The inclusion of a Standard Reference Material cigarette that is of the old Pall Mall design (SRM 1196 type) would fulfill this purpose. Use of another cigarette may not provide that layering of protection. Dr. Dick Gann of NIST has said that while some, currently on the market, “fire safe” cigarettes may have the full length burn characteristics and other physical properties, the type of tobacco used may result in varying degrees of burning temperatures and therefore different levels of ignition strength [private communication].

At a minimum, cigarettes that are used in this method should be tested against the most current version of ASTM E2187, “Standard Test Method for Measuring the Ignition Strength of Cigarettes.” This 2009 standard is being revised now and should be re-issued by mid-2014.

- **Under Annex B, Standard Polyurethane Foam Substrate –** It would be important to have reliable, repeatable standard PU foam to use as a substrate under cover fabric or barrier materials. I do not think the description of the foam in this section is adequate. There should be a flammability or ignition range specified similar to that NIST has talked about in past years. Otherwise, it would be possible to use a PU foam that was engineered to be more flame resistant (without added flame retardants) than other foams. This would have a direct impact on pass/fail results for some cover fabrics, for example. This is certainly true if fabrics or barriers had borderline passes. As you know, CPSC and NIST have been working on this standard PU foam issue for several years now and have still not come to a final conclusion. **It was premature to issue this standard before this issue was satisfactorily resolved.**

- **By not including a test to assess the open flame resistance of cover fabrics, filling materials or finished furniture products at all, the standard assumes that open flame caused fires are not an addressable consumer hazard and ignores these fires, and their corresponding fire losses.** **With a smolder only test the standard may increase the use and risk of materials prone to flaming ignition. This is not acceptable.**
• **ASTM E1353-08a** – I am very concerned with the use of ASTM E1353-08a. For one, this standard calls out the use of a test cigarette which is also referenced in TB 117-2013 but could be defined by some users in different ways, e.g., the tobacco used from different sources could have different burn characteristics yielding varying test results. This standard is up for its 5-year review in 2014. If it is not re-approved, it will be dropped from the ASTM books as a matter of ASTM policy. I think it would be bad policy to reference a standard that may not remain an active standard. I sit on the ASTM E05.15 subcommittee on Furnishings and Contents and am also a member of the E1353 task group looking to revise the standard. My view of that task group is that there is a real chance of “gridlock” on provisions of the test standard and it may not be re-approved this year. While the 2008 version is called out in TB 117-2013 I think it would be unwise to use it when there is a more up to date functionally equivalent standard at hand. Mr. Khanna requested comments on the possibility of improving this E1353 standard at the June 2013 ASTM meetings. I submitted suggestions for this but as of this writing no further action (December 2013 ASTM E05 meetings) has been taken and it looks like no action will be taken.

The other consensus standard which is functionally equivalent to ASTM E1353 is NFPA 260, 2013 edition. This standard which is also modeled after the UFAC cigarette smoldering standard has been around longer than ASTM E1353. It is also a full consensus standard and has just been updated (to use the NIST SRM 1196 cigarette as the ignition source). **It makes more sense to use the NFPA 260 standard for the Bureau’s standard test method needs.** In the Bureau’s Initial Statement of Reasons document, p. 4, top, it says, “Approximately 80-85% of U.S. manufacturers currently comply with the ASTM E1353-08a standard.” It could equally be stated that they also comply with the NFPA 260 standard (at least the 2009 edition). Actually these manufacturers say they comply with the UFAC cigarette smoldering requirements. You do not see ASTM “hang tags” on pieces of retail furniture but rather UFAC hang tags!

**Issues with “Toxic” Flame Retardants**

Certainly there has been a very high level of press coverage over the last several years of so-called toxic flame retardants used in upholstered furniture. Most of this coverage has had to do with the use of pentabromodiphenylether and derivatives. As you know, production and use of this flame retardant ceased in 2004 and that seems to be a past issue now. Another flame retardant that has been commonly used in furniture padding is TDCPP or TDCP [tris-(dichloropropyl) phosphate]. This FR is also either out of use or is in the process of phasing out for furniture use. The main issue with these FRs is toxicity or presumed toxicity and the exposure of people to these chemicals in the home. It has been found that some very small amounts of FRs have come out of upholstered furniture because of foam dust that migrates out or perhaps due to volatility. These two FRs are “free” compounds, that is they are not chemically bound to the polymer and they could be ingested if dust were itself ingested. However, the human toxicity of these materials is very low and exposure has been very limited.

There are many flame retardants that could be used for flexible PU foam. Each chemical has to be viewed on its own, as other chemicals like pharmaceuticals are. The toxicity profile, volatility or leaching potential of an FR chemical must be examined on a case by case basis. There is no such thing as a broad brush determination of the safety for a class of compounds, e.g., not all halogenated compounds are toxic
and, by comparison, not all pharmaceuticals are ‘safe.’ In fact a number of pharmaceutical drugs contain halogens. It just does not make sense to “through the baby out with the bath water.” To develop a standard based on emotional grounds (“we don’t want any flame retardants”) rather than on sound science would be an embarrassment to science and rational thought.

An important toxicological aspect of chemical safety is bioavailability. Small molecules are more easily assimilated and metabolized in the body than larger molecules. Generally, as the molecular weight of a chemical compound increases passed about 1,000 g/mole its bioavailability decreases dramatically (however, there are a few exceptions such as bio-based chemicals like proteins). There are a number of flame retardant chemicals currently on the market which are polymeric on their own, that is their molecular weight is much greater than 1,000 g/mole, and therefore are far less bioavailable. With the higher molecular weight they are also far less volatile to reduce the possibility of entering indoor living space. Another classification of FRs currently on the market that can be used for flexible PU foam today are so-called reactive chemicals, that is they react into the polyurethane polymer backbone and again, because of that they are not as bioavailable.

Almost every week I see papers or advertisements for the use of new non-halogen containing, non-volatile, non-toxic flame retardants. For example, a relatively new class of flame retardants that can be used in flexible polyurethane foam are the nanocomposite based materials. These materials provide an extremely thin layer of non-burnable material, frequently clays, on all surfaces of the foam matrix, thus preventing ready burning of the polyurethane foam as a whole. Dr. Jamie Grunlan of Texas A&M University reported on one aspect of these materials at the January 2013 Fire and Materials Conference in San Francisco. He reports that some of these materials have excellent fire resistant properties and that his advances are now well protected by patents so he is able to share the technology freely (private communication).

The adversaries of open flame requirements for upholstered furniture and those against the use of any chemical flame retardants do not talk about these materials. There has been no mention of any toxic, or not, effects for any of these last classes of flame retardants.

As a scientist and home owner, husband and father with upholstered furniture in my own house I find it extremely objectionable to preclude the use of any reasonable means of reducing the risk of fire deaths and injuries! This includes ignitions from both smoking materials and small open flame sources. It appears that CPSC is headed down a path to provide a lower level of fire protection than is certainly available with today’s technology – in very environmentally and physiologically acceptable ways – only because of political pressure.

Summary and Recommendations

- For reasons stated throughout my comments, an open flame resistance requirement for at least padding and barrier materials, if not cover fabrics, is called for.
- The past TB 117 [2000] (open flame test for padding materials) does add fire safety value but does not go far enough. A more stringent open flame resistance requirement would be a better option, similar to the TB 117 [2002] draft test standard. Opponents of open flame testing requirements talk about the limited value of TB 117 [2000 version] compliant PU foam based on testing. They have not tested PU foam or furniture to the higher standard of
TB 117 [2002] or even higher levels of fire resistance like BS 5852, crib 5 for padding. The UK has had superior fire safety experience with this British Standard for furniture.

- It is important to keep in mind that flame retarded PU foams have a lower heat release rate in furniture fires which leads to slower fire growth and longer escape times. This is especially true with homes that are equipped with smoke detectors.
- An alternative to fire resistant padding materials would be to use either a high-loft or sheet type barrier under the cover fabric.
- The open flame resistance requirement for barriers similar to that found in the 2008 draft CPSC test method is a positive step forward.
- CPSC has stated their studies have shown that bench-scale to full- or large-scale cigarette smoldering testing results do not have good correlation. More work, including an interlaboratory study, is needed before a new test standard is adopted by CPSC or NFPA for the nation.
- Because CPSC is still working to finish its flammability testing of upholstered furniture and because the turn-over rate of residential upholstered furniture is slow, in the neighborhood of 20 years when secondary use is taken into account, there is not a pressing need to adopt a standard prematurely before the additional testing has been completed.
- Consideration should be given to using the NFPA 260 (and 261), 2013 edition standard as the main reference document instead of the ASTM E1353-08a standard for cigarette smoldering ignitions. The ASTM standard may be dropped from ASTM’s books as an active standard for reasons given in the text. It would make more sense to use an active consensus standard like the NFPA version which is a functional equivalent to ASTM E1353-08a.
Subject: FW: Comments regarding a potential open flame fire test to fill the void of California TB 117.

From: Carl Ogburn [mailto:cogburn@chestnutridgefoam.com]
Sent: Friday, January 17, 2014 4:24 PM
To: stds_admin
Cc: Fuller, Linda

Subject: Comments regarding a potential open flame fire test to fill the void of California TB 117.

NFPA, 1-16-14

Dear NFPA,

I am submitting this as a result of your notice to seek comment regarding a potential new open flame fire test in lieu of the TB 117 open flame fire test being discontinued by the State of California.

I am submitting these comments in favor of NFPA developing a replacement fire test method.

Our firm, Chestnut Ridge Foam, Inc., is a manufacturer of highly fire resistant foam cushioning, including completed mattresses. The majority of our products are used in public occupancy, vehicle, or marine applications such as rail and bus vehicle seating, detention and mental health facility mattresses, military vessels and vehicles (mattresses and seating), mattresses for long term care and behavioral facilities, etc. Many of these applications experience accidental or intentional vandalism and accidental or intentional open flame ignition of upholstered composites.

Several of our fire-resistant cushioning products easily comply with the past California Technical Bulletin #117 open flame vertical burn test, without the use of flame retardant chemicals which were the driving force behind the recent change in California. In addition, several other types of our fire-resistant cushioning use minimal amounts of flame retardants (which have not proven to be problematic), which could be eliminated, but would have trade-offs such as higher density of cushioning and higher cushioning costs.

The current use of the traditional California Technical Bulletin #117 test is extensive throughout North America, and we use the standard as an effective quality control tool for testing and certification of incoming raw materials. These raw materials primarily include open cell polyether polyurethane cushioning materials, but also include other foams and fabrics as well. This open flame vertical fire test is a great tool for testing incoming composite foam and other materials.

For our firm, one primary use of this open flame fire test is to verify and govern the fire performance of the foam and other components in ALL of our mattresses, including ones which comply with the 16 CFR 1633 open flame fire test for mattress assemblies. If an alternate test is not available, we’d either have to continue to verify incoming materials to the obsolete method (not preferred) or change to a less or more stringent alternate test which would then require re-qualification fire tests for compliance to 16 CFR 1633 of the mattress assembly.

I believe if a similar standard is not developed by NFPA, ASTM, ISO, etc., that a HIGHER fire performance requirement of open flame criteria may fill the void such as 14 CFR 25.853(a) 12 or 60 second vertical open flame fire test used globally in aviation, or NFPA 701, both of which would require the use of MORE flame-retardants, accomplishing the opposite of the current State of California intentions.

In many of the non-residential applications for upholstered products, accidental or intentional vandalism and accidental or intentional ignition dictates that the fire performance of such composites not be limited to an exterior upholstery fabric or to the use of secondary fire barrier fabrics. In such markets, ALL of the components in the assembly must have
some minimal level of open flame fire performance. Until this recent action by the State of California, their open flame vertical fire test procedure helped serve this purpose.

From a purely residential furniture perspective, I believe an open flame test is still a considerable improvement over the smoldering replacement test. It appears from the NFPA stated statistics, that open flame ignition of upholstered furniture is still a contributor in a high percentage of home fire deaths. The new California Technical Bulletin #117 supposedly provides fire protection utilizing primary or secondary upholstery fabrics. However, it does not address issues in relation to wear or possible recovering these fabrics, which residential furniture experiences in continued use. The FAA conducted a study “The Effect of Wear on Fire-Blocking Layer Material Effectiveness” by J. Michael Barrientos (DOT/FAA/CT-TN94/16) in 1995 and determined that wear does have a negative effect (failing their criteria) after in-service wear. This is one example of why the reliance of fire performance of an upholstered assembly should not be solely determined by the exterior covering fabric or by a secondary fire barrier.

The NFPA consideration of an equivalent test method is to be applauded. This is a test which is needed, regardless of how the State of California chooses to regulate the fire performance of residential furniture within their state. This potential test method has numerous uses, beyond residential furniture in the State of California.

Your consideration of my comments is appreciated. Thank you.

Sincerely,

NFPA Member # 135531
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January 20, 2014

Standards Council – Fire Test Committee  
National Fire Protection Association  
1 Battery Park  
Quincy, MA 02169

Re: Request for Public Comments - New test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source

Based on current information, the Polyurethane Foam Association does not support an initiative to develop a flaming ignition standard for residential upholstered furniture.

The Polyurethane Foam Association (PFA) is a not-for-profit industry trade association representing manufacturers of flexible polyurethane foam (FPF), a cushioning material commonly used in upholstered furniture construction. Since PFA’s founding in 1980, the association has been on the forefront of fire safety education and has supported testing and research efforts to better understand ignition and combustion characteristics of upholstered furniture that contains FPF filling materials.

As an industry stakeholder, PFA is aware of various approaches that have been taken to develop flammability standards for home furnishings products. Key to development of a sound scientifically-based standard, that might gain industry support, is identification of the hazard and risk that the standard should address. Defining the problem must be the first step. Initial information needed for standard development should include:

- accurate fire incidence statistics that identify, appropriately categorize and quantify fires by various reported ignition sources;
- analysis of the ignition strength and heat exposure duration of identified ignition sources and,
- evaluation of the relative risk (hazard x incidence frequency) presented by identified ignition sources.

Once this information is in hand, research can begin to determine whether there are ways to mitigate significant fire risks in a practical, environmentally-acceptable and commercially feasible manner.

While PFA is on record in support of research to investigate the need for an open flame standard for upholstered furniture, we are not yet of the opinion that significant addressable risks of open flame ignition exist. Current fire incidence statistics and
collection methodology are not defensible. Reliable statistics, having an identified confidence interval, have not been presented. The accuracy of the National Fire Incident Reporting System (NFIRS) data has been questioned. Expanded analysis of NFIRS data to create a combined estimate for the contribution of household furnishings as items of first ignition to also include items that become involved in fire propagation due to fire spread from another item of first ignition will be less exact than initial information. While PFA strongly supports efforts to help reduce the incidence of household fires involving home furnishings, we believe that before unreliable statistics are used to support possible research to develop a test method, an emphasis should be placed on establishing a confidence interval for fire loss estimates. If reliable fire loss estimates demonstrate a need for open flame testing, then efforts can be directed toward development of a test method that will address an identified risk. Such a test method will need to be appropriate to the risk of ignition, based on the composite performance of the finished goods including all items of assembly, free from bias toward any component, must be reproducible and technically feasible, must allow compliant products to be commercially viable and salable and they must be safe for workers, the public and the environment.

Summary information shared by NFPA does not accurately quantify specific open flame ignition sources. These data, presented in support of NFPA furniture open flame test method initiative, combine many types of potential open flame ignition scenarios ranging from small open flame, such as ignition by lighter or candle, to large-scale fires involving a number of household items. These data do not serve to identify potential heat of ignition or flame exposure duration that are necessary factors for development of a possible test method. We believe, before there can be efforts to develop potentially protective strategies, the actual risks must be better identified and priorities must be established. We are not aware of any commercially feasible technology that will protect upholstered furniture from all types of open flame ignition and contain the heat of combustion under all fire circumstances, once an item has ignited.

We respectfully recommend that more work is needed to better understand the risk of fire involving upholstered furniture including development of scientifically-reliable data to accurately quantify the frequency of household fires involving various types of ignition sources with identified heat and potential exposure duration information. Once these data are available, and if significant risks are established using acceptable statistical methods with a stated confidence interval, priorities can be established and work can begin to develop a possible appropriate open flame test method to address specific ignition and combustion conditions.

For additional information, please see PFA’s report, “Overview on the Combustibility and Testing of Filling Materials and Fabrics for Upholstered Furniture,” that was provided to NFPA representatives at the December 11, 2012 at the U.S. Fire

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2 William M. Pitts, Summary and Conclusion of a Workshop on “Quantifying the Contribution of Flaming Residential Upholstered Furniture to Fire.”
Administration, Changing Severity of Home Fires Workshop in Gaithersburg, Maryland. Also attached is PFA’s position on the development of an appropriate open flame standard for upholstered furniture is also provided. (Attachment 2).

The Polyurethane Foam Association appreciates the opportunity to have been involved in discussions with NFPA staff regarding these efforts and we look forward to continuing joint efforts with the goal of improving fire safety.

Sincerely,

[Signature]

Robert J. Luedeka
Executive Director

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Overview on the Combustibility and Testing of Filling Materials and Fabrics for Upholstered Furniture

Prepared by the Polyurethane Foam Association
Based on research findings of the Product Research Committee and Dr. Herman Stone

The overview covers the history of flammability issues affecting flexible polyurethane foam (FPF), testing procedures and factors that affect test performance, variability in ignition and flame spread, combustion modifying additives and reactives flame retardant technologies.

FPF was developed shortly after World War II. FPF found many different applications in the 1950s. One of the largest markets for FPF was the upholstered furniture industry. In this application, it was noted early on that FPF had the potential to ignite and, depending upon the conditions, burn vigorously.

Almost all carbon-based products burn, but in the case of FPF, this tendency is increased by the fact that foam has a very large surface area in proportion to its weight and its open cell structure allows ready access to oxygen required for combustion.

Recognition of factors contributing to flammability led to early attempts to measure FPF performance when ignited by small ignition sources and to attempts to reduce the tendency toward ignition by including ignition and combustion inhibiting additives.

In the early 1970’s U.S. Testing Company collected and noted more than forty different test methods. Many were primitive by today’s standards such as ASTM D 1692. With many different testing options, it was possible to find one or two that almost any FPF product could pass. The use of claims based on passing flammability tests such as “self extinguishing” and “non-burning” resulted in charges against the FPF industry by the Federal Trade Commission (FTC).

A consent decree was entered into in 1972 by foam producers, raw material suppliers and the American Society of Testing Materials (ASTM) with the FTC which prohibited the use of misleading fire performance descriptions. In addition, a disclaimer was required to be used in connection with any small scale flammability tests such as: “This flammability rating is not intended to reflect hazards by this or any other material under actual fire conditions.”

As part of the consent decree the FPF industry spent five million dollars over a period of five years on sponsored research aimed at understanding the relationship of foam and fire.

A Products Research Committee was formed, chaired by the National Bureau of Standards, with representatives from industry and academia. Research findings were published in 1980 under the title: “Fire Research on Cellular Plastics: The Final Report of the Products Research Committee”. The report provides evidence that there is no such thing as a “standard” real fire by which performance of a material can be measured and projected to perform under all conditions. Every fire is unique. The process of testing cellular materials for ignition and combustion performance is complicated by the complexity of fire and the difficulty of measuring the interactions of varied materials and conditions involved in fire scenarios.
Tests for the ignition and burning performance of upholstered furniture items must take into account a number of variables. It is unlikely that any single test can cover all the possible variations.

Some of the variables include the filling material such as foams of different types and grades, synthetic fiber, natural materials such as cotton, down and feathers. There also can be Combinations of these products sometimes including layers of different cushioning materials.

Upholstery fabrics are key to fire performance and fabric variables include: weight, weave and fiber denier and crimp. Porosity and construction design are significant variables including the presence of welt cords and the possibility of raised fibers as found in flocks and piles. Fabric backing plays a role as do fiber treatments for soil and stain resistance and waterproofing.

The composition of the fabric is important. Fiber content can vary greatly including: cellulosics such as cotton, rayon and linen and protein-based fibers like wool and leather. There are thermoplastic synthetics like polyester, nylon, polypropylene and PVC, and other synthetics such as acrylcs and modacrylcs and countless blends. The application of Inner liners which are layers of material such as fiberglass, Kevlar® and carbon fibers between the fabric and filling material can impact ignition and burning characteristics.

Furniture construction is important including size of the piece, thickness of the seat and back, positioning and angle of the seat to the back, the presence of full sides, flanges, skirts and other trim. Today, very few residential upholstered pieces have foam filled backs. The great majority of backs have blown-in loose fiber construction and this affects vertical ignition propensity, combustion and heat release. The ignition source is also critical including whether smoldering or open flame, the size of the flame, length of contact, configuration of the flame, and location of the ignition point in relation to the upholstered item. Room conditions, ventilation, and the presence or absence of secondary ignition sources also impact fire performance. It is therefore apparent why a single test protocol with the goal of covering all these variables remains an elusive target.

In developing a flammability test method, the goal is to create a repeatable test that relates as close as possible to the real life challenge of an actual fire. As documented by early Products Research Committee work, this is difficult due to the number of variables that must be factored.

In practice there are two different objectives for conducting tests. Qualification tests are performed to determine if a construction is fit for application. These tests tend to be complex, time consuming and costly. Qualification tests may be highly sophisticated and require special facilities and instrumentation.

It is not practical to perform such elaborate tests for all possible combinations of filling and fabric materials. It is therefore necessary that quality control tests be available that can be performed at the manufacturing site on a small scale.

A further consideration in development or selection of a test method is whether to test performance of components of a piece, even though in furniture neither the foam nor the fabric is ever used alone, or to test the composite structure as would be found in real life.

The question of component or composite is a key issue. From a control standpoint, manufacturers often prefer component tests because the component product is in the supplier’s domain and can be certified.

However, since components are not used alone, and since there are recognized interactions between the materials, component tests alone are not sufficient for predicting performance of a finished product.

There are available test methodologies representing qualification and quality control tests and there are methodologies focused on components and other test that can be used to evaluate performance of composites.
In the small scale ignition testing category, two types of ignition sources are addressed: *smoldering ignition*, as would be found with a mishandled or discarded burning cigarette and *small open flame ignition* as could be caused by a child playing with a lighter or matches.

Smoldering ignition is defined as a source of sufficient heat without the appearance of a visible flame. U.S. fire incidence statistics show that smoldering ignition is, by far, the most frequent identifiable cause of household fires involving upholstered furniture.

While testing for cigarette ignition may appear uncomplicated, even such a straight-forward test must take into account the specific properties of the source including the density or weight of the cigarette, length, propensity to burn full length, heat release, type tobacco and moisture content.

A cigarette ignition test for mattresses (16 CFR Part 1632) became one of the first mandated flammability standards for the U.S. home furnishings industry.

Based on more than 35 years of CFR Part 1632 smolder ignition testing experience, two important observations are noted: 1) The performance of the finished mattress product, including the combination of fabric and filling materials, depends largely on the fabric that is first exposed to the ignition source; 2) FPF on its own is generally resistant to cigarette ignition.

Non-flame retardant (non-FR) FPF traditionally was used in most mattress constructions to achieve CFR Part 1632 smolder ignition compliance. Non-FR FPF exhibits a tendency to withdraw from a radiant heat source, removing fuel potential and thereby inhibiting ignition. This performance attribute led to rapid growth of FPF in mattress construction in the 1970’s and FPF today continues play the same role in mattresses.

**Smolder Ignition Testing**

For upholstered furniture, several small scale composite smolder testing procedures are used today. One is California Technical Bulletin 117 (TB 117) which uses a small chair mockup configuration with one horizontal “seat” surface and one vertical “back” surface, a standardized cotton fabric, and a smoldering cigarette placed at the intersection of the two surfaces. Based on this test method, a “pass” or “fail” criterion is applied. A “pass” means that there is no continuing smolder and the sample weight loss does not exceed 20%. Another test method, developed as a voluntary fabric classification standard by the Upholstered Furniture Action Council (UFAC). It has been standardized by ASTM as E-1353. The test procedure uses a non-FR foam to test variations in fabric performance.

Because of often unpredictable, interactions between filling materials and fabric covers, composite testing is often preferred.

**Open Flame Testing**

Open flame composite test methods can be used to evaluate interactions between components. One of the most familiar and widely used open flame composite testing methods is the British Standard (BS 5852). BS 5852 contains two procedural parts: Part One specifies a mockup smoldering ignition test and small flame burner with short ignition time; Part Two specifies the use of two gas burners with larger flames for longer periods and four wood crib protocols. Residential upholstered furniture cushioned with FPF mandates Crib 5 testing. Larger ignition sources (Crib 6 and Crib 7) are reserved for higher risk applications.

**Open Flame Component Testing**

Open flame component tests are numerous and do not consider the effects of combining materials. These tests were developed to screen the open flame performance of components for various end uses. None of the open flame component test methods address the fact that materials in combination with other materials will perform differently than they do by themselves. Open flame component tests differ in terms of sample size, orientation (horizontal or vertical), intensity of the open flame, duration of flame exposure, and
performance criteria. Although it is generally assumed a vertical ignition test is more demanding than horizontal, this is not always the case. You cannot assume because a product passes a vertical flame test that it will survive a horizontal burn test.

Probably the most common open flame component test is the original TB117, Part D, which used a vertical orientation, bottom ignition and criterion for time of burning after ignition and maximum burn and char length. While this test often shows a difference between conventional non-FR FPF and combustion modified products, the difference noted in TB 117 qualification may be much smaller or non existent in larger scale composite tests with larger ignition sources under conditions imposing higher ambient temperatures and more significant heat rise.

Other open flame component tests include the Federal Vehicle Motor Vehicle Safety Standard 302 (MVSS 302), a horizontal open flame test used to evaluate the materials used in the passenger compartment of automobiles. UL 94 is the Underwriter's Laboratory test for materials that come in contact with electrical equipment and includes horizontal testing of a thin sample before and after accelerated aging.

There are known deficiencies in small scale flammability test methods. A major deficiency is the lack of measurement of heat rate and effect of changing heat on fire development. Also, there is no measurement of smoke generation and change in smoke during a fire. And, there is no measurement of the effects of radiant heat from the burning material.

A number of instruments and flammability tests have been developed to partially address these factors. These involve larger scale testing procedures that are not practical for frequent quality control work. However, full-scale furniture tests are the most realistic means of checking performance of a composite piece of furniture under various fire scenarios.

**Larger Scale Testing**

There are a number of full scale room tests including those developed by NIST, ASTM, UL and the Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation (BEARHFTI). They are all similar in that they require a large test facility with door opening, non-burning walls, and similar instrumentation. Room fire testing is time consuming and they may vent combustion byproducts into the atmosphere.

Room fire testing is not an efficient method for evaluation of different material combinations or item construction variables or the impact of different placements of the ignition source.

The Calorimeter method, originally developed by NIST, consists of a large weight sample, a large cone shaped heat source and a means of measuring exhaust gases. It suffers from some of the same problems of full scale room tests although it does not require the confines of a room. Under certain testing conditions, results may not be reproducible.

Computer modeling is not a burn test, but rather a means of predicting performance based on computer models using data such as known heat release rate, smoke development, and evolution of gases. As is true of all computer models, they are limited by the availability and the accuracy of the background data used to model results, as well as assumptions regarding ignition source, test room arrangements, proximity of other potentially involved materials and degree of ventilation.

**Test Result Evaluations**

It’s relatively easy to devise a test protocol to check the performance of any material under some specified ignition condition. But, there are many reasons why evaluation of the burning behavior of materials, particularly composites, is very difficult.

There are significant material interactions that impact burning behavior including: interactions between filling and fabric; the fact that no “standard” foam exists due to variations in formulation, additives or
fillers; the physical variables that are associated with solid, laminated or shredded materials; the multitude of fabric materials and fabric characteristics; the performance of inner liners, and the fact that composite system results are not predictable

By the nature of the product and its production requirements, no standard foam exists in commercial use. There are numerous combinations of FPF type, density, physical size and shape having different degrees of cell openness, differing formulations, and the presence or absence of fillers, combustion modifiers, dyes, antistatic additives, etc.

Filling materials may be solid, laminated, glued, chopped, shredded, loose or tightly packed. Particular fibers used in filling blends will perform differently in an ignition or smoldering test, and then differently again in combination with various foams and fabrics.

There are a multitude of fabric materials and fabric characteristics including natural covering materials like cotton, wool, leather and rayon. And there are synthetics such as nylon, polyester, acrylic, modacrylics and polyolefins as well as PVC. The wide use of blends of fibers and natural with synthetic materials makes the upholstered furniture covering matrix all the more complex. The performance of the covering material also will be influenced by its weight, weave, fiber denier, degree of openness, by back coatings, thickness of the pile; by dyes, impurities and the use of topical treatments.

Application of an inner liner will certainly affect performance and there may be unexpected fire performance results. Some systems with inner liners have actually performed worse than those without them.

Because composite system results are impacted by many variables, qualification tests must be conducted on the composite system to make any sort of useful judgment about fire performance.

Filling materials behave in one of two ways when exposed to flame or heat... they either melt or form a char layer. Char layers differ in how well they standup to further exposure to flame. In some tests the char or melt behavior will affect the results of the tests without necessarily reflecting real life performance. Tests that use a fixed location for an ignition point may favor materials that melt away without igniting, while charred materials remain exposed. As noted previously, composition, mass and physical structure of the filling and cover material greatly impact ignition and combustion performance.

With FPF components there are more considerations. The relative amount of ethylene oxide and propylene oxide in the polyol component and the presence or absence of copolymer of styrene acrylonitrile can influence burning behavior and can result in differing char or melt tendencies. The TDI disiocyanate which traditionally is used the U.S. can be modified with blends of MDI or the foam can be made with only MDI. This also impacts melt and burning behavior.

FPF can be formulated to resist more severe ignition scenarios using certain combustion modifying additives to form a continuous char layer. Water vapor that can be generated using such combustion modification techniques may also reduce heat available to support continued combustion. Another approach is the combination of combustion modifiers and large amounts of melamine. The melt characteristics of this type of formulation may create a product that is very difficult to ignite. However, the use of melamine additives is not compatible with many foam processing systems used in the U.S.

Adding stabilizers and antimicrobial agents can affect FPF burning behavior, as does the density and total weight of the cushion.

Cell size, cell uniformity and air permeability have a major affect on burning and flame spread rate particularly in horizontal testing.

Fiber and fabrics share similar considerations. Natural fabrics behave much differently than do synthetics. Natural fabrics may leave a char layer and synthetic fabrics may melt on exposure to heat. The physical characteristics of the fabric and the component fibers themselves all must be considered.
Fabrics are classified by char and melt behavior. Cellulosics tend to char while synthetics tend to melt. Melting fabrics may leave the filling materials open to ignition. If the fabric is treated and the substrate is not ignited by the ignition source, the composite often exhibits satisfactory performance. However, small differences in the intensity and duration of the ignition source can result in big differences in the performance of composites with nylon or polyester fabrics of equal weight.

*Component Tests By Themselves Should Not Be Used As The Absolute Criterion For Approving Composite Structures Assembled From Those Components*

One of the frustrations in predicting performance is that the composite performance is rarely equal to the sum of the performance of individual components. The behavior of melting fabrics on an FPF filling is generally much different than the behavior of the melt fabric on its own. Charring fabrics can also produce unexpected results that may not be revealed in component testing. A charring fabric or inner liner over a melting filling material can produce a cavity under the char layer which continues to burn and propagate because the heat of combustion is retained and reflected back to the interior. The same filling material used under a melt fabric or one that produces a fragile char layer will not continue to burn because the heat from burning can escape.

Some labs conducting BS5852 tests have noted that some combinations of PVC fabrics and polyester fabrics with FPF containing high concentrations of melamine failed the test requirements, while other much less flame retarded systems passed.

Such examples support the point that component test should not be used by themselves as the absolute criterion for approving the use of composites assembled from components that individually pass combustibility requirements.

Due to a number of variables in materials that cannot be accounted for in laboratory testing, the limitations of all laboratory tests must be stated and communicated.

There are also variables affecting test procedures such as: ignition source intensity and duration; ignition point location; possible secondary ignition by fabric, and fabric melt behavior affect on composite performance.

The choice of ignition source is one of the most basic variables in laboratory testing. Considerations include source intensity and duration and ignition location. In composite testing, when the ignition source is applied to the sample, close observation is required to determine whether the component of the sample that first sees ignition becomes a secondary and potentially larger ignition source on its own. In many cases the ignited fabric can be a much larger ignition source than the test flame.

*Flame Spread and Heat Release*

The way in which the fire develops also contributes greatly to the degree of the hazard. If the ignition source does not continue burning, then presumably no hazard will develop. However, if the test material becomes involved, a number of other considerations apply. Fire growth rate is based on the involvement of the test material. Fire spread behavior and the fire growth rate are vital to the time at which a room becomes untenable.

FPF when burning usually produces a hot flame with melting, but lateral flame spread speed is relatively slow. Slow flame spread is important because it impacts the involvement of adjacent materials. Burning with melting can very quickly produce burn-through with flaming dripping, which can involve flooring materials. The behavior of fabrics whether burning with charring or melting also plays an important role in determining flame spread.
The rate of heat release is determined by rate of material consumption and the chemical composition of the material. The hazard potential is largely impacted by the rate at which heat evolves. Unless rapidly ventilated, heat can accumulate on the ceiling and reflect back increasing the sample’s burning rate.

Fire Toxicity

Fire toxicity also is a complex issue. It is generally agreed that carbon monoxide is the greatest hazard because it is rapidly produced during combustion and is present in the largest amount. It also must be remembered that all organic materials are carbon-based and they will burn consuming oxygen to produce carbon monoxide and carbon dioxide and carbon either as smoke, soot or char. In the combustion of carbon about two-thirds of the heat evolved comes from the production of carbon dioxide.

The combined hazard is the depletion of oxygen, the increase in carbon dioxide, the concentration of carbon monoxide, the smoke, the elevated room temperature (which is often the most disabling), and the presence of other toxins and irritants which generally are slower building and may have less impact on escape and survival.

Flame Retardant (FR) Additives and Reactives

Improved performance in FPF against various ignition sources is generally accomplished by use of additives. The types and amounts will vary depending on the level of ignition resistance required. The highest performance is generally required for end-use conditions where escape is delayed or difficult such as in prisons, hospitals, extended care facilities, mass transportation, public arenas and dormitories.

There are some basic considerations applicable to selection of FR additives or polymer-like FR reactives. The FR component must be stable during production conditions that may include elevated exothermic temperature.

The volatility of any additives must be low so that they remain in the foam to provide long term performance capability and also to pass non-fogging requirements for automotive applications.

Additives also must resist leaching and not be readily soluble to remain in the FPF during routine cushion cleaning over the life of the end product.

Reactive FRs become part of the foam’s molecular structure and may be workable if other considerations are satisfied. The FR technology needs to be capable of providing the desired level of ignition and combustion resistance. It must also satisfy environmental, health and safety objectives and be safe for workers, the environment and consumers. It must not detract from foam physical performance, nor contribute to foam discoloration during production, or add odor to finished products. Ideally, the FR technology would be effective over a wide range of foam densities and firmnesses. It must be economically viable and not add unreasonable cost to finished goods.

Fabric Treatments

There are many fabric treatment technologies that can be applied. Combustion modifying agents can be added to the fiber during spinning. Topical treatments are also possible. Fabric treatments should be evaluated for EH&S considerations. They must resist hydrolyzation, migration and provide good durability for in-use conditions, and they must not detract from fabric “hand” or drape characteristics.

Regulatory Considerations

There are also regulatory issues. Regulatory standards must be based on performance criteria and not on a specified product and should be related to an actual risk. Any standard, whether voluntary or by government agency, must apply equally to all competing or future materials and equally to natural and synthetic products.
Tests should be reproducible and established by Round Robin Tests with stated variability similar to ASTM guidelines.

Application of standards should result in economically and technically feasible products that are safe for workers, the environment and the public. Performance criteria should not restrict development of alternate or improved compliance technology, because that would not encourage development of alternate or improved technologies. And, specific construction requirements should not be imposed so that improved production practices can be investigated and possibly developed.

A “pass” or “fail” criterion must be clearly stated and based on observable and measurable results.

It must be recognized and clearly stated that test criteria do not predict performance in an actual fire.

**Quality Control Test Procedure Mechanical and Logistical Issues**

To be practical for quality control screening, small scale testing equipment must fit into an average laboratory hood with ventilation controls and not require elaborate or unreasonably costly instrumentation. The test procedure should be rapid to accommodate production schedules and to allow for frequent testing.

**Summary**

Fire evaluation of materials and finished goods is complex. With upholstered furniture there can be unpredictable interactions between components in varying fire conditions.

There are critical factors in a real fire that cannot be adequately simulated in test including, but not limited to: ignition source and size, ignition location, ignition source duration, the involvement of secondary materials, and the rate of heat release and fire growth.

In regard to test criteria, the performance of composites can approximate some, but not all, of the complexities of an actual fire, while component testing cannot.

A test protocol suitable for quality control and compliance must be based on a number of composite testing procedures.
Attachment 2

PFA Position Statement on Small Open Flame Testing

To help achieve fire safety goals, PFA offers the following Position Statement on Small Open Flame Testing of Upholstered Furniture.

The Polyurethane Foam Association (PFA) has been a long time supporter of a national, performance-based small open flame standard for upholstered furniture. To be effective, a standard must:

1. be based on the composite performance of the finished piece including all items of assembly;
2. be appropriate to the risk of small open flame ignition;
3. be free from bias toward any component;
4. be reproducible and technically feasible.

Combustion modification technologies used to produce flexible polyurethane foam to help furniture manufacturers meet such a standard must be compatible with available foam production methods.

Products that comply with any resulting test protocol should be:

- Commercially viable and saleable;
- Effective in resisting ignition by small open flame without compromising smoldering ignition performance;
- Safe for workers, the public and the environment.

At this point, PFA is not aware of reliable statistics that would support the development of an open flame standard for residential upholstered furniture. Before a standard can be considered, the source of ignition must be identified and the risk of ignition must be quantified. These essential steps have not been completed.
January 18, 2014

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169-7471

Re: Comments to the NFPA on Proposed Flaming Ignition Test For Upholstered Furniture

Dear Sir or Madam:

I am an attorney who has spent nearly 21 years litigating furniture flammability cases in 6 states in the Southeast to date. I have represented families whose lives have been forever changed by the flammability defects which exist in typical upholstered furniture sold in this country. In those cases, 24 loved ones, 20 of which were children, have died tragically. Twelve more were seriously injured, with medical costs in many cases exceeding one million dollars per person. I am writing this body to express my views as an attorney who helps families pick up the pieces following furniture fire tragedies because of a serious problem with the flammability of residential upholstered furniture. A problem which can be addressed by a standard which minimizes ignition and controls the heat release rates of burning so that people can escape their dwellings without injury. Having a standard test method to assess the effects of open flame ignition will go a long way towards giving regulators a benchmark to incorporate into law and improve fire safety.

Furniture makers in litigation always raise as defenses that there is no law or rule they are violating relating to the flammability of their furniture, that the federal government through the CPSC has been looking at the issue for decades, and since they have passed no law to date, the problem must not be as bad as I say. Fire statistics don’t lie. As has been true for decades these fires are associated with more fire deaths than any other product under the jurisdiction of the CPSC.

Furniture makers tell me in their sworn depositions that they have no intention to change the way they build their furniture until a law or regulation is passed making them do it. And all of them say in unison in their defense that they are only doing what every other furniture maker is doing, so they are following “industry standard” and therefore shouldn’t be held liable for their product killing or injuring one of my clients.

Since 21 years of litigating against the furniture industry has not brought about any change in the design and construction of upholstered furniture in order to reduce fire deaths and injuries from such fires, I am hopeful that this body will undertake and develop a test method(s) which will address open flame ignition of upholstered furniture, and most importantly limit the heat release rates of furniture if and when ignited. In my work with my consulting expert witnesses who are fire scientists, I have learned that this variable is the single most important...
factor in determining a fire hazard presented in the furniture product in question. Even the defense expert fire scientists who work against me in litigation share the same belief.

This is my first time writing the NFPA on this subject. I have however, previously expressed my views in 2008 to the CPSC addressing my opposition to the draft proposed Rule relating to upholstered furniture which did not provide for any testing for open flame ignitions. I am attaching that letter to this written communication for the benefit of this body. I am hopeful that real progress can be made in reducing deaths and injuries from upholstered furniture fires to the point that I am out of the business of litigating these type cases.

With kind regards,

Sincerely,

Robert P. Foster

RPF/dg
Enclosure
May 13, 2008

Office of the Secretary  
Consumer Product Safety Commission  
4330 East West Highway  
Bathesda, MD 20814

RE: Comments to the CPSC on Proposed Rule for the Flammability of Residential Upholstered Furniture. 16 CFR Part 1634

Dear Sir or Madam:

I am an attorney who has spent nearly 15 years litigating furniture flammability cases in 6 states in the Southeast to date. I have represented families whose lives have been forever changed by the flammability defects which exist in typical upholstered furniture sold in this country. In those cases, 24 loved ones, 20 of which were children, have died tragically. Twelve more were seriously injured, with medical costs in many cases exceeding one million dollars per person. I am writing this body for the second time on this subject, to express my concerns about the Rule proposed by the CPSC to address a serious problem with the flammability of residential upholstered furniture.

**CPSC Disregards Decades of Prior Progress towards a Meaningful Rule**

First and foremost, the proposed rule, in my opinion, disregards decades of hard work by this body and many interested individuals, and simply sings the same old song sung by industry in the 1970's when the UFAC was formed - address smoldering cigarette ignition of furniture, not the flammability of the foam cushioning material, and that will be enough. That ignition source was addressed by UFAC primarily through the use of thermoplastic covering materials, which did reduce losses of this type. At the same time, however, these covering materials are among the worst choices to prevent open flame ignitions of upholstered furniture, exposing the most flammable and highest fuel load in the home to immediate ignition, and flashover in as little as three to five minutes. The Commission, while noting the reduction of fire losses from smoldering sources in its 1997 and 2001 briefings on the subject, also found that deaths from open flame ignition of upholstered furniture had remained constant for more than twenty years, according to their fire statistics. The Rule also completely disregards the 1994 Petition by the NASFM, to address small open flame ignition, which was specifically the portion of the petition granted by the CPSC. Why the CPSC would ignore the portion of the petition it granted is beyond rational reasoning.
Recent Industry Changes in Fire Loss Statistics Methodology

Industry recently hired and paid CRA International to “revamp” the methodology to assess furniture fire losses. According to this body’s comment on the study in the April 25, 2007 AHFA flammability update, the company criticized CPSC’s fire loss statistics and methodology when it “recommended two alternative methods to reduce estimated losses”, and “recommended changes to reduce estimated benefits, increase estimated costs” from a possible standard.[www.cpsc.gov/library/foia/foia07/foia07/os/ahfa.pdf; (page 19)] The Commission then accepted these industry sponsored methods and criticisms without debate, and for the first time, concluded that the deaths from open flame ignitions of upholstered furniture were annualized at 20 per year, and were now “insignificant”, and would not be addressed by the proposed rule.

I believe the industry method is an arbitrary attempt to reduce furniture fire losses to allow industry to limit the scope of a possible standard. I firmly believe this method serves to greatly underestimate open flame ignition related deaths. If the “new” approach estimates 20 deaths per year from this ignition scenario, then for the year 2003, Foster Law Firm represented six fatalities, or nearly 1/3 of the national yearly total. Those six children died in an upholstered sofa fire started by a child with a cigarette lighter July 9, 2003, in a mobile home outside the gates of Camp Lejune in Jacksonville, N.C. This ignition scenario was firmly established in the course of three years of discovery. The facts of the ignition scenario in civil cases are subject to thorough discovery through the use of experts, and prove to be extremely reliable. The complaint filed on behalf of the six estates is attached for the Commission’s review. [Exh. 1] I would like to find out whether these six children appear in the database of open flame ignition related furniture deaths for the year 2003. I truly do not believe that I represented 1/3 of all persons killed in 2003 by this type of ignition scenario. I believe the estimates are arbitrarily low, and not “insignificant”, as stated by this body.

I hope to bring the mother of these 6 children, who also had 4 other children who were seriously injured in the fire, as well as two other burn survivors, from other furniture fires, to appear before the Commission to share with this body how the flammability defect in their upholstered furniture has forever changed their lives.

I think it is helpful to change the focus on numbers, and to appreciate the fact that we are dealing with real people, innocent children, with names and faces, who have lost their lives tragically, and most importantly, that a comprehensive meaningful standard can change the status quo. Attached are names and photographs of some of the deceased children whose families I have represented, including the six death cases referenced above. [Exh. 2]

Noted NFPA fire researcher John Hall has studied child play fires occurring since 1980. [Exh. 3] In 1999, excluding intentional fires, children started 41,000 home fires. Lighter fires accounted for 7490 fires annually from 1994 through 1998. Matches accounted for 6970 per year for the same period. Upholstered furniture, along with mattresses and clothing, accounted one of the top three first items ignited, with 1300 fires that year. These statistics clearly demonstrate an ignition scenario that represents a very real hazard, which will not be addressed by the proposed standard. Any one of these 1300 ignitions could bring flashover conditions in as little as three to five minutes, costing more lives and injuries. A prudent Commission should address this hazard.
Controlling Fire Growth Rates and Heat Release Rates is Vital

As has been stated by experts much more learned than I, we must control the growth rate of upholstered furniture fires to prevent or slow the development of lethal conditions in a residence when an item of furniture is ignited, from any reasonably expected source. This control of the heat release rate gives the occupants more time to escape, and thereby saves lives. In fire emergencies, valuable additional seconds can make the difference between life and death.

A fire performance standard based on heat release rates and/or mass loss as a function of time, for burning furniture, is the more prudent approach, and will create substantial economic benefit in improvements in lowering rates of death and injury, as well as property damage, regardless of the ignition source. I have recently seen a number of cases where property damage, injury and death have resulted from electrical devices inside furniture which have caused furniture fires, including heaters, massagers, telephones and power lift mechanisms. Electrical ignition sources from outside the upholstered item, as well as those interior electrical sources, will not be addressed by the proposed standard. Electrical ignition sources have long been recognized by this body to be in the top three in terms of items first ignited in fire losses. [Exh. 4]

The Commission has in the past taken note of the marked improvement in fire loss statistics in the United Kingdom as a result of its 1988 fire safety regulation. [Footnote 1] That regulation implemented a performance based standard which also banned the use of non fire retardant foam. The furniture industry in the UK was able to implement measures to comply with the regulation to make furniture safer at minimal cost. [Exh. 5] Part of the reason for the higher level of fire safety is accomplished with construction materials, which control the heat release rates of burning furniture.

Although I am critical of the Commission’s insertion, without time for public comment, of a preemption statement in the preamble of the mattress flammability rule passed last year, I applaud the Commission for passing a comprehensive performance based flammability standard using heat release rate/maximum heat release criteria. Many of the country’s most respected fire scientists, some of whom I use as expert witnesses on behalf of victims of these fires, share this view of the new standard. It is my hope that this process of public input and debate will cause the approach to be a more comprehensive one.

Final Furniture Flammability Rule should have Similar Goal and Approach as the Final Mattress Flammability Rule

In the mattress rulemaking proceeding, the CPSC set forth some of the purposes, goals and approaches to achieve these in passing the final rule: “...the standard is intended to reduce deaths and injuries resulting from residential fires involving mattresses ignited by open flame sources. The Commission estimates that the standard will substantially reduce the incidence and cost of these fires by minimizing the possibility of or delaying the time for flashover conditions to occur.” 71 Fed. Reg 13493 (March 15, 2006); “The goal of the standard is to minimize or delay flashover when a mattress is ignited in a typical bedroom fire.” 71 Fed. Reg 13472 (March 15,2006); “The standard’s limit on the early contribution of the mattress to the fire (15 MJ in the first 10 minutes) will help to maintain tenable conditions early in the fire and allow for timely discovery and escape from growing fire conditions.” 71 Fed. Reg 13477 (March 15,
2006); “For virtually all of the fires started by children less than 15 years of age, the ignition was not witnessed by an adult (Boudreault and Smith, 1997). Reducing the likelihood of flashover in the first 30 minutes of the fire may therefore benefit children disproportionately, as it allows enough time for adults to detect the fire and save young children in close proximity to the fire. Also children between 5 and 9 who sometimes do not cooperate with adults and run away from adults to other parts of the occupancy will have enough time to be found and rescued by an adult.” 71 Fed. Reg 13491 (March 15, 2006)

Why the same goals, purposes, and approaches would not be an important in promulgating a standard to reduce the hazards from upholstered furniture fires, the leading causes of fire deaths among all products under the CPSC’s jurisdiction, including mattresses, defies logic. Hopefully, the public comment period, as well as a public hearing on the proposed rule, will cause this body to consider a comprehensive standard using concepts of preventing or delaying flashover as it did in enacting the final mattress rule.

Furniture Company Comments in Litigation Cases

The President of the 6th largest furniture maker Berkline-Benchcraft LLC, testified in a deposition in one of my cases that he was not proud to have his name associated with his furniture for its flammability short-comings, after he viewed the conflagration depicted in the full scale fire video of one of his sectional sofas ignited with an open flame, in a case in which killed 3 children and their mother in a 2000 fire in Louisville Ky., which started by a child with a lighter. [Exh. 6] This video is included on enclosed electronic media.[Exh. 7] This ignition would not be addresses in the proposed standard.

Another furniture company manager of product development with Bassett for 42 years, testified in a deposition in one of my cases that he was concerned for the American public who had bought its upholstered furniture with non fire retardant foam before the company switched to an all TB 117 foam in 2001. [Exh. 8]

One senior vice president of Mohasco Upholstered Furniture Co. testified that if his company was the only one who passed along the explicit flammability warnings given to him by his foam supplier, he didn’t think he would do any business. This statement can be viewed in a video (entitled Extra Feb. 2000) on my firm’s website (cited below) in the video fire gallery. I happen to see a furniture manufacturing company who did attach such an explicit warning recently in my stay in a S.C. hotel.

I have attached electronic media containing video footage of a number of full-scale fire tests of upholstered furniture, mostly performed in connection with furniture fire litigation.[Exh. 7] These and other full-scale fire tests can also be viewed on my law firm’s web site, Foster Law Firm, LLP, at www.fosterfoster.com. These videos demonstrate open flame ignitions of upholstered furniture where heat release rates are not controlled. Clearly modern technology allows heat release rate to be tamed in a variety of ways to prudently address this serious problem.

Achieving Fire Safety using Fire Retardants

Commissioner Nord said February 1, 2008, in her statement about the proposal, that the objective is to avoid the use of fire retardant chemicals. Most of the public
information about brominated fire retardants and California's stand on them has caused some uninformed persons concern. We should not forget furniture industry based U.S. House Rep. Roger Wicker (Ms) and his efforts to derail CPSC's efforts to pass a standard in 1998, when he asked the U.S. taxpayers to fund a large GAO life safety study to determine the effects of fire retardant chemicals which were used, or could be used, to treat upholstered furniture components. The study concluded that at least eight such chemicals of the sixteen studied "would present a minimal risk, even under worst case assumptions about exposure". CPSC 2001 Briefing on Regulatory Options for Upholstered Furniture, p. 35, Tab G. The CPSC agreed those eight were safe for use in upholstered furniture. Id. The CPSC should not toss the efforts of the taxpayer sponsored study (cost of $500,000) because of industry lobby efforts. The CPSC has also stated in the final rule for mattresses: "In the view of the CPSC staff, there are inherently flame resistant materials and FR chemicals available that can be used to meet the standard and that are not likely to present a hazard to consumers, workers, or the environment. The CPSC and Environmental Protection Agency (EPA) staffs will continue to evaluate the potential effects of FR treatments to ensure that they do not present a hazard to consumers, workers, or the environment." 71 Fed. Reg. 13479 (March 15, 2006).

Additionally, CPSC's comment in its November 2007 briefing stated: "inherent fire retardant interior barrier materials (as in mattress technology) can be used to protect filling materials." [cite quote] Even Commissioner Moore said in his February 2008 statement on the proposed rule, that the study, at great time and taxpayer expense, validated the fact that safe fire retardants are available to make furniture safer at "little or no health risk".

How can the use of fire retardant chemicals to make safe mattresses which we sleep on be justified in 2007 with the mattress standard, but not in 2008 when we are dealing with the identical issue with a product made of the same construction materials, posing similar flammability hazards? In that process the CPSC agreed [FR] chemicals studied were not expected to pose any appreciable risk of health effects to consumers who sleep on the mattresses. Nothing has changed since the passage of the mattress rule to justify such an about face. Hopefully, this process of public comment and debate will get the furniture flammability rule on a similar track as the case with the mattress rule, and injury and death can be minimized.

Federal Preemption of State Law Claims and other State Flammability Rules for Upholstered Furniture

I am also concerned that CPSC's passage of a rule that fails to address foreseeable fire hazards of upholstered furniture, such as small open flame ignition or electrical ignition, will allow furniture manufacturers to escape responsibility for deaths and injuries caused by these defects or hazards that are not addressed by a proposed standard that is not comprehensive. Federal preemption of state law remedies for these defects will be argued by furniture manufacturers to avoid responsibility for the tragedy caused by the fire hazards of upholstered furniture. In connection with the passage of the mattress flammability rule, the CSPS inserted a preemption clause in the rule's preamble two weeks before the vote, certainly requested by the industry to limit its responsibility. Commissioner Moore criticized the last minute move because it did not allow for public input or debate on an issue, which could potentially affect many victims of product defects.
Another possible consequence of a furniture rule which does not require the heat release rate of burning upholstered furniture to be controlled, could be the undoing of decades of progress the state of California has made in enacting and enforcing the TB 117 and TB 133 standards. Depending on the actual language of the final rule, a furniture maker could argue that the California standards are preempted and of no force and effect. In fact, the state of California was ready in 2002 to update the TB 117 standard for residential furniture to make furniture even safer, but suspended the process when this body in 2003 stated it was moving forward on a standard to address these issues. This aspect of the rulemaking process must be taken into consideration when deciding what is best for the American people as we move forward towards what we hope will be a meaningful comprehensive standard for upholstered furniture sold in this country.

In conclusion, I see the highly flammable foam used in 100% of upholstered furniture as a time bomb with a fuse, waiting for an ignition source. I believe that this time bomb explodes 2500 to 3500 times a year, killing and maiming American citizens who are totally unaware of the burning characteristics of the furniture in their homes. The current proposal seeks to prevent the lighting of the fuse from only one source, smoldering cigarettes, instead of disarming the bomb beneath the fuse. Since the NASFM petitioned this body in 1994 to develop a meaningful standard to reduce these hazards, 8000 people have died in upholstered fires. It is time for the Commission to develop and pass a meaningful performance based flammability standard which controls the heat release rates of burning upholstered furniture sold to the American public, and, to carefully consider the effect of any preemption clause which could be interpreted to deny victims’ access to the courts.

Respectfully submitted,

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r foster@fosterfoster.com

Footnotes:  
1) The Furniture and Furnishings (Fire) (Safety) Regs. 1988 (commonly referred to as BS 5852).
Standards Council – Fire Test Committee  
National Fire Protection Association  
1 Battery Park  
Quincy, MA 02169  
stds_admin@nfpa.org

Re: New test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source

The National Council of Textile Organizations (NCTO) is the national trade association that represents the entire supply chain of the U.S. Textile Industry from fibers to finished textile products, and from machinery manufacturers to energy suppliers. Our comments are submitted primarily on behalf of our Upholstery Fabrics Committee which is comprised of members who manufacture cover fabrics for use by the furniture industry.

Our membership has been deeply involved in furniture flammability activities since the 1970’s when California promulgated the first mandatory standard on the flammability of residential furniture and its components, and we intend to remain involved in this and related issues such as the Consumer Product Safety Commission’s current rulemaking on furniture flammability.

Thank you for the opportunity to comment on Standards Council’s request for input on the need for an open flame test method for furniture flammability. We believe the Standards Council has received comments from a variety of stakeholders voicing opposition to its proposal, and we join the National Home Furnishings Alliance (AHFA) and others in calling for the NFPA Standards Council to focus its efforts on supporting improvements in the smolder resistance of upholstered furniture since smoldering ignition continues to be the primary ignition source for furniture fires.

While there has been tremendous progress in reducing property damage, injuries and deaths as a result of efforts addressing smolder resistance, continued support by NFPA in this area as opposed to starting a new effort on open flame ignition is strongly recommended as delineated by AHFA and others.

We will be pleased to answer any questions you might have regarding our position or our industry.

Sincerely,

Hardy B. Poole  
Vice President, Regulatory and Technical Affairs

1001 Connecticut Ave., NW, Suite 315 • Washington, DC 20036 • 202-822-8028 • fax: 202-822-8029  
469 Hospital Drive, Suite C • Gastonia, NC 28054 • 704-824-3522 • fax: 704-671-2386  
www.ncto.org
NFPA Standards Council:

I strongly support the development of a fire test by NFPA to assess the flaming ignition performance of upholstered furniture.

I have been a California resident since 1970. I retired from U.S. Borax/Rio Tinto Minerals after 30 years of service. The decision by California to eliminate the open flame ignition part of TB117 shows that no standard test method available for assessing the performance of residential upholstered furniture when exposed to open flame ignition (except Cal 133 for high occupancy application).

It is well known that open flame ignition of upholstered furniture can result in fatalities. For example, the open flame source could be candle, cigarette lighter, match. Recently my insurance agent told me that he has experienced a few cases of candles ignited upholstered furniture.

Whether it is flexible or rigid PU foam, once ignited PU can reach the flashover stage very rapidly.

It is imperative that a standard test procedure with an open flame ignition source be developed as soon as possible.

Regard,

Kelvin Shen, Ph.D.
FR International
9372 Darrow Dr.
Huntington Beach, Ca. 92646
January 16, 2014

To: NFPA Standards Council  
via email: stds_admin@nfpa.org  
lfuller@nfpa.org

With the elimination of the open flame test from the recently approved Cal TB 117:2013, there is now no flaming ignition test required to evaluate the performance of upholstered furniture. Evaluating upholstered furniture can occur in the following ways: (1) As an evaluation of the furniture as a single whole piece, (2) As an evaluation of the individual components of the furniture, or (3) As an evaluation of the composite makeup of the furniture. ICL supports the development of an open flame test by NFPA to assess the fire performance of upholstered furniture, composite and/or its components.

NFPA data shows that open flame ignition of upholstered furniture continues to be a major cause of fire deaths as well as property loss. It is also known that an open flame is more prone to rapid spread moving to flashover more quickly than smoldering cigarettes. With flashover, the fire scenario can easily move from the original source room to others in the building leading to increased chance of harm to people as well as increased damage to the structure. This is the case unless high flammability performance materials are used in the construction of upholstered furniture. With no open flame test to assess the performance of materials, flammability performance will be compromised.

It is imperative that a sound test protocol be developed to assess performance of upholstered furniture. The importance of understanding and defining the criteria of fire performance is a significant challenge and opportunity to save lives. A robust open flame test provides governing bodies the foundation to establish a national standard for residential upholstered furniture.

With the removal of the open flame test in Cal TB 117:2013, a void in fire test performance exists. Development of a test by NFPA will fill this void.

Best regards,

ICL-IP America, Inc

Michael J. Nagridge
Manager, Global Market Support Polyurethane
January 14, 2014

Via Electronic Mail to NFPA (stds_admin@nfpa.org)

Standards Council – Fire Test Committee
National Fire Protection Association (NFPA)
1 Batterymarch Park
Quincy, MA 02169

Re: New Test Method to Evaluate Fire/Ignition Resistance of Upholstered Furniture Subject to a Flaming Ignition Source

These comments have been developed on behalf of the US home furnishings industry (industry stakeholders) by the American Home Furnishings Alliance (hereafter AHFA), the Upholstered Furniture Action Council (UFAC), the Polyurethane Foam Association (PFA), the National Council of Textile Organizations (NCTO), and the North American Home Furnishings Association (NAHFA).

The AHFA is the world's largest trade organization serving the home furnishings industry. AHFA member companies primarily operate residential upholstered furniture manufacturing facilities and comprise an extensive global supply chain that provides a wide variety of residential home furnishings to the US consumer.

The issue of upholstered furniture flammability has been a topic of discussion and debate at the US Consumer Product Safety Commission (hereafter CPSC) since it inherited the Flammable Fabrics Act from Congress in 1973. The issue of small-open flame and smolder ignition standards have been proposed and evaluated by the CPSC since 1981. For over 30 years, the CPSC has inherently understood that the focus on cigarette-smolder ignition remains the highest value effort in reducing the incidence and severity of residential upholstered furniture fires.

Since the 1980's, upholstered furniture manufacturers' efforts have directly led to significant declines in both the number of incidents where upholstered furniture was the first article ignited, as well as the severity of those incidents as measured in injuries and deaths. In fact, data collected by the National Fire Protection Association (hereafter NFPA) from 2005-2009, demonstrates that upholstered furniture was the first ignited item in only 2% of reported home structure fires\(^1\). In numbers, fires reported where upholstered furniture was the first ignited item has decreased from 21,500 in 1980 to 1,500 in 2010. This 93% decrease can largely be attributed to voluntary programs such as the Upholstered Furniture Action Council (UFAC) program, as well as voluntary testing standards such as the ASTM E1353 standard. This 93% decrease speaks volumes to the success of the industry in addressing this issue. It is important to note these numbers are actually conservative, as they do not account for the increase in US population or furniture placements within US homes. Also, fire incidents continue to

\(^1\) NFPA-Mary Ahrens; Home Structure Fires; May 2011 P. 42-43 Table 11
trend downward, as older furniture is removed from the marketplace and is replaced with newer models.

It should also be noted that the contribution of upholstered furniture as the material first ignited in home smoking materials fires has decreased significantly since 1980\(^2\). In 1980, 30% of fire events identified upholstered furniture as the primary ignition source. In 2010, that number had decreased to 8.5\(^2\). **The number of fire events is decreasing!** The percentage of those events where upholstered furniture was the material first ignited in home smoking materials fires is also dropping, showing a 72% reduction over 30 years\(^2\). All of this occurred while the number of US homes and the number of articles of furniture within those homes continues to rise. In 2010, there were 0.387 fire deaths per million pieces of furniture placed within US homes\(^3\).

The two primary modes of furniture ignition remain smolder and small-open flame. However, these two modes have significant differences in their contribution to overall upholstered furniture fires. In its 2008 ANPR, the CPSC noted that of those fires considered addressable, 90% of the deaths that occurred were ignited by smoking materials\(^4\). In other words, 90% of the deaths within addressable fires were caused by a fire that began with a smoldering ignition source. It should be noted that recent evidence on smolder ignition sources is promising. The reduced ignition propensity (RIP) cigarette, while introduced in 2003, did not see complete implementation across all 50 states until 2011\(^5\). For example, in 2008 only 38% of the United States population lived in states that mandated the RIP cigarette\(^6\). With the complete implementation of the RIP cigarette legislation now completed, in combination with fewer smokers, continuously more aggressive anti-smoking campaigns, higher tax rates on these products, improved use of smoke detectors and sprinkler systems, these improvements will continue to drive the decrease of smolder ignited furniture events.

That takes us to the remaining 10% of fires, attributed to all other sources including open flame. Since 1994 barrier technology has been discussed, but has proven inconclusive at best and ineffective at worst in addressing the primary cause of residential upholstered furniture fires. Currently available barrier technology utilized by the mattress industry, with its simple uniform shape, limited types of ticking fabrics and use, is not well-suited for application to upholstered furniture. The various geometries, spatial relationships, design, construction, cover fabric options and varying consumer use all specifically prevent a simple uniform application of barriers. These primary differences prevent a one size fits all solution to barrier technology within upholstered furniture. Additionally, consumer preferences and comfort remain the driving force behind design advancements. Upholstered furniture flammability performance has improved 93% without consumer sacrifice of hand, drape, seat or price of residential upholstered furniture. There is little data to support that an inconclusive solution that requires compromises by the consumer within selection, comfort, style AND price will find a great level of demand in the marketplace.

This leads us to a discussion of upholstered furniture that is involved in a ‘fire event’ not as the primary source of ignition but as the second or third item ignited. Current estimates of fires or deaths where upholstered furniture is the primary contributor to fire or flame spread but not the first item ignited are pure speculation. The assumptions made when generating these estimates are not

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\(^3\) UFAC Upholstered Furniture Items Sold, 2004-2010.
supported by data. Additional data collection and extensive research with fire departments participating in NFIRS would be needed before any standard development could be justified.

In conclusion, the AHFA believes NFPA should not pursue the development of a 'small open flame test method' because it shifts the focus from arguably the greatest risk, smolder ignition:

1. Smoldering ignition rather than small open flame ignition is still responsible for the majority of fire deaths from fires originating in upholstered furniture.
2. The State of California updated TB-117 by eliminating the requirement for a small open flame standard. In their research and in the interest of fire safety, they determined to move to a smolder ignition standard.
3. Open flame testing will require a full scale ‘build one-burn one’ testing scheme that will create a significant testing burden on manufacturers. With the vast number of different constructions and styles utilized in the industry, a single cover fabric may be used on numerous builds and a single build could be sold with numerous cover fabrics. Without the ability to meet a standard using a component level testing scheme, the marketplace is hurt by limiting availability and options.
4. With the technology currently available, an open-flame standard can only be met using flame retardant chemicals. Many states are looking at various restrictions on flame retardant chemicals. This could leave manufacturers in a situation of being required to meet an open-flame standard for one state and required to meet chemical requirements in another; an obvious untenable situation.
5. Other options to address open flame ignition of upholstered furniture, such as barriers, have been proven not to be cost effective and limit the styling and comfort demanded by consumers.
6. Several UK studies indicate high concentrations of flame retardant chemicals are used to meet the open flame requirements of BS 5852.
7. AHFA believes NFPA should evaluate and understand why California moved away from an open-flame standard. It is clear that in their complete evaluation of available research, they determined the best benefit to fire-risk was a smolder ignition test method similar to UFAC.

AHFA appreciates the opportunity to provide comment on this important subject. We greatly respect the important work and research performed by NFPA and its members. Should NFPA decide to pursue the development of an open flame standard we respectfully request that industry be invited to participate so that real world manufacturing and design issues can be considered during the process.

Respectfully,

Bill Perdue
VP Regulatory Affairs
American Home Furnishing Alliance
bperdue@ahfa.us, 336-881-1017
January 20, 2014

Codes and Standards Administration, NFPA
1 Batterymarch Park
Quincy, MA 02169-7471

Subject: Comments on Project Initiation on a New Test Method to Evaluate Fire/Ignition Resistance of Upholstered Furniture

To Whom It May Concern:

UL supports the initiation of an NFPA project towards the development of a test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source. Such a test method would complement existing methods involving smoldering ignition sources. We believe the NFPA planned project could play a critical role in addressing the fire performance needs. In our opinion any fire test method should be performance based and should not be dependent on any particular construction or materials.

UL has been actively involved in this fire/ignition resistance of upholstered furniture subject, and offers the following UL Report as a resource on the subject matter.


Very truly yours,

Dwayne E. Sloan
Principal Engineer, Manager
Building Materials & Suppression
Phone: 919-549-1676
Dwayne.E.Sloan@us.ul.com
Upholstered furniture flammability

UL is in the final stages of an exploratory study to determine if commercially available products such as fire retardant foams and fire barriers (interliners) can retard and/or reduce the fire growth rate of upholstered furniture exposed to small, open flames in a similar manner as endorsed by the mattress industry. The National Fire Protection Association (NFPA) determined more than 95% of home fires resulting from fires beginning with upholstered furniture and mattresses started by any other item. During the five-year period of 2005-2010, those fires accounted for 10% and 13% of deaths and 7% and 10% of the injuries respectively. They also accounted for 790M in direct property damage (Mary Ahrens, “Home Structure Fires”, National Fire Protection Association, One BatteryMarch Park, Quincy, MA 02169, (August 2012)).

Materials utilized in this investigation included eleven commercially available barrier materials constituting different chemistries and physical structures (including flat weaves, knits, and high twist), two comparable density polyurethane foam materials, a non-flame retardant foam commonly used in upholstered furniture and a California Technical Bulletin (TB) 117 compliant fire retardant treated foam, and the most popular cover fabric from the largest upholstered furniture cover fabric supplier in the USA (CPSC 16 CFR Part 1634 Type I compliant beige polyester microsuede).

Experiments were conducted on three scales of combustibility: (1) material-level experiments, (2) mock-up assembly experiments, and (3) experiments with full size furniture pieces constructed using the materials investigated. The combustibility behavior of the individual sample materials and combinations of materials (i.e. foam/barrier interliner/fabric) under well-ventilated, early stage flames was characterized using a cone calorimeter (ASTM E 1354). In the mock-up assembly experiments, cushions of the foam and barrier liner combinations evaluated in the material-level experiment phase were arranged to replicate an interior corner formed by the seat, back, and arm of a chair/electric. The mock-up assemblies were ignited at the interior intersection of the three cushions using a match-flame equivalent gas burner (BS 5652 Flaming Ignition Source 1). Heat release rate and mass loss rate were measured under an open calorimeter. Combustibility of full-size chairs made from four of the foam and barrier liner combinations was compared. Furniture pieces were ignited at an seat-back arm interior corner, center of the seat and cushion, and the back leg area using the same match-flame equivalent gas burner as for the mock-up assemblies. Heat release rate and mass loss rate were measured under a product calorimeter.

The results of these experiments provide knowledge on the potential fire growth reduction for this different set of materials. Implementation feasibility, the interaction between different chemistries and components, and the influence of experimental scale and sample design on fire performance. Collectively this information can be used by researchers, manufacturers and industry associations, and regulators such as the Consumer Public Safety Commission (CPSC) and California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation (CA BEARRITT) toward the development of a compliance program for upholstered furniture akin to the CPSC program for mattresses.

For more information about this project please see the EXECUTIVE SUMMARY or the FULL REPORT.

Mock-up assembly experiment on polyester wrap covered polyurethane foam cushions with a flat fire barrier inside the cover fabric:
(10 sec ignition flame exposure)
Comparison of Upholstered Furniture on Living Room Flashover

Supplemental to the upholstered furniture flammability exploratory study, a series of living room fires were conducted to illustrate the impact upholstered furniture materials play in fire growth.

The rooms were 12 ft by 12 ft, with an 8 ft ceiling built using typical SPF stud walls and engineered joist ceiling. There was an 8 ft wide by 7 ft tall opening on the front wall. The walls and ceiling were lined with 9/16 inch painted gypsum board and the floor was covered with carpet and padding.

The rooms were identically furnished with engineered wood television stand, book case, coffee table and end tables purchased from a national department store chain. The end table had a lamp with polyester shade on top of it and a woven basket inside it. The coffee table had six color magazines, a television remote and a synthetic plant on it. The television stand had a color magazine and a 37 inch flat panel television. The book case had two small plastic bins, two picture frames and two glass vases on it. The right rear corner of the room had a plastic toy bin, a plastic toy tub and four stuffed toys. The rear wall had polyester curtains hanging from a metal rod and the side walls had wood framed pictures hung on them.

The only furnishings that differed in the tests were the materials used in the upholstered chair and sectional sofa as follows:

- Cotton-based upholstered furniture: cotton batting around metal spring cushions, cotton cover fabric.
- Foam-based upholstered furniture: polyester wrap covered polyurethane foam cushions, polyester microfiber cover fabric.
- Barrier modified foam-based upholstered furniture: high loft fire barrier covered polyurethane foam cushions, polyester microfiber cover fabric.

All of the furniture pieces used the same hardwood frames. The furniture was not intended to represent all furniture on the market, but provide a common baseline for this experiment. Cotton fill furniture was most commonly used prior to 1970 and foam-based, post 1970.

The fires were ignited by placing a lit candle on the right side of the sofa and allowed to grow until flashover. The Foam-based upholstered furniture furnished room transitioned to flashover at 4 minutes and 45 seconds, the Cotton-based upholstered furniture furnished room transitioned at 34 minutes and 15 seconds, and the Barrier modified foam-based upholstered furniture furnished room self-extinguished at 15 minutes. When the fire was ignited in the center of Barrier modified foam-based upholstered sofa, the room transitioned to flashover at 21 minutes and 40 seconds.

View the entire video, or you may also download the video:

Download high resolution (922 MB)
High download time expected - 40 minutes (DSL)

Download low resolution (90 MB)
Comparison of Upholstered Furniture on Occupant Tenability and Survivability

The impact upholstered furniture materials play on fire growth and subsequent occupant tenability and survivability was investigated in a series of full-scale house fire experiments conducted in UL’s large fire facility. Two houses were used: one was a one-story, 1,000 ft², 3 bedroom, 1 bathroom house (6 rooms total); the second house was a two-story 2,000 ft², 4 bedroom, 2.5 bathroom house (12 rooms total). The external house featured a contemporary open floor plan with the two-story great room and foyer open to the upper-level bedrooms.

The living/dining rooms were identically furnished with engineered wood television stand, coffee table and end tables purchased from a national department store chain. The end tables had a lamp with polyester shade on top of it. The only furnishings that differed in the experiments were the materials used in the upholstered chair and sectional systems as follows:

- Foam-based upholstered furniture: polyester wrap covered polyurethane foam cushions, polyester microsuede cover fabric
- Barrier modified Foam-based furniture: high-loft fire barrier covered polyurethane foam cushions, polyester microsuede cover fabric

All the furniture pieces used the same hardwood frames.

The fires were ignited by placing a lit candle on the right side of the sofa and allowed to grow until temperatures in a remote location from the fire reached an unsurvivable level of 150 °C (302 °F). Preliminary data analysis suggests the living room flashover fire experiment findings.

Houses and room furnishing arrangements used in the Tenability and Survivability Experiments.

Data collected from these house fire experiments is being analyzed and will be presented here once completed.

Publications

UL is a global independent safety science company offering expertise across seven key strategic businesses: Product Safety, Environment, Information and Insights, Life & Health, Verification Services, Enterprise Services, and Workplace Health & Safety. Our breadth, established objectivity and proven history mean we are a symbol of trust and enable us to help provide peace of mind to all.

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Barry Badders  
Southwest Research Institute  
6220 Culebra Road  
San Antonio, TX  78238-5166  

Dear Mr. Badders:

I am transmitting to you herewith the following action of the Standards Council  
(July 29-August 1, 2013):

The Council reviewed the request of Barry Badders, Chair of the Fire Test Committee that  
NFPA consider the establishment of a new test method to evaluate fire/ignition resistance  
of upholstered furniture subject to a flaming ignition source. After review of all the  
material before it, the Council voted to publish a notice to solicit public comments on the  
need for the project, information on resources on the subject matter, those interested in  
participating, if established, and other organizations actively involved with the subject.

Very truly yours,

Linda Fuller, Manager  
Codes and Standards Administration  
c:  T. Vecchiarelli, C. Cronin  
TC Fire Test  

13-8-36
New Project Initiation Form
(To be completed by proponent of new project/document)
Additional pages may be attached if necessary.

a. Explain the Scope of the new project/document:

This document would provide a test method to evaluate fire/ignition resistance of upholstered furniture subject to a flaming ignition source.

b. Provide an explanation and any evidence of the need for the new project/document:

The State of California publishes Technical Bulletin 117, Requirements, Test Procedure and Apparatus for Testing the Flame Retardance of Resilient Filling Materials Used in Upholstered Furniture, which previously included a test method for evaluating fire resistance of upholstered furniture when exposed to an open flame ignition source. The California Bureau of Home Furnishings and Thermal Insulation has proposed the removal of the small open flame test requirement. Organizations have argued that requiring an open flame test will result in the continued use of fire retardant chemicals that can cause health problems.

NFPA currently publishes two upholstered furniture test methods, NFPA 260, Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture and NFPA 261, Standard Method of Test for Determining Resistance of Mock-Up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes. Both of these standards use cigarettes as an ignition source, representing smoldering ignition. NFPA’s research proves that smoldering ignition only represents 45% of the fire deaths associated with upholstered furniture. None of the leading U.S. SDOs for fire testing currently publish a test method to evaluate upholstered furniture subject to open flame ignition sources, leaving a gap in the industry.

NFPA conducted an analysis of national statistics regarding upholstered furniture related fire losses. The analysis found that upholstered furniture is the leading item involved in home fire deaths, accounting for 24% of all home fire deaths in recent years. Of those deaths, 45% is attributed to cigarette ignition, 10% is attributed to small open flame ignition and 21% can be attributed to flaming ignition from another burning item. The other 24% are ignitions that are an unknown mix of smoldering and flaming, such as arching or overheating from operating equipment.

1 William M. Pitts, Summary and Conclusions of a Workshop on “Quantifying the Contribution of Flaming Residential Upholstered Furniture to Fire Losses in the United States,” NIST Technical Note 1757, National Institute of Standards and Technology, Gaithersburg, MD, 2012.

c. Identify intended users of the new project/document:

Upholstered furniture manufacturers, testing laboratories

d. Identify individuals, groups and organizations that should review and provide input on the need for the proposed new project/document; and provide contact information for these groups:


e. Identify individuals, groups and organizations that will be or could be affected, either directly or indirectly, by the proposed new project/document, and what benefit they will receive by having this new document available:

The NFPA 101/NFPA 5000 technical committees on Interior Finish and Residential Occupancies and the NFPA 1 technical committee could reference this new standard as a requirement for upholstered furniture in residential occupancies. Both the TCs on Interior Finish and Residential Occupancies have reviewed this proposal. Neither TC opposed the development of this document.

f. Identify other related documents and projects on the subject both within NFPA and external to NFPA:

NFPA 260, Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of
Components of Upholstered Furniture

NFPA 261, *Standard Method of Test for Determining Resistance of Mock-Up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes*

TB 117, *Requirements, Test Procedure and Apparatus for Testing the Flame Retardance of Resilient Filling Materials Used in Upholstered Furniture*

Consumer Product Safety Commission - Furniture Flammability Standards

ASTM Committee E-5, Fire Tests

BS 5852, *Methods of Test for Assessment of the Ignitability of Upholstered Seating by Smouldering and Flaming Ignition Sources*

g. Identify the technical expertise and interest necessary to develop the project/document, and if the committee membership currently contains this expertise and interest:

   The committee membership currently contains the expertise to develop this new standard. The technical committee informally voted during their last committee meeting (April 2013) to support this project.

h. Provide an estimate on the amount of time needed to develop the new project/document:

   Two to three years.

i. Comment on the availability of data and other information that exists or would be needed to substantiate the technical requirements and other provisions of the proposed new project/document:

   The committee could build on the many years of test data gleaned under the California test program. Manufacturers of upholstered furniture would be asked to share their research or data on use of alternate methods to pass a flaming ignition test without the use of FR chemicals.

Please send your request to:  
NFPA  
Codes and Standards Administration  
1 Batterymarch Park  
Quincy, MA 02169  
Stds_admin@nfpa.org  
Rev. 10/09

Signature: _____________________________

Name: Barry Badders, Chair of the Fire Tests Committee __________ (please print)

Affiliation: _____________________________
WHITE PAPER

on

UPHOLSTERED FURNITURE
FLAMMABILITY

National Fire Protection Association

September 2013
Executive Summary

The upholstered furniture fire problem

Upholstered furniture accounts for the largest share of fire deaths of any first item ignited in US home fires.
In 2006-2010 US home structure fires, upholstered furniture as first item ignited accounted for
- 480 civilian deaths per year (19% of all home fire deaths),
- 6,700 structure fires per year (2%),
- 840 civilian injuries per year (7%), and
- $427 million in direct property damage per year (6%).

Estimates of the upholstered furniture home fire problem increase when the traditional estimates based on item first ignited are supplemented by estimates of fires involving upholstered furniture as the principal item contributing to fire spread but not item first ignited.
In 2006-2010 US home structure fires, upholstered furniture as first item ignited or principal item contributing to fire spread accounted for
- 610 civilian deaths per year (24% of all home fire deaths),
- 8,900 structure fires per year,
- 1,120 civilian injuries per year, and
- $566 million in direct property damage per year.

There are five major upholstered furniture home fire scenarios plus a sixth scenario with little or no detail that accounts for few fires and losses.
- Cigarette-ignition scenario. Smoldering ignition by lighted tobacco product, principally cigarette (45% of total upholstered furniture home fire deaths),
- Open flame ignition by another fire, where upholstered furniture is the principal item contributing to fire spread but not the first item ignited (21%),
- Ignition by arcing or heat from operating equipment (12%),
- Small-open-flame ignition by candle, match or lighter (10%),
- Smoldering ignition by ember, ash or other or unclassified hot or smoldering object (10%),
- Unclassified, other or multiple heat source (3%).

The relevance of existing requirements to the major upholstered furniture fire scenarios

The cigarette-ignition scenario was the first upholstered furniture fire scenario to be addressed by formal fire test requirements, beginning in 1975 in California with Technical Bulletin (TB) 117, Requirements, test procedure and apparatus for testing the flame retardance of resilient filling materials used in upholstered furniture, and in 1980 in the UK with requirements (e.g., “The Furniture and Furnishings (Fire) (Safety) Regulations 1988.” Statutory Instruments 1988, No. 1324, Her Majesty’s Stationary
Office, London, UK, 1988) built around **British Standard (BS) 5852, Methods of test for assessment of the ignitability of upholstered seating by smouldering and flaming ignition sources**.

The **small-open-flame scenario** was also first addressed by TB 117 in California in 1975 and by the UK in 1980 using tests based on BS 5852. A simulated match was used as the ignition source, replacing the cigarette ignition source in the cigarette-ignition tests in these same two standards.

The **scenario of ignition by another fire**, as when a piece of upholstered furniture is the primary item contributing to fire spread but not the item first ignited, has never been the explicit basis for requirements. Some requirements use a larger open-flame igniting heat source, such as the wood crib fire used in one part of the UK requirements. Some requirements – for furniture used in public occupancies not in homes, such as California **Technical Bulletin (TB) 133, Flammability test procedure for seating furniture for use in public occupancies** – use a larger igniting heat source and evaluate performance not on ignition resistance but on speed of fire growth and peak severity. These test conditions and criteria could be used as a starting point for design of a standard test method, with evaluation criteria, which would be appropriate for the severity of this scenario and the safety goals appropriate to the scenario.

**Changes to upholstered furniture fabrics and filling materials**

Improved resistance to cigarette ignition has been achieved through the selection of **covering fabrics** (e.g., thermoplastic fabrics rather than cellulosic fabrics) and **filling materials** (e.g., polyurethane foam rather than cotton batting). These fabric and filling material choices not only pass the cigarette-ignition tests but have also been shown through experiments to sharply increase measured cigarette-ignition resistance.

**Fire retardants and their effects on fire performance, health and the environment**

**Fire retardants** applied to polyurethane foam filling materials have been used to pass tests for small-open-flame resistance of filling materials since the introduction of such tests in 1975.

The small-open-flame ignitions that motivated the introduction of fire retardants constitute a modest share of total upholstered furniture fatal fire deaths (about 10-15%) and always have. For other fire scenarios – notably the large open flame ignitions involving fire spread from another burning item – available test evidence has not shown a significant effect, and one would not expect an effect because the treatments were never designed to resist such large ignition heat sources. Either way, the evidence suggests the past impact of historically favored fire retardant treatments on fire deaths could not have been very large, even if they reliably performed as intended in all fires.
Based on studies linking fire-retardant chemicals to toxic health effects, the two principal chemicals (penta- and octa-brominated diphenyl ethers) that were used as fire retardants for furniture were phased out of production nearly a decade ago. Other fire retardants, including deca-BDE and chlorinated organic phosphates, are reportedly now being used to pass TB 117, but they also are being challenged on grounds of health effects.

California is actively exploring the possibility of removing the small-open-flame ignition test from TB 117, which would remove the only US regulation that has induced the use of fire retardants in upholstered furniture.

**Fire barrier systems**

**Fire barrier systems** are combinations of fabric layers or coatings that prevent ignition of the protected filling material or delay the involvement of filling material in fire, thereby slowing the growth of fire and lowering the peak heat release rate (fire intensity).

Experiments on fire barriers have been very encouraging, suggesting that they can achieve improved flammability and compliance with existing and proposed requirements, often better than defined fire-retardant treatment options. At the same time, real-scale experiments to date have shown too much variation to permit a standard test and associated requirements to be written on the basis of current knowledge.
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Introduction

Why a White Paper on this topic?

Regulations intended to reduce furniture flammability have been around for nearly 40 years. Evidence began building perhaps two decades ago of serious health effects attributable to the chemicals (polybrominated diphenyl ethers or PBDEs) that are used as fire retardant treatments of upholstered furniture filling materials, to comply with the open flame test portions of these existing regulations. About a decade ago, manufacturers began phasing out the PBDEs used as filling material fire retardants.

In late 2012, California began work on revising its state regulation to remove the only open flame test requirement for domestic upholstered furniture in the US. Meanwhile, CPSC is continuing work toward a possible federal regulation for upholstered furniture but one that is only intended to address cigarette ignitions.1

Also potentially relevant is growing concern over the threats to occupants and firefighters of faster-growing, more severe fires.

This situation adds timeliness and urgency to several questions:

- What is the size of the upholstered furniture fire problem?
- What are the different parts of that fire problem that involve different aspects of upholstered furniture fire performance, and what is the relative size of these different parts?
- Which parts of the upholstered furniture fire problem are addressed by existing regulations, and what is the evidence on how well those regulations have worked?
- What are the different engineered options used to comply with existing regulations and intended to reduce furniture flammability, and what are the pros and cons of those options (e.g., effectiveness in reducing flammability, other effects such as health effects, cost)?

A short note on terminology

“Flammability” is understood to mean the fire performance of furniture – everything from ease of ignition to speed of fire growth and peak intensity of fire.

“Furniture” is understood to mean upholstered furniture specifically. In the national fire incident data base, upholstered furniture accounts for eight times as many civilian fires.

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deaths as all types of non-upholstered furniture combined. The non-upholstered furniture that is thereby excluded from the scope includes the following:

- Non-upholstered chairs, which account for very few fires and deaths per year,
- Cabinetry, including desks, tables, bookcases, chests, dressers, filing cabinets, pianos, and other pieces collectively referred to as case goods,
- “Other” furniture or utensils (household utensils and appliance housings or casings), which may include some upholstered furniture fires where the item first ignited was not fully specified in the report.

Other furnishings that might be considered furniture, such as mattresses, are not listed under “furniture” in the national fire data base and are not included in this White Paper.

The White Paper uses the term “engineered option” to refer to any technology or design approach to improving furniture flammability. This includes but is not limited to the use of fire retardants or fire barrier systems.
Section 1
Overview of Upholstered Furniture Flammability
How Big is the Fire Problem? What Are the Largest Parts?

Size of upholstered furniture fire problem

Upholstered furniture accounts for the largest share of fire deaths of any first item ignited in US home fires.2

In 2006-2010 US home structure fires, upholstered furniture as first item ignited accounted for

- 480 civilian deaths per year (19% of all home fire deaths),
- 6,700 structure fires per year (2%),
- 840 civilian injuries per year (7%, the fourth largest share, after cooking materials, mattress or bedding, and flammable or combustible gas or liquid), and
- $427 million in direct property damage per year (6%, the fourth largest share, after structural member or framing, exterior wall covering, and cooking materials).

As can be seen above, the upholstered furniture share of civilian fire deaths (19%) and injuries (7%) and direct property damage due to fire (6%) are all larger than the upholstered furniture share of fire incidents (2%). Therefore, when considering the relative importance of upholstered furniture fires versus other parts of the home fire problem, it is important to focus on shares of losses, especially fire deaths, and not on shares of fires alone.

Over the past three decades, there has been a downward trend in fires beginning with ignition of upholstered furniture, in associated losses and in the upholstered furniture shares of home structure fires and losses.

From 1980-1984 to 2006-2010, estimated annual average upholstered furniture home fires and losses have declined as follows:

- Civilian deaths have declined by 61%, from 1,220 (25% of total home fire deaths) to 480 (19%).

---

Fires have declined by 77%, from 29,400 (4% of the total) to 6,700 (2%).
Civilian injuries have declined by 68%, from 2,630 (13% of the total) to 840 (7%).
Direct property damage, after adjustment for inflation to 2010 dollars, has declined by 17%, from $522 million (7% of the total) to $434 million (6%).

In 1980-1984, there was an average of one death for every 24 home upholstered furniture fires. By 2006-2010, there was an average of one death for every 14 home upholstered furniture fires. This may be seen in Figure 1, where fires are divided by ten for ease of comparison with deaths. For example, 6,700 fires in 2010 are plotted as 670.
Figure 2 shows that upholstered furniture home fires and associated deaths have also declined as a share of the totals for all home fires. This suggests that the decline in upholstered furniture home fires and losses has been a combination of:

- *an overall declining trend in total home structure fires and losses* (e.g., due to the increase in usage of home smoke alarms from 50% of homes in 1980 to more than 95% in 2010), and
- *an additional declining trend in the upholstered furniture share of home structure fires and losses* (due to changes in upholstered furniture that affect only those fires, such as reductions in furniture flammability).

**Would better or more complete fire incident (NFIRS) data significantly add to or change these estimates?**

More specifically, are there fires coded as “upholstered furniture” that do not belong or do not burn the way typical pieces of upholstered furniture burn? Are there fires not coded as “upholstered furniture” that are in fact upholstered furniture?

- Throw pillows and decorative fabrics are examples of accessories normally used with upholstered furniture but not technically part of the furniture. Would a fire starting on these items be coded as upholstered furniture or as something else, such as “soft goods, wearing apparel, other”?

- What is being identified as “furniture, utensil, other”? Is this category used only for well-defined items in the furniture and utensil group that are not specifically listed by name? Or, is this category being used as a partial unknown, including items that fall within the furniture and utensil group but have not more specifically identified? If so, then some of these items are probably additional upholstered furniture fires.

If upholstered furniture accounts for *all* of the fires identified as “furniture, utensil, other,” that would add 25% to estimated deaths in fires with upholstered furniture as first item ignited or 20% to estimated deaths in fires with upholstered furniture as either first item ignited or primary item involved in fire spread.

If upholstered furniture accounts for *a proportional share* of the fires identified as “furniture, utensil, other,” that would add 21% to estimated deaths in fires with upholstered furniture as first item ignited or 16% to estimated deaths in fires with upholstered furniture as either first item ignited or primary item involved in fire spread.

If all of the fires identified as “furniture, utensil, other” are items not specifically listed, that would add nothing to the upholstered furniture fire estimates.

These are the kinds of questions that could be explored in a special data collection research project with fire departments participating in NFIRS. The answers could indicate that the upholstered furniture fire problem is even larger than has been estimated.
Major parts of the upholstered furniture fire problem

Most fires and losses from home structure fires starting with ignition of upholstered furniture involve smoldering ignition.3

In 2006-2010, home structure fires and losses involving upholstered furniture as item first ignited can be divided among four major scenarios and an “other” group:

- **Cigarettes and other lighted tobacco products**, which cause *smoldering* ignitions, accounted for 28% of upholstered furniture fires and 57% of associated deaths, down from 68% of these deaths in 1980-1984. The decline in share of fire deaths for this scenario may reflect not only the fact that it has been the focus of furniture flammability requirements throughout this period but also continued declines in the percentage of the population who smoke. The recent advent of requirements for reduced-ignition-strength cigarettes is also likely to become a contributing factor to prevention of these fire deaths in the future.

- **Ignitions due to arcing or heat from operating equipment** (principally space heaters and cords or plugs), which are an unknown mix of smoldering and flaming ignitions, accounted for 22% of these fires and 15% of these deaths, up from 14% of fires in 1980-1984 and up from 11% of these deaths in 1980-1984.

- **Candles, matches, lighters, and other open-flame heat sources**, which cause *flaming* ignitions, accounted for 22% of these fires and 13% of these deaths, up from 19% of fires in 1980-1984 and down from 19% of these deaths in 1980-1984.

- **Embers, ashes and other or unclassified hot or smoldering heat sources**, which cause ignitions that should also be *smoldering* ignitions, accounted for 20% of upholstered furniture fires and 12% of associated deaths, up from 3% of fires in 1980-1984 and up from 2% of deaths in 1980-1984.

- **Unclassified, multiple or other heat sources** accounted for 8% of these fires and 3% of these deaths, up from 3% of fires in 1980-1984 and up from 1% of these deaths in 1980-1984.

Note that the combined smoldering-ignition share of upholstered furniture home structure fire deaths has changed relatively little (from 70% in 1980-1984 to 69% in 2006-2010), but there has been a dramatic shift in the shares for lighted tobacco products (from 68% to 57%) and for embers and ashes (from 2% to 12%).

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3 “Smoldering-ignition” fires are not the same as “smoldering,” a term which could be understood to mean only fires that never transition to flaming. Smoldering-only fires account for a very small share (about 1%) of total home fire deaths, whereas smoldering-ignition fires account for roughly 40% of home fire deaths. Nearly all of the deaths and property damage caused by smoldering-ignition fires are caused by fires that transition to flaming at some point and have most of their growth after that transition.

4 Embers and ashes are typically too small to ignite upholstered furniture. However, people familiar with NFIRS coding believe that a cigarette – which produces embers and ash and can ignite upholstered furniture – might be coded as an ember or ash. There is also the possibility of fireplace embers, but it is unlikely that such ignitions could be as common as the statistics suggest.
This shift could reflect changes in how fires start, or changes in how the same fire starts are being reported, possibly induced by changes in the coding used in NFIRS. Figures 3 and 4 show this dramatic shift in the two smoldering-ignition scenarios as well as the smaller shifts in size of the other scenarios.

If they represent a real shift in how fires start, the shift in the components of smoldering ignitions could have implications for standardized tests of smoldering-ignition resistance. The test conditions may not do well to represent ignitions by ember or ash, even if all or nearly all the embers and ashes are from cigarettes.

Very few open-flame ignitions involve torches, road flares, or lighting torches, the larger open flames identified in the fire incident reporting categories.
Roughly one-quarter of the flaming ignitions are intentionally set fires, and roughly one-third of the flaming ignitions are caused by someone, usually a child, playing with fire. There is considerable overlap between the intentional and fireplay ignitions, and the combination accounts for nearly half of flaming ignitions. Ignitions of the exposed side or front vertical surfaces or even the bottom of the furniture may be common when fires are set, especially when young children are involved. This also could have implications for standard tests of furniture flammability.

We do not know enough about the details of ignitions by operating equipment to know how many of those fires can be prevented by engineered cigarette ignition resistance or by engineered small open flame ignition resistance.

If the estimates are expanded to include fires where upholstered furniture is the primary contributor to fire or flame spread but not the item first ignited, the estimates of upholstered furniture fires and losses increase substantially, and the flaming ignition shares increase even more dramatically.5

See *Estimating Fires When a product is the Primary Fuel But Not the First Fuel, With an Application to Upholstered Furniture* by John R. Hall, Jr. for more details.

### Table 1. Upholstered furniture fire problem with and without the inclusion of flaming-ignition fires with upholstered furniture as primary item contributing to fire spread

<table>
<thead>
<tr>
<th>Annual average for 2006-2010 home structure fires</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Damage (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upholstered furniture as item first ignited (A)</td>
<td>6,700</td>
<td>480</td>
<td>840</td>
<td>$427</td>
</tr>
<tr>
<td>Upholstered furniture as item first ignited by flaming ignition (B)</td>
<td>1,500</td>
<td>60</td>
<td>220</td>
<td>$73</td>
</tr>
<tr>
<td>Upholstered furniture as primary contributor to fire or flame spread but NOT first item ignited (C)</td>
<td>2,200</td>
<td>130</td>
<td>280</td>
<td>$138</td>
</tr>
<tr>
<td>Combined upholstered furniture fires with flaming ignition (B+C)</td>
<td>3,700</td>
<td>190</td>
<td>500</td>
<td>$210</td>
</tr>
<tr>
<td>Combined upholstered furniture fires (A+C)</td>
<td>8,900</td>
<td>610</td>
<td>1,120</td>
<td>$566</td>
</tr>
<tr>
<td>Combined upholstered furniture fires as percent of home total</td>
<td>2%</td>
<td>24%</td>
<td>9%</td>
<td>8%</td>
</tr>
</tbody>
</table>

With the inclusion of fires where upholstered furniture is the most important fuel package but not the first fuel package, the upholstered-furniture share of home fire deaths rises from one-fifth (19%) to one-fourth (24%).

To get a sense of how fires start when upholstered furniture is the primary item contributing to fire spread, it is useful to look at the leading items first ignited (other than upholstered furniture) in those fires:

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5 Analysis taken from John R. Hall, Jr., “Fires with upholstered furniture as the primary item contributing to fire spread,” undated memorandum to Bill Pitts, NIST Fire Research Division, 2012.
The upholstered furniture fire problem is considerably larger than past estimates have indicated, but it is also a different kind of fire problem.

Of the expanded number of upholstered furniture fire deaths, only 55% occurred in fires started by lighted tobacco products (45%) or small open flames (10%), the two types of igniting heat sources that accounted for nearly all (87%) of upholstered furniture fire deaths as they were being estimated in the early 1980s. These two scenarios are also the only two fire scenarios to be explicitly and intentionally addressed by furniture flammability requirements for domestic upholstered furniture.

Summary of overview

After incorporating the scenario of upholstered furniture as the principal but not the first item ignited, there are five major upholstered furniture home fire scenarios plus a sixth scenario with little or no detail that accounts for few fires and losses. The combined upholstered furniture fire problem is shown in Table 2; scenarios are defined by igniting heat source and listed in order of estimated average annual deaths.

Table 2. Upholstered furniture fire problem, 2006-2010 averages, including fires with upholstered furniture as primary item contributing to fire spread, by major scenario

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighted tobacco product</td>
<td>1,900 (21%)</td>
<td>270 (45%)</td>
<td>320 (29%)</td>
<td>$97 (17%)</td>
</tr>
<tr>
<td>Open flame from other fire</td>
<td>2,200 (25%)</td>
<td>130 (21%)</td>
<td>280 (25%)</td>
<td>$138 (24%)</td>
</tr>
<tr>
<td>Operating equipment</td>
<td>1,500 (17%)</td>
<td>70 (12%)</td>
<td>140 (13%)</td>
<td>$81 (14%)</td>
</tr>
<tr>
<td>Small open flame</td>
<td>1,400 (16%)</td>
<td>60 (10%)</td>
<td>220 (20%)</td>
<td>$69 (12%)</td>
</tr>
<tr>
<td>Ember, ash or other or unclassified hot or smoldering object</td>
<td>1,300 (15%)</td>
<td>60 (10%)</td>
<td>130 (11%)</td>
<td>$150 (27%)</td>
</tr>
<tr>
<td>Unclassified</td>
<td>600 (7%)</td>
<td>20 (3%)</td>
<td>30 (3%)</td>
<td>$31 (5%)</td>
</tr>
</tbody>
</table>
Figure 5 focuses on fire deaths and spotlights that:

- Lighted tobacco products account for the largest share of fire deaths, or nearly half (45%). If ash, ember or unclassified hot or smoldering object is principally embers and ashes from lighted tobacco products, then the total for that heat source could rise to more than half (55%).

- Small open flames account for only 10% of the total, but when fires spreading to upholstered furniture as the principal item ultimately involved in fire, flaming heat sources combined rise to roughly one-third (31%).

- Ignitions by operating equipment could add an unknown fraction of their 12% of deaths to the smoldering, small-open-flaming, or large flame from other fire shares.

<table>
<thead>
<tr>
<th>other or multiple heat source</th>
<th>8,900 (100%)</th>
<th>610 (100%)</th>
<th>1,120 (100%)</th>
<th>$566 (100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>8,900</td>
<td>610</td>
<td>1,120</td>
<td>$566</td>
</tr>
</tbody>
</table>
Section 2
What Parts of the Upholstered Furniture Fire Problem Are Addressed by Existing or Proposed Regulations?

Three of the five major fire scenarios identified at the end of Section 1 have been the basis for fire safety requirements somewhere in the world:

Table 3.
Fire scenarios addressed and not addressed by existing or proposed upholstered furniture flammability requirements

<table>
<thead>
<tr>
<th>Fire scenario</th>
<th>Is this fire scenario addressed by any existing requirement?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ignition by lighted tobacco products and other smokeable products, principally cigarettes (45% of deaths) (Smoldering)</td>
<td><strong>Addressed by cigarette ignition resistance test</strong> applied separately to components (e.g., covering fabric, filling material) or to real-scale furniture pieces or mock-ups. Voluntary standards or requirements exist in the US, the UK, Finland, Sweden, and Norway, and possibly other countries.⁶</td>
</tr>
<tr>
<td>Ignition by open flame spreading from other burning item (21%) (Flaming)</td>
<td>Not directly identified as a design scenario but <strong>could be addressed by tests that measure rate of heat release and time to flashover</strong> (i.e., rate of growth and peak severity of fire). No requirements for home furniture but requirements exist for furniture in public occupancies in the US (California). Also the UK requirements include tests using a wood-crib fire,</td>
</tr>
<tr>
<td>Ignition by arcing or heat from operating equipment (12%) (Smoldering or Flaming)</td>
<td>Not directly discussed or addressed in any requirements. Relative importance may not be recognized. May be assumed to be covered by other tests but has not been tested directly.</td>
</tr>
<tr>
<td>Ignition by small open flame (10%) (Flaming)</td>
<td><strong>Addressed by small open flame (match or simulated match) ignition resistance test</strong> applied separately to components (e.g., covering fabric, filling material) or to real-scale furniture pieces or mock-ups. Standards or requirements exist or existed in the US (California, currently being reconsidered) and the UK.</td>
</tr>
<tr>
<td>Ember, ash or other or unclassified hot or smoldering object (10%) (Smoldering)</td>
<td>Not directly discussed or addressed in any requirements. Share of problem has grown markedly in recent years and may not yet be widely recognized. Ember or ash from cigarette is a weaker ignition heat source than a cigarette and would be resisted by anything able to resist a cigarette. Ember or ash from fireplace could be a stronger ignition source than a cigarette, and if the ember is flaming, it would not be a smoldering heat source. It is possible that “unclassified hot or smoldering object” includes some heat sources not yet identified. Therefore, could be addressed by cigarette ignition resistance tests.</td>
</tr>
</tbody>
</table>

Requirements addressing the three scenarios – ignition by cigarette or other lighted tobacco product or smokeable product, ignition by open flame spreading from other burning item, and ignition by small open flame – are described in the following sections,

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which are presented in order of the introduction of the requirements, not in order of the size of the scenario fire problem, which means small open flame fires are discussed before large open flame ignitions.

**Cigarette ignition**

**History of requirements**

In 1967, the Flammable Fabrics Act was amended to include home textiles other than the wearing apparel it has originally been created to address. The Act mandated action on fabrics that constitute an unreasonable flammability risk. The National Bureau of Standards (NBS), which had responsibility for test method development for the Flammable Fabrics Act, began funding laboratory research on the flammability of the newly incorporated home textiles in 1968.

In 1973, the US Consumer Product Safety Commission (CPSC) was created and the Flammable Fabrics Act became its responsibility, although NBS retained responsibility for test method development.

The first formal requirement was **California Technical Bulletin 117**, *Requirements, test procedure and apparatus for testing the flame retardance of resilient filling materials used in upholstered furniture*, first issued in 1975. TB 117 required cigarette ignition testing of filling materials under a specified fabric. It did not require tests on upholstered-furniture covering fabrics or of as-used upholstered furniture pieces or mock-ups.

In 1976, the NBS submitted to CPSC a draft cigarette-ignition-resistance standard for upholstered furniture. CPSC did not address the proposal until 1978, when CPSC staff modified the NBS proposal and recommended publication of the requirement to the CPSC commissioners.

In 1979, the industry’s **Upholstered Furniture Action Council** (UFAC) introduced a voluntary standard that was a cigarette ignition test of covering fabrics over a specified filling material and of filling materials under a specified fabric. In essence, it tested the parts of an upholstered furniture piece separately, each paired with a standard reference component for the other part. Barrier materials were allowed as a solution for covering fabrics that would not otherwise pass the test.

**California Technical Bulletin 116**, *Requirements, test procedure and apparatus for testing the flame retardance of upholstered furniture*, first issued in 1980, is a voluntary test of resistance to cigarette ignition, performed on a variety of surfaces of a complete piece of upholstered furniture.

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7 In this White Paper, “covering fabric” refers to the fabric that covers the upholstered furniture, also called the upholstery. It does not refer to the fabric used in some test methods to cover the lit cigarette in a test of direct cigarette-to-filling-material ignition resistance.
Also in 1980, the United Kingdom issued its first requirements, largely based on British Standard (BS) 5852, *Methods of test for assessment of the ignitability of upholstered seating by smouldering and flaming ignition sources*. After some significant modifications in the 1988 edition (“The Furniture and Furnishings (Fire) (Safety) Regulations 1988,” Statutory Instruments 1988, No. 1324, Her Majesty’s Stationary Office, London, UK, 1988), the requirements have remained fairly stable. Like the US standards, the UK requirement uses a cigarette test. Unlike TB 117, it tests mock-up assemblies as well as components. This responded to a growing realization that tests of components do not reliably predict the real-scale performance of complete upholstered furniture pieces.

Picking up on the NBS work, NFPA’s Fire Test Committee began developing versions of the proposal as standards within its process.

In 1983, NFPA first issued two standards, both based in large part on the NBS work and proposal. NFPA 260 (first numbered as 260A), *Standard methods of tests and classification system for cigarette ignition resistance of components of upholstered furniture*, was also based on the UFAC test method and has been modified over the years to make it even more consistent with UFAC. NFPA 261 (first numbered as 260B), *Standard method of test for determining resistance of mock-up upholstered furniture material assemblies to ignition by smoldering cigarettes*, unlike UFAC, tests mock-up assemblies.


Testing for cigarette ignition resistance has been complicated by the advent of requirements that cigarettes sold in all 50 states and the District of Columbia must comply with tests for reduced ignition strength. Discussions have been underway in recent years to identify what ignition heat source should now be used in cigarette ignition resistance tests.

**Small-open-flame ignition**

**History of requirements**

The first formal requirement was *California Technical Bulletin 117*, first issued in 1975.**

TB 117 required small open flame ignition testing of bare filling materials directly. It did

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**TB 117** cites an older US Department of Commerce flaming ignition test for upholstered furniture covering fabrics (designation 191-53). It is not clear when or how this test was required or what effect it might have had on fabrics in use.
not require tests on covering fabrics or on as-used upholstered furniture pieces or mock-ups.


In 1992-1993, the National Association of State Fire Marshals petitioned CPSC to establish new requirements for both small open flame ignitions and large open flame ignitions. CPSC agreed to pursue a small open flame test and looked at TB 117 as the only US test providing a starting point.

In 1997, CPSC staff concluded that the TB 117 component test results did not do a sufficiently good job of predicting the performance of real-scale upholstered furniture and that TB 117, if adopted, would not ensure a substantial reduction in risk of small open flame ignitions. More generally, researchers were discovering that tests of components did not accurately predict fire performance of mock-ups or complete pieces of furniture.

CPSC next turned to the UK requirements and focused specifically on a small-open-flame mock-up test as their starting point. CPSC’s draft method was published in 1997 for comment.

CPSC also identified a distinct hazard in the flammable dust covers, typically located on the underside of upholstered furniture and designed to conceal webbing and springs. The dust covers could be ignited during fireplay.

Before CPSC could conclude this work, they were directed by Congress, based on industry concerns, to investigate the toxic hazard presented by fire retardant chemicals during manufacture of upholstered furniture. Because CPSC was focused on prevention and small-open-flame tests, they interpreted this mandate as applying to fire retardant treatments of covering fabrics, not filling materials.

A US National Research Council review of literature related to fire retardant treatments for covering fabrics found that of the 16 chemicals examined, eight were clearly not harmful and the other eight could not be definitively judged harmful or not.

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Around the year 2000, CPSC felt free to return to their goal of developing cigarette resistance and small open flame resistance tests. However, at about the same time, CPSC was directed by the US Government Accounting Office (GAO) to change the way that they analyzed national fire incident data to determine the size of the fire problem targeted by a candidate rule. Specifically, CPSC was directed to exclude certain fires – those involving some deliberate fire-setting action, such as intentional fires – as “not addressable” by product requirements.

Before making the modifications directed by GAO, CPSC had found a ratio of 4- or 5-to-1 between upholstered furniture fires started by lighted tobacco products and those started by small open flames. After excluding small open flame ignitions deemed to be not addressable, that ratio grew to 6-to-1 or higher, and there was no longer a sufficient basis for continuing to work on a small-open-flame ignition resistance test.

There is another rationale for including a small-open-flame ignition resistance test for upholstered furniture filling material, and it relates to the requirement for cigarette ignition resistance. Specifically, if the covering fabric fails to prevent smoldering ignition, the smoldering covering fabric may transition to flaming and expose the filling material – or the filling material surrounded by a barrier – to an open flame challenge. Any engineered option that prevents ignition of the filling material by a small open flame applied directly may also prevent ignition of the filling material by a small open flame arising from an initial smoldering ignition of the covering material.

**Ignition by large open flame spreading from other burning item (with upholstered furniture as primary item contributing to fire spread)**

**History of requirements**


The UK regulations using the British BS 5852 wood-crib fire ignition source (called their level 5 ignition source) are the only requirement for home upholstered furniture that uses fire test conditions that might be severe enough to represent this fire scenario. This wood crib provides a more severe test than do any of the small open flame tests.

In addition to more severe fire test conditions, a standard test for this scenario would need different evaluation criteria, specifically, evaluation in terms of fire growth, including speed of fire growth (e.g., rate of rise in rate of heat release) and peak fire severity (e.g.,
peak rate of heat release). It does not appear that the UK test requirements, designed for ignition-resistance purposes, include any fire growth criteria.

In 1991, California issued Technical Bulletin 133, a test of rate of heat release (fire growth and intensity) following a large flaming ignition. This test was designed only for furniture used in public occupancies, where large numbers of upholstered furniture pieces may create a very large combined fuel load in a single room. TB 133 uses a square gas-fueled burner to create a large open flame exposure.

In 1993, ASTM issued its version of this test – now informally referred to as the furniture calorimeter – as ASTM E1537, Test method for fire testing of upholstered seating furniture.

NFPA issued its version in 1994 as NFPA 266, Standard method of test for fire characteristics of upholstered furniture exposed to flaming ignition source. The standard was withdrawn in 2001 as part of the harmonization project among NFPA, ASTM and UL, where the three organizations sought (and still seek) to reduce unnecessarily redundant standards addressing the same need.

In 1992-1993, the National Association of State Fire Marshals petitioned CPSC to establish new requirements for both small open flame ignitions and large open flame ignitions. CPSC agreed only to pursue the small open flame test.

This scenario has received little attention in the many forums devoted to furniture flammability strategies, with the notable exception of the 2012 NIST Furniture Flammability Workshop.11

It is through this scenario that the furniture flammability issue connects to the concern over a modern trend toward faster, more severe fires, leading to compressed fire growth timelines. That concern has been spotlighted in the NIST Dunes II project12 because of its relevance to modern measures of home smoke alarm performance and in work at Underwriters Laboratories, NIST, USFA, and other places where the concern is with threats to the lives and health of firefighters in situations that can deteriorate far more rapidly than in decades past.

These different threats – as well as the statistical calculation that roughly one out of four upholstered furniture fires and associated losses involve this scenario – combine to put a high priority on better strategies to mitigate upholstered furniture fires that are ignited by heat sources too large to allow prevention. The twin-burner test used in the 16 CFR 1633

11 William M. Pitts, Summary and Conclusions of a Workshop on “Quantifying the Contribution of Flaming Residential Upholstered Furniture to Fire Losses in the United States,” NIST Technical Note 1757, National Institute of Standards and Technology, Gaithersburg, MD, 2012
mattress flammability test appears to be one example of a test providing exposure severity comparable to that produced by a fire spreading from another burning item.

Summary of Regulations

The cigarette-ignition scenario was the first upholstered furniture fire scenario to be addressed by formal requirements, beginning in 1975 in California with TB 117 and in 1980 in the UK with requirements built around BS 5852. The earliest requirements depended solely on fire tests of upholstered furniture components. At some point, the UK added tests of mock-ups. Component tests do not reliably predict the fire performance of complete pieces of furniture.

The Upholstered Furniture Action Council test method, NFPA 260 and 261, and ASTM E1352 and E1353, all were developed from the base of TB 117 and BS 5852, and all are designed solely to address the cigarette-ignition scenario.

Currently, CPSC is attempting to develop a national requirement built around some combination of real-scale tests of mock-ups or complete pieces of furniture and bench-scale tests of furniture components that have been validated as predictive of the performance of complete pieces of furniture.

The small-open-flame scenario was also first addressed by TB 117 in California in 1975 and by the UK in 1980 using tests based on BS 5852.

The scenario of ignition by another fire, as when a piece of upholstered furniture is the primary item contributing to fire spread but not the item first ignited, has never been the explicit basis for requirements. Some requirements use a larger open-flame igniting heat source, such as the wood crib fire used in one part of the UK requirements. Some requirements – for furniture used in public occupancies not in homes, such as TB 133 – use a larger igniting heat source and evaluate performance not on ignition resistance but on speed of fire growth and peak severity. These test conditions and criteria could be used as a starting point for design of a standard test method, with evaluation criteria, which would be appropriate for the severity of this scenario and the safety goals appropriate to the scenario.
Section 3.
What Are the Engineered Options for Reducing Upholstered Furniture Flammability? What Are the Pros and Cons of These Options?

Engineered options can be broadly grouped as follows:

- Choice of covering fabric (so as to resist ignition itself and protect the filling material from ignition)
- Choice of filling material(s) for what are often multiple layers under the covering upholstery fabric (so as to resist ignition and/or burn slowly with a low peak intensity)
- Fire retardant treatment of fabric or filling materials (to reduce flammability)
- Use of fire barrier (between covering fabric and filling materials to further protect the filling materials from ignition and/or slow growth of fire for the upholstered furniture)

In addition to the above primary options, there are others, for example:

- Design to prevent dripping of burning material onto the floor
- Design to prevent formation of openings in furniture that increase fuel/air mixing during the fire

Only primary options are discussed further here. Also not discussed further are options that address the ability of heat sources to ignite upholstered furniture, such as reduced ignition-strength cigarette, child-resistant lighter, space heater designs to alert occupants when burnable items are too close, or electrical cords more resistant to damage.

Choice of (upholstery) covering fabric or filling materials

History of product change due to requirements, and relative ignitability of different covering fabrics and filling materials

When UFAC and California TB 117 and TB 116 were introduced, the principal engineered options involved changes to the covering fabrics and filling materials. In particular, there was pressure to move away from untreated (by fire retardants) cotton and other cellulosic covering materials and away from untreated cotton batting as filling material because of their tendency to smolder.

The relative ignitability of different types of fabric and filling materials was estimated in the mid-1980s by NFPA, based on tests performed by CPSC and the National Institute of Standards and Technology (NIST, then known as the National Bureau of Standards) between 1975 and 1986, with data formatting by CPSC.
The results were organized into four fabric groups and two filling-material groups. These are the four fabric groups, in order from most likely to ignite to least likely to ignite:

- Cellulosic fabrics excluding prints (specifically including velvet, corduroy, jacquard, flock and dobbly)
- Cellulosic or thermoplastic print, or thermoplastic flock or dobbly
- Thermoplastic velvet, corduroy or jacquard
- Vinyl (a specific group of thermoplastic fabrics)

The two filling-material groups were as follows:

- Untreated (i.e., no fire retardant treatment) cotton batting
- Anything else, including polyurethane foam with or without fire retardant treatment, cotton batting with fire retardant treatment, mixed fibers, and polyester, as well as more exotic filling materials such as horsehair.

Tests of ignitability were conducted with cigarettes placed on a flat surface (such as a seat) and with cigarettes placed in a crevice between two seat cushions or between a seat cushion and the arm/side or back of the furniture. Not every combination was tested, but for those that were, ignition was always more likely in a crevice than on a flat surface and almost always as likely or more likely with untreated cotton batting than with the combined results for the other materials tested.

Vinyl covering fabrics were not tested with untreated cotton batting but allowed no ignitions in any of 18 tests (12 on flat surface, 6 in crevice) with other materials. Therefore, Table 4 does not show results for any of vinyl materials.

**Table 4. Propensity of different covering fabrics and filling materials to be ignited by cigarette, at various locations on upholstered furniture (based on tests from 1975-1986)\(^\text{13}\)**

<table>
<thead>
<tr>
<th></th>
<th>Untreated cotton batting</th>
<th>Any other filling material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% tests with ignitions</td>
<td># of tests</td>
</tr>
<tr>
<td><strong>Flat surface</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cellulosics except prints</td>
<td>91%</td>
<td>19</td>
</tr>
<tr>
<td>Cellulosic or thermoplastic print, or thermoplastic flock or dobbly</td>
<td>30%</td>
<td>40</td>
</tr>
<tr>
<td>Thermoplastic velvet, corduroy or jacquard</td>
<td>0%</td>
<td>3</td>
</tr>
<tr>
<td><strong>Crevce</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cellulosics except prints</td>
<td>99%</td>
<td>16</td>
</tr>
<tr>
<td>Cellulosic or thermoplastic print, or thermoplastic flock or dobbly</td>
<td>No data</td>
<td>0</td>
</tr>
<tr>
<td>Thermoplastic velvet, corduroy or jacquard</td>
<td>No data</td>
<td>0</td>
</tr>
</tbody>
</table>

Test data were made available from the UFAC program but were not included in the mid-1980s NFPA analysis because the UFAC data differed so markedly from the results of the other tests – in the direction of predicting much better performance. (For example,

there were no ignitions in 16 tests on flat surface, untreated cotton batting, cellulosic fabrics other than prints, compared to 91% ignitions in the dataset used.)

It is unclear why the UFAC test data, taken from the first full year of the UFAC program, differed so much from the other data available from that period. These data may not have been representative of the kinds of results UFAC itself obtained in succeeding years, when testing should have settled into a stable routine. It is also possible that the special test conditions used in UFAC testing produced results more favorable and less accurate than would be produced by TB 116, BS 5852, or NFPA 260 or 261. In any event, as noted in section 2, component tests like those in UFAC have not proven to provide good predictions of the fire behavior of composite mock-ups or complete furniture pieces.

Using data on the characteristics of upholstered furniture sold in the US and an economic product-life model, CPSC provided estimates of the dramatic shift in usage of the different covering fabrics and filling materials, from 1975 (before UFAC began) to 1982 (four years after UFAC began):

Table 5. Percentage of upholstered furniture in use in homes, by covering fabric and filling material, 1975 versus 1982

<table>
<thead>
<tr>
<th></th>
<th>1975</th>
<th>1982</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Covering fabric</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cellulosics excluding prints</td>
<td>64%</td>
<td>44%</td>
</tr>
<tr>
<td>Cellulosic prints</td>
<td>13%</td>
<td>14%</td>
</tr>
<tr>
<td>Thermoplastic except vinyl</td>
<td>15%</td>
<td>32%</td>
</tr>
<tr>
<td>Vinyl</td>
<td>8%</td>
<td>9%</td>
</tr>
<tr>
<td><strong>Filling material by location</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% untreated cotton batting, in seat</td>
<td>53%</td>
<td>23%</td>
</tr>
<tr>
<td>% untreated cotton batting, in arm</td>
<td>80%</td>
<td>47%</td>
</tr>
</tbody>
</table>

Note that there is a slight mismatch between the groups of covering fabrics in the percent-of-inventory table compared with the groups of covering fabrics in the relative-ignitability table. However, the most ignitable group of covering fabrics provided the largest decline (cellulosics excluding prints, down from 64% to 44%) and the least ignitable groups provided the largest increase (thermoplastics including vinyl, up from 23% to 41%). The shift in filling material was even more dramatic.

CPSC analysis in the mid-1990s indicated that the inventory continued to shift in the desired direction. CPSC found 86% of all upholstered furniture in the retail marketplace met all UFAC requirements, and the cigarette ignition likelihood averaged about 15% of all pieces of upholstered furniture sold, whether known to be compliant or not.

A piece of upholstered furniture is expected to last about 16 years. Based on that estimate of turnover US home upholstered furniture has turned over twice since the 1982 data was collected and once since the mid-1990s updated analysis by CPSC. There does not appear to be any reasonably current but comparably detailed upholstered furniture fabric and filling material usage data available.

**Potential of better or more complete fire incident (NFIRS) data to add significantly to our understanding of the fabrics involved in upholstered furniture fires**

National fire incident reporting has never provided much detail on the type of material first ignited. In particular, cellulosic and thermoplastic fabrics cannot be distinguished with confidence. The leading types of material first ignited for 2006-2010 home structure fires where upholstered furniture was first item ignited were as follows, ranked by percentage share of fire deaths:

- Fabric, fiber, cotton, blends, rayon or wool (73% of fire deaths; appears to refer to cellulosic materials, but categories like fabric, fiber, and blend could refer to anything)
- “Other” fabric, textile or fur (17% of fire deaths; could be a place to record thermoplastic materials that do not look like plastic or could be used for fabrics and textiles of unknown composition, in which case, the category might be mostly more cellulosics)
- Multiple types of material (4% of fire deaths)
- Unclassified type of material (2% of fire deaths)
- Wood or paper (1% of fire deaths; ignition of parts of the upholstered furniture that are neither covering fabric nor filling material)
- Plastic or plastic-coated fabric (1% of fire deaths; could capture any type of thermoplastic or might be used only for fabrics that look like plastic, such as vinyl)
- “Other” natural product (1% of fire deaths)
- Leather (0.2% of fire deaths)

These are the kinds of questions that could be explored in a special data collection research project with fire departments participating in NFIRS, but accurate identification of fabrics and filling materials (or rather, each of the layers of filling material) would probably require fire departments to collect samples for examination by specialists.

**Fire retardant treatments**

**History of product change due to requirements**

Industry sources have indicated that they found polyurethane (PU) foam would pass the TB 117 small-open-flame test if treated with fire retardants to a necessary level and

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would not pass otherwise. This helped drive the use of fire retardants in home upholstered furniture, and although the legal requirement existed only in California, industry experts say the standard affected upholstered furniture across the country.

The UK requirements also had a wider impact than the place where the requirements began, influencing or upholstered furniture across the European common market countries. Figure 6 shows the results of studies of data collected in 1994 on percentage of upholstered furniture passing either or both of the cigarette and small-open-flame (match) tests.¹⁶

Just over half of the pieces tested passed the small open flame test. Of the 26% of pieces that passed only the cigarette test, only 38% had fire retardant treatments in either covering fabric or filling material (PU foam), and only 28% had fire retardant treatments specifically in the filling material, which tends to be type of fire retardant that inspires the greatest concerns and objections.

![Figure 6. Percentages of European upholstered furniture pieces passing cigarette and/or small open flame (match) test in 1994](image)

Of the 32% of pieces that passed both cigarette and match test, 62% had fire retardant treatments in either covering fabric or filling material. Only 39% had fire retardant treatments specifically in the filling material.

**Chemicals used as fire retardants**

Fire retardant treatments can be applied to covering fabric or filling material, including but not limited to different types of polyurethane foam. Most of the concerns raised over health effects from fire retardants have been raised specifically over the use of polybrominated diphenyl ethers (PBDEs) as fire retardant treatments for polyurethane foam used as filling material in upholstered furniture.

Different fire retardant chemicals mitigate fire in different ways. PBDEs work by disrupting the chemical reactions that sustain flaming, focusing on the step in the sequence where the greatest amount of heat is produced.

Of at least 10 different PBDEs, three accounted for nearly all of the manufacture and sales until recently:

- Penta-brominated diphenyl ether (penta or penta-BDE for short), the principal PBDE used in upholstered furniture filling materials,
- Octa-brominated diphenyl ether (octa or octa-BDE for short), the other PBDE used in upholstered furniture filling materials, and
- Deca-brominated diphenyl ether (deca or deca-BDE for short), principally used in the plastic housings of electronic devices.

Due to concerns regarding health effects, Penta-BDE and Octa-BDE were voluntarily phased out of production in 2004. Also in 2004, the sale of penta and octa in concentrations higher than 0.1% by mass were banned in the European Union.

In 2006, EPA required that any new manufacture or use of penta or octa would constitute a new use and require prior evaluation before approval.17

It appears that upholstered furniture manufacturers are now using Deca-PBE, previously associated primarily with electronic device housings, and other alternative fire retardants, such as chlorinated organic phosphates, to meet the requirements of TB 117.

Fire prevention and mitigation effects of fire retardants

Fire retardants have been used to pass small-open-flame tests of filling material. It is not clear how effective these treatments are in resisting small-open-flame ignition of a complete piece of upholstered furniture or in resisting the kind of flaming heat source created when smoldering ignition of the covering fabric is not prevented.

Recent experiments by CPSC and UL have not shown a consistent or significant effect of fire retardants on measures of fire growth, such as peak heat release rate or time to reach peak heat release rate. For example, a memo on tests conducted in 2012 by CPSC concluded “a relative difference was noticed in the foams, but the fire-retardant foams did not offer a practically significantly greater level of open-flame safety than did the untreated foams.”18 If the fire-retardant treatment tested was applied in order to pass a test like TB 117, however, then it was not designed for that kind of fire performance.

In other words, the small-open-flame ignitions that motivated the introduction of fire retardants constitute a modest share of total upholstered furniture fatal fire deaths (about 10-15%) and always have. For other fire scenarios – notably the large open flame ignitions involving fire spread from another burning item – available test evidence has

not shown a significant effect, and one would not expect an effect because the treatments were never designed to resist such large ignition heat sources. Either way, the evidence suggests the past impact of historically favored fire retardant treatments on fire deaths could not have been very large, even if they reliably performed as intended in all fires.

Next generation fire retardants

The recent replacement fire retardants used in upholstered furniture have not been new chemicals so much as existing chemicals repurposed for use as upholstered furniture fire retardants. This may serve as a stopgap strategy but is less likely to provide a long-term solution. There are long-term efforts focusing on the possibility of next-generation fire retardants that might be effective for fire safety and free of adverse health effects.

EPA’s Design for the Environment Program, created in 1992, is a partnership that currently includes CPSC, the American Fire Safety Council (formed in 2003 as the successor organization to the Fire Retardant Chemicals Association), the American Furniture Manufacturers Association, the Business and Institutional Furniture Manufacturers Association, and GreenBlue (a non-profit association formed in 2002 to promote improved life-cycle sustainability in products).

In 2005, EPA published a two-volume review of alternative chemicals for use as fire retardants in polyurethane foam. This kind of review provides the technical details and judgments required to determine acceptability of candidate replacements for existing fire retardant chemicals, as well as a process to determine acceptability of the next generation of candidate fire retardant treatments.

Fire-barriers

Use of fire-barriers as an engineered option to reduce upholstered furniture flammability

In the realm of fire safety, "barrier" is a catch-all term for a material layer that significantly reduces the fire contribution of a product. (One can consider drywall as a barrier protecting against the fire contribution of combustible thermal or sound insulation in the wall cavities.) For soft furnishings (upholstered furniture and mattresses) a barrier material could be a woven cloth, a non-woven fabric, a felt, etc. Some upholstery fabrics are back-coated with the coating designed to act as a barrier; in such designs, there is no need for an extra layer of fabric in the furniture assembly.

Mechanisms by which a barrier material might reduce furnishing flammability are:

- **Thermal resistance.** This keeps the rate at which filling materials are heated below temperatures at which they generate flammable vapors.

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- **Inhibition of vapor transport.** The barrier reduces the rate at which the combustible vapors from the filling materials reach the oxygen needed for burning.

- **Dilution and heat absorption.** The barrier can degrade to generate inert gases, such as water vapor, that decrease the flammability limits of the vapors in air.

- **Chemical interaction.** The barrier can degrade to release gases that retard the degradation of the filling materials or inhibit the combustion of the generated vapors.

These mechanisms can have contradictory properties. For instance, a barrier that unduly restricts the flow of degradation gases also restricts the flow of air in and out of the cushions during normal use. This reduces the resiliency of a cushion. A barrier that has a lot of fiber surface areas might be prone to smoldering ignition.

The installation of a barrier can have a major effect on fire performance, but to be fully effective, the barrier must block every path flame might take to the interior padding materials and so must surround those materials.

It may be possible – and less expensive – to install the barrier only in the location(s) needed to pass the regulatory test. For cigarette ignition resistance, this might mean protecting the top of the seat and the inside of the arms and back. This would not provide protection against thermal ignition by a space heater, for example.

Seams and zippers are potential installation weaknesses. If the seam fails, then there will be a gap where the barrier is not present.

Barriers have been recognized at least as far back as the introduction of the UFAC tests in 1979, where barriers were offered as an alternative way to comply with a smoldering-ignition-resistance requirement if the covering fabric did not perform well enough by itself.

More recently, barrier materials have drawn increased attention as an alternative to fire retardants. The 2008 version of the draft CPSC requirement resembles the original 1979 UFAC protocol in its use of a fire-barrier option as an alternative route to compliance for upholstered furniture that does not pass the cigarette-ignition-resistance test. Also, the recently revised CPSC mattress flammability standard (16 CFR 1633) achieves compliance through the use of barriers.

**Recent experimental work at CPSC and at Underwriters Laboratories (UL) provides the best estimate of the effectiveness of fire barriers.**

The fire-barrier system studied by CPSC in a round of tests in 2012 was described as follows:20

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The system consisted of polyester batting over a commercially available fire-barrier. The fire-barrier was composed of a fiberglass base needle-punched with polyester and modacrylic fibers. The polyester batting was 100% polyester fiber (nominally 4 oz/yd²) in non-woven construction, 0.375” thick.

The conclusions from the 2012 CPSC tests on barriers were quite favorable: “Overall, the results demonstrated that the addition of a fire barrier markedly increased the fire safety of the furniture. The data indicated that the fire sizes were smaller and the time to reach the peak fire size was slower with fire barriers, regardless of the fabric or foams used.”

A second memo provided further definition of fire-barriers and further quantification of their performance:21

“A qualified fire barrier … must be smolder resistant and open-flame resistant…” because “…if the cover material is not smolder-resistant and can transition to flaming, then the fire barrier would be called upon to protect filling materials from flaming combustion.” This is a more precise restatement of the UFAC rules in which the barrier material is treated as a back-up for smoldering resistance by the covering fabric.

- Chairs with fire barriers had a peak heat release rate more than 50% lower than the peak heat release rate for chairs without barriers.
- Chairs with fire barriers took more than three times as long to reach peak heat release rate than chairs without barriers.

When CPSC moved on to full-scale tests later last year, the results were not so favorable:22 “…staff expected that the chairs constructed with the fire barrier would not result in any smoldering ignitions and would limit combustion in an open-flame exposure scenario. However, when tested, the fire barrier did not consistently provide a clear result on protection against smoldering ignitions. The chairs constructed with fire barriers demonstrated a considerable amount of smoldering.

“During testing, it was found that the construction of the chairs was not uniform. For example, in some cases, the plastic that wraps the foam prior to use was included in the final chair, and the seams may not have been at the exact edge of the cushions. Despite these irregularities, staff determined that they did not affect considerably the actual result of the tests. The performance of the fire barriers, when exposed to an open-flame ignition source, did indicate that the fire barrier was somewhat successful in reducing fire severity.”

Additional work remains before CPSC can say that they have a valid standard test of performance, suitable for use in a national requirement.

The work at UL was described by Tom Fabian of UL in a presentation at a 2012 NIST workshop on furniture flammability:23

A series of experiments performed on mock-ups and complete pieces of furniture showed that use of an appropriate barrier significantly slowed fire growth and reduced peak heat release rates. Among the experiments was a series comparing contemporary furniture with non-retarded foam, polyester covering fabric, and polyester wrap to contemporary furniture with added cotton-based fire barrier. Flashover was observed in 4 minutes for the contemporary furniture without fire barrier but not until 21 minutes for the contemporary furniture with fire barrier.

A second series of experiments measured time to untenability (defined as a temperature of 150° C at a location 1.5 meters above the floor) in an upstairs bedroom as affected by a living room fire in upholstered furniture. Time to untenability was 5 minutes 3 seconds with no barrier and 32 minutes 39 seconds with an added fire barrier.

Summary of Engineered Options

Improved resistance to cigarette ignition has been achieved through the selection of covering fabrics (e.g., thermoplastic fabrics rather than heavy cellulosic fabrics) and filling materials (e.g., polyurethane foam rather than cotton batting). These fabric and filling material choices can not only pass the cigarette-ignition tests but have also been shown through experiments to sharply increase measured cigarette-ignition resistance.

Fire retardants have been used to pass tests for small-open-flame resistance of filling materials since the introduction of such tests in 1975.

In fires where a smoldering ignition progresses far enough to transition to an open flame fire on the covering fabric, fire retardants in the filling material might be able to have an impact, but it is not clear what fraction of such smoldering-to-flaming fires are small enough to be affected by the type and level of fire-retardant treatment currently used in filling materials.

Fire retardants are also used in some covering fabrics to pass the tests of covering fabrics. These are different types and levels of fire retardants than are used to treat filling materials, and there has been little or no expressed public concern about the health effects of these fire retardants.

23 Taken from notes on presentation by William M. Pitts, Summary and Conclusions of a Workshop on “Quantifying the Contribution of Flaming Residential Upholstered Furniture to Fire Losses in the United States,” NIST Technical Note 1757, National Institute of Standards and Technology, Gaithersburg, MD, 2012, pp. 4-5.
Polyurethane foams fire-retarded to pass TB 117, have also been tested for their ability to slow fire growth and reduce peak heat release rate. Recent tests by CPSC and UL have shown some effect but not enough to make a significant practical difference.

In other words, the small-open-flame ignitions that motivated the introduction of fire retardants constitute a modest share of total upholstered furniture fatal fire deaths (about 10-15%) and always have. For other fire scenarios – notably the large open flame ignitions involving fire spread from another burning item – available test evidence has not shown a significant effect, and one would not expect an effect because the treatments were never designed to resist such large ignition heat sources. Either way, the evidence suggests the past impact of historically favored fire retardant treatments on fire deaths could not have been very large, even if they reliably performed as intended in all fires.

Due to concerns regarding health effects, the two principal chemicals (penta- and octa-brominated diphenyl ethers) used as fire retardants were phased out of production nearly a decade ago. Other fire retardants, including deca-BDE and chlorinated organic phosphates, are reportedly being used to pass TB 117, but they also are being challenged on grounds of health effects.

California is actively exploring the possibility of removing the small-open-flame ignition test from TB 117, which would remove the only US regulation that has induced the use of fire retardants in upholstered furniture.

**Fire barrier systems** are combinations of fabric layers or coatings that prevent ignition of the protected filling material or delay the involvement of filling material in fire, thereby slowing the growth of fire and lowering the peak heat release rate (fire intensity).

Fire barriers have long been recognized in regulations as an engineered option to provide ignition resistance when the covering fabric and filling material choices are not sufficient.

More recently, fire barriers have been explored as options for a wide range of fire safety goals, but particularly for the flaming scenarios.

Experiments on fire barriers have been very encouraging, suggesting that they can achieve improved flammability and compliance with existing and proposed requirements, often better than defined fire-retardant treatment options. At the same time, real-scale experiments to date have shown too much variation to permit a standard test and associated requirements to be written on the basis of current knowledge.

**An overview of the match between engineered options and major upholstered furniture fire scenarios**

While the past 30 years have seen large reductions in the upholstered furniture fire problem, it remains one of the largest parts of the US home fire problem, with an estimated 610 fire deaths a year. This includes 130 fire deaths a year involving
upholstered furniture as the principal item contributing to fire spread but not as the item first ignited.

The cigarette-ignition scenario still accounts for by far the largest share of fire deaths (45%). Current research is focused on development of a new test standard to be administered by CPSC, demonstrated to predict real-scale fire performance of complete upholstered furniture pieces, with compliance to be achieved by choices of covering fabrics and filling materials, possibly supported by fire-barrier systems or acceptable fire retardants.

The small open flame ignition scenario is the other scenario traditionally addressed by regulation. It accounts for a small share of fire deaths (10%). Current research is focused on shifting the basis for compliance with any test standard from traditional fire retardants to fire-barrier systems or next-generation fire retardants.

The scenario of large open flame ignitions due to fire spreading from another burning item has only recently been quantified and accounts for 21% of fire deaths. Current research has not yet focused on this leading scenario or on the potential for fire-barrier systems or next-generation fire retardants to address the scenario.

The operating equipment ignition scenario accounts for 12% of fire deaths and has had a similar share of upholstered furniture fire deaths for as long as we have had good data. Current research is not focused on this scenario.

The scenario of embers, ash, or other hot or smoldering ignition accounts for 10% of fire deaths but did not account for a significant share in the 1970s and 1980s when current regulations were developed. Current research is not focused on this scenario. It is assumed that this scenario may be equivalent to the cigarette-ignition scenario – either a different coding of actual cigarette ignitions or ignition heat sources that are mostly weaker than but similar to cigarettes – and so may not require separate testing or separate safety strategies.
Section 4.
Summary of Current Status of Regulations and Research Related to the Upholstered Furniture Fire Problem

Review of current global regulatory situation for furniture flammability

- Beginning in 1975, the US, the UK, and parts of Europe have been covered by some type of cigarette-ignition-resistance standard for upholstered furniture.
- In the past, California and the UK have supplemented the cigarette-ignition-resistance standard with a second standard covering small open flame ignition resistance for the filling material or the entire piece of upholstered furniture. This second standard induced the widespread use of polybrominated biphenyl ethers (PBDEs), principally penta-BDE, as a fire retardant treatment for polyurethane foam filling materials.
- Rising health concerns regarding PBDEs led to increasingly comprehensive bans on manufacturing and sale of penta-BDE in particular. Both penta-BDE and octa-BDE were largely phased out almost a decade ago. There is pressure to ban or phase out other fire retardants, including deca-BDE and chlorinated organic phosphates, which are reportedly the fire retardants used by manufacturers to replace the phased-out penta and octa.
- In 2012, California began considering a proposal to rescind the small-open-flame ignition-resistance test part of TB 117, which is the only requirement in the US inducing use of fire retardants in filling materials of home upholstered furniture.
- The UK has maintained both their existing small-open-flame ignition resistance test requirement and a larger open-flame (wood crib fire) test requirement, while also moving away from the use of traditional fire retardants to comply with those tests. It is likely that compliance in the UK will depend increasingly on the use of fire barriers, but the technical literature is currently quite thin on fire-barrier fire performance data to support this shift.

Assessment of impact of regulatory change on fire loss in the United States

- Cigarette ignition-resistance requirements induced substantial shifts in covering fabrics (from cellulosic to thermoplastic) and in filling materials (from cotton batting not treated with fire retardants to any other filling material). Both shifts have been associated with sharp improvements in measured cigarette ignition resistance of upholstered furniture in use and sharp declines in upholstered furniture fires and associated losses.
California has the only US legal requirement for cigarette-ignition resistance, as part of TB 117 and TB 116, but its requirements are very similar to those of the UFAC program, which has been adopted across the country despite being a voluntary program.

Fire retardants have been the principal engineered option used to comply with small-open-flame ignition-resistance requirements in TB 117. Fire retardants in filling materials have been used solely to address this part of the requirements.

Small-open-flame ignition-resistance requirements targeted a much smaller part of the upholstered furniture fire problem. Because the targeted fire problem was relatively small, the estimated benefits from this part of the requirements have also been small. This does not mean it was ineffective, only that it was designed for a comparatively small fire problem.

Shifts in materials used in upholstered furniture, in part induced by flammability requirements, have resulted in far fewer fires but fires with a higher average severity. Recent studies have drawn attention to the sharp decline in time to escape in some typical home fire scenarios over the past several decades. These declines also compress the time for effective action by firefighters, reducing their chances of success and increasing their own risks of injury or death.

Fires that grow quickly when not prevented require a different engineered option than do fires where prevention through ignition resistance is a realistic goal. Options that slow fire growth or reduce peak heat release rates would be fire barriers or fire retardants, where the latter would need to be next-generation fire retardants that are shown to be effective for fire safety goals and acceptably free of serious health effects.

Overview of global research and development activities

There is considerable research underway to identify and qualify a next generation of fire retardant treatments that will be effective for fire safety and safe for environmental health. The Environmental Protection Agency’s Design for Environment (DfE) initiative is a major leader in this work and a major source of systematic evaluation protocols to be applied to candidate new materials.

There is some research underway to refine test procedures and standards for assessment of cigarette-ignition resistance of upholstered furniture. In the US, the Consumer Product Safety Commission is the entity most likely to act on this work if it is successful and is also a principal researcher.
➢ There is some research underway (e.g., CPSC and Underwriters Laboratories) to evaluate the performance of fire-barrier systems against various ignition scenarios and for various fire performance goals.

➢ NIST, NFPA and the US Fire Administration have contributed to recent awareness of the size of the fire problem associated with upholstered furniture as the principal item contributing to fire spread. There is not yet any significant research underway to identify technologies capable of significantly mitigating these challenging fires or to develop a standard test for this fire scenario.

➢ There does not appear to be any active research on the opportunities for improved ignition resistance through selection or design of covering fabrics and filling materials from among those that are compliant with current requirements.

➢ There does not appear to be any active research on tests for ignition-resistance effectiveness with respect to smoldering ignition heat sources other than cigarettes (e.g., ember or ash), even though they now account for a large share of upholstered furniture fires and losses. This may be as simple as verifying that these reported fires are primarily cigarette ignitions reported under a different name.

➢ There does not appear to be any active research on a test for ignition-resistance with respect to ignitions due to arcing or heat from operating equipment, even though they account for a large share of upholstered furniture fires and losses. It is likely that the relative importance of this scenario has not been widely recognized.

➢ There has been a little thinking, but no major projects, on ways to supplement the data collected in NFIRS and/or better understand what details typically lie behind some of the less well-defined reporting categories. For example, how many upholstered furniture fires are coded as “other” furniture or utensil? Are cellulosic and thermoplastic fabrics being coded into the same reporting groups, or are they being reported in different groups?
Estimating Fires When a Product is the Primary Fuel But Not the First Fuel, With an Application to Upholstered Furniture

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Estimating Fires When a Product is the Primary Fuel But Not the First Fuel, With an Application to Upholstered Furniture

Abstract

Since 1980, it has been possible to estimate the size of the fire problem associated with many types of burnable products when those products are the first items ignited. However, many burnable products also have a major role as the largest fuel package in the room and may be the most important fuel package even if not the first item ignited. Only in the last few years have we had enough years of fire data with coding sufficient to support sound estimates of fires where a defined product is the primary fuel but not the first fuel. This article describes a proposed methodology for making those estimates and describes the results of application of the new methodology to upholstered furniture. The application to upholstered furniture demonstrated that one-quarter of upholstered furniture fires, civilian injuries, and direct damages, and one-fifth (21%) of associated civilian deaths are associated with fires in which upholstered furniture is the primary item contributing to fire or flame spread but not the item first ignited. The traditional focus on cigarette resistance leaves roughly half of the fire deaths from upholstered furniture fires untouched.

Introduction

In addition to support for estimates of the size, characteristics, and trends in the national fire problem, national fire incident data and statistics can be highly useful in analyzing the likely impact of alternative strategies and choices. This includes alternative choices for the design of products, including products that serve as fuel for the fire, either initially or at some point during the growth and spread of the fire (where the products range from contents like mattresses, bedding, and upholstered furniture, to installed furnishings like cabinets and wall linings, to parts of the building, like thermal insulation).

Since 1980, U.S. national fire incident statistics have been developed using standard analysis rules applied to detailed data from the National Fire Incident Reporting System (NFIRS), which is administered by the U.S. Fire Administration (part of the Federal Emergency Management Agency, within the U.S. Department of Homeland Security). NFIRS collects standardized fire incident and casualty reports from participating fire departments. States set the NFIRS participation requirements for their jurisdictions and perform varying amounts of quality control and training.

NFIRS is a large database, containing a large fraction of all the U.S. fires reported to municipal fire departments. It is not complete enough to be treated as a census, and it is not a random sample, where the statistical rules for projecting from samples are well defined. There are systematic biases in participation by departments, which may reflect differences in state requirements (is participation mandatory or voluntary?) or differences in resources required to maintain full participation. There are systematic biases in the likelihood that a fire will be included, which may reflect differences in thresholds of fire.
severity for mandatory reporting. At the same time, NFIRS includes such a large share of total U.S. fires (reported to fire departments) that it can be treated as having some or much of the representativeness found in a true random sample, certainly more than is found in other fire incident databases not designed as random samples.

Also, unknown percentages are large for some data elements (as will be illustrated for specific data elements later in this article), and this problem is greater for some fires and some data elements. For example, some data elements are not mandatory for some fires. Unless some compensation is made for missing fires and this missing data, fire statistics will seriously under-estimate the fire problem.

In the early 1980s, NFIRS users at the U.S. Fire Administration (USFA), the Consumer Product Safety Commission (CPSC), and the National Fire Protection Association (NFPA) experimented with variations of standard rules for developing NFIRS-based national estimates in a consistent and defensible manner. By the end of the decade, there was broad agreement among national analysts of NFIRS data on the principles to be used in making projections. (Hall and Harwood, 1989)

The standard method compensates for missing fire departments by using a stratified random-sample based survey – the NFPA annual fire experience survey – to estimate the annual totals for fires and losses, and then treats the NFIRS dataset as a sample from those totals, using scaling ratios based on the NFPA-survey-based totals divided by the corresponding NFIRS totals. Other methods use other sources for totals – such as the U.S. death certificate data base – but these other databases typically have important differences in the definition of an eligible fire or fire loss. For example, death certificates are not limited to deaths in fires reported to fire departments and may not include homicides, suicides and vehicle fire deaths. Insurance fire loss databases may not include uninsured fire losses or deductibles and may include losses in fires not reported to fire departments.

The standard method compensates for missing data by proportionally allocating unknowns for any data element over the knowns, thereby assuming that the unknowns are most likely to resemble the knowns.

The specifics have changed because some data elements have changed, but the general approach, with some added specifications, applies equally well to the new data elements and other changes in successive versions of NFIRS, including the current version 5.0.

**Estimating the Fires Associated with a Burnable Product**

When the specific concern is with a product’s role as the first item ignited, it is natural to talk about the goal of prevention. A fire may be stopped before it begins if the initial fuel is changed. There are standard fire tests for ease of ignition of particular products when exposed to certain heat sources (such as a test for ease of ignition of upholstered furniture by a cigarette or other smoldering heat source). There are code requirements and other regulations that block products from entering the marketplace if they do not pass such tests.
When the specific concern is with a product’s role as the primary fuel but not the first fuel, the implied fire scenario involves ignition of the product by another unwanted fire, which can be safely assumed to be a stronger ignition heat source, larger and more intense, than a smoldering cigarette or small open flame. In such cases, complete prevention may be an unattainable goal, but if such a product can be reengineered so that it burns with a slower rate of growth and/or a lower, less intense peak, then there should be fewer large fires and potentially substantial reductions in fire loss.

Of course, before spending the resources required to pursue this kind of loss mitigation through product redesign, there should be evidence that the loss reduction will be worth the cost. The benefits from a design change will be some fraction of the losses associated with the current design. Therefore, the first quantities needed for policy analysis are best estimates of the fire losses associated with a particular product of interest when that product’s role is that of principal secondary fuel package, not initial fuel package. That is the estimation problem that this article seeks to address.

Changes in NFIRS That Made the Desired Type of Estimation Possible

In 1999, version 5.0 of NFIRS introduced a data element labeled *item contributing most to flame spread*. The coding choices for this new data element are identical to the coding choices for the long-time data element labeled *item first ignited*. This means estimates can be developed for the same product groups for fires involving the product in either role, as first fuel or as the most important secondary fuel.

Prior to 1999, NFIRS data elements on contributors to fire spread were either

- a) **not designed to distinguish types of products** (for example, based on the material composition of the product not its function),
- b) **structured in terms of a long list of candidate factors**, including many factors that were not burnable products (which means that many fires with this data element coded would not have been evaluated in terms of principal item contributing to fire spread), or
- c) **focused on other fire performance characteristics** than fire or flame spread (for example, *item generating most smoke*, a data element used during some of the versions of NFIRS).

The new data element saw relatively little use in the first several years after the introduction of NFIRS version 5.0. Analysis of this data element involves some technical complications that cannot be addressed by simple extensions of the standard method for analyzing NFIRS data. One complication is the need to isolate all and only those fires with enough fire/flame spread that it is meaningful to ask which item was the primary contributor to that spread. Another complication is the need to avoid double-counting fires where the product was both the first item ignited and the primary contributor to fire/flame spread.

A third complication is the variation in descriptions of fire spread in two important data elements. The data element that identified the “item contributing most to flame spread”
refers to “flame spread” while the data element describing the size of the fire refers to “fire spread.” In order to use these two data elements together in an analysis, it is necessary to assume that these two terms are being used in the field to describe the same kind of spread. It is possible that the term “flame spread” may provide a subtle push toward surfaces (room linings) that flame may spread along rather than major fuel packages that will support fire growth leading to fire spread. This may tend to understate the contributions of major fuel packages like upholstered furniture and overstate the contributions of room linings like ceiling and wall coverings.

Events That Led to the Development of This Analytic Approach

In order to make it worthwhile to work through the technical complications, there needed to be a particular product type that was (a) known to account for a major share of the fire problem, (b) credibly suspected to also have a major role as a secondary major fuel, and (c) in the spotlight because of heightened national interest in new strategies for fire-safe design of the product or new information on the safety of old strategies. The two products that fit those descriptions best in recent years were mattresses (grouped with bedding) and upholstered furniture. For one thing, they are the products that have long ranked second and first in number of civilian deaths in home fires when ranked by product as item first ignited.

During the 2000s, test standards for mattresses were overhauled, but those discussions did not pursue quantification of the secondary fuel part of that fire problem. In part, this might have been because the U.S. was still converting to version 5.0 of NFIRS during the early part of this period, when the problem was framed, and the potential power of the new data element may not have been widely recognized.

The situation was different for upholstered furniture. A 2012 National Institute for Standards and Technology workshop on flaming residential upholstered furniture identified a need to fill out existing estimates of the upholstered furniture fire problem with estimates of fires where upholstered furniture’s role was that of the principal fuel package, not the first fuel package.

This article describes the methodology developed in response to that identified need and includes the results obtained when it was applied to upholstered furniture. The methodology can be applied to any product, and the author has begun using the method to develop more complete summaries of the total fire problem associated with various product classes, in support of periodic advocacy prioritization exercises and as input to the design of broadly effective fire risk reduction strategies for the whole fire problem associated with a target product class.
Estimating the Number of Fires with a Defined Item as Primary Contributor to Fire/Flame Spread

The Special Problem of Blanks

As suggested by the earlier description of unique technical complications, the development of this new analysis method primarily involved questions about how best to handle fires with missing data. More specifically, the central question was how best to handle fires where item contributing most to fire/flame spread was left blank. Under NFIRS rules, a blank can be recorded for any or all of four reasons. The first two of these reasons can be addressed fairly straightforwardly:

1) There was no “significant” fire/flame spread or (2) it was not possible to determine whether there was fire/flame spread. In keeping with the general principles of the established standard method, fires with unknown fire size can be proportionally allocated across the known fire sizes. Analysis can then be conducted on only those fire sizes that constitute “significant” fire/flame spread.

Some fire sizes clearly involve “significant” fire/flame spread (for example, not confined to floor of origin). Some fire sizes clearly do not (for example, fires confined to object of origin). Therefore, the analytical question is how to treat fire sizes in between these two extremes.

If the use of blanks for these intermediate-size fires closely resembles the use of blanks for one or the other of the two extremes of fire sizes, then there is an empirical basis for including or excluding these intermediate-size fires in the group of fires with “significant” fire/flame spread, based on the approach taken with the more extreme fire sizes that they resemble.

Using 2006-2010 NFIRS fire data for home fires (where home includes all housing units, including multi-family and manufactured home), the percentages blank and unknown are as follows, by extent of fire spread:

- Confined fires\(^1\) – 100% blank; 0% undetermined
- Confined to object of origin – 95% blank; 1% undetermined
- Beyond object but confined to room of origin – 62% blank; 4% undetermined
- Beyond room but confined to floor of origin – 59% blank; 7% undetermined
- Beyond floor but confined to building of origin – 63% blank; 9% undetermined
- Beyond building of origin – 62% blank; 11% undetermined

The last two groups (everything with fire spread at least beyond floor of origin) should be considered large enough to satisfy any definition of “significant” fire/flame spread. The first two groups (both confined to object of origin) just as clearly should not involve

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\(^1\) NFIRS Version 5.0 identified a new category of “confined fires” – confined to cooking vessel, chimney or flue, fuel burner or boiler, incinerator, compactor, or trash – and allows much less detailed reporting for such fires. In terms of fire size, these fires should all be confined to object of origin.

*Estimating Fires When a Product is the Primary Fuel But Not the First Fuel, With an Application to Upholstered Furniture*, 2/14

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“significant” fire/flame spread under any definition. In terms of percentage blanks, the middle two groups clearly resemble the last two groups closely and much more than they resemble the first two groups. Therefore, analysis should focus on the last four groups as all representing significant fire/flame spread. Any blanks reported for these fires should be assumed to involve one of the other two reasons allowed under NFIRS:

(3) The item contributing most to flame spread was the same as the item first ignited or (4) the type of item contributing most to flame spread was unknown. If the reason is #3, we want to identify those fires and separate them to avoid double-counting. If the reason is #4, we want to proportionally allocate those fires over the known items.

There is no direct way to check which of these situations applies, but it is possible to look at related statistical data. NFIRS uses the same list of items for recording of item first ignited and primary item contributing to fire/flame spread. Some of these items would not be expected to be present in sufficient quantity to contribute to fire/flame spread. Some other items are recognized as classic primary avenues of fire/flame spread or growth.

The two extreme forms of analysis are to assume that all blanks signify the same item as the item first ignited or that none of the blanks so signify. If all blanks signify item first ignited, then all blanks can be assigned values based on the item first ignited. If no blanks signify item first ignited, then all blanks can be treated as unknowns on primary item contributing to fire/flame spread and proportionally allocated over the knowns. In either case, it is possible to develop a distribution of items as primary items contributing to fire/flame spread, as shown in Table 1.

<table>
<thead>
<tr>
<th>Primary item contributing to fire/flame spread</th>
<th>If all blanks are treated as unknowns</th>
<th>If no blanks are treated as unknowns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural member or framing</td>
<td>17.9%</td>
<td>12.1%</td>
</tr>
<tr>
<td>Unclassified structural component</td>
<td>8.2%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Exterior wall covering</td>
<td>7.6%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Cooking materials</td>
<td>7.3%</td>
<td>9.1%</td>
</tr>
<tr>
<td>Interior wall covering</td>
<td>5.9%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Cabinetry</td>
<td>5.9%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Mattress or bedding</td>
<td>5.0%</td>
<td>4.6%</td>
</tr>
<tr>
<td>Upholstered furniture</td>
<td>4.0%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Unclassified furniture or utensil</td>
<td>3.3%</td>
<td>2.8%</td>
</tr>
<tr>
<td>Clothing</td>
<td>2.8%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Wire or cable insulation</td>
<td>1.8%</td>
<td>6.7%</td>
</tr>
</tbody>
</table>

Source: NFPA analysis of data reported to NFIRS and the NFPA survey.

The items with higher percentages in the right column – cooking materials, clothing, wire or cable insulation – are all items with insufficient mass to form a basis for fire/flame spread in most instances. The items with the higher percentages in the left column,
especially the items with the largest differences relative to the right column – structural member or framing, unclassified structural component, cabinetry, interior wall covering – are all items that are natural candidates as paths for fire/flame spread. This suggests – but does not conclusively demonstrate – that the more plausible analytical approach is to treat blanks as unknowns.

Overview of the Statistical Method

Here are the final steps in the statistical method, incorporating the decisions made above regarding the handling of unknowns and blanks when analyzing the number of fires involving an “item of interest” as the primary item contributing to fire/flame spread.

1) Develop estimates of fires and losses for each of the six fire sizes, including proportional allocation of fires with extent of fire/flame unknown or blank.

2) For each of the four fire size groups involving fire/flame spread beyond the object of origin, estimate the number of fires and associated losses with the item of interest coded as the primary item contributing to fire spread, including proportional allocation of unknown or blank entries for primary item contributing to fire spread.

3) To avoid double-counting, for each fire size, estimate the number of fires and associated losses with the item of interest coded as both item first ignited and primary item contributing to fire/flame spread, then remove these fires and losses from the final estimate of fires with item as primary item contributing to fire/flame spread.

There is a discretionary step involving the two smallest fire sizes, wherein fires are included if they are reported as involving the item of interest as primary item contributing to fire/flame spread, but there is no allocation of blanks and unknowns, which as noted earlier account for nearly all these fires. In the application to upholstered furniture, the two smaller fire sizes were included, which changed the estimates by at most 1%.

4) Sum the estimates from step 3, and the result is the desired combined estimate.

Application to Upholstered Furniture

As noted earlier, this new statistical method was developed to support more complete estimates of the fire problem associated with upholstered furniture. This section describes the results of applying the method to the upholstered furniture fire problem, and the associated implications for the overall size of that fire problem.

First, the method described in the previous section must be applied to NFIRS data on reported upholstered furniture home structure fires. This analysis used 2006-2010 data because that was the latest data available at the time. Table 2 summarizes the results of this
exercise and the estimates of reported fires and associated losses for upholstered furniture as primary item contributing to fire/flame spread.

### Table 2. Fires With Upholstered Furniture as Primary Contributor to Fire or Flame Spread But NOT as Item First Ignited

<table>
<thead>
<tr>
<th>Fire spread</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confined fire</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>US$0</td>
</tr>
<tr>
<td>Confined to object of origin</td>
<td>11</td>
<td>0</td>
<td>2</td>
<td>US$0</td>
</tr>
<tr>
<td>Confined to room of origin</td>
<td>944</td>
<td>41</td>
<td>101</td>
<td>US$28</td>
</tr>
<tr>
<td>Confined to floor of origin</td>
<td>369</td>
<td>17</td>
<td>41</td>
<td>US$23</td>
</tr>
<tr>
<td>Confined to building of origin</td>
<td>808</td>
<td>64</td>
<td>109</td>
<td>US$74</td>
</tr>
<tr>
<td>Beyond building of origin</td>
<td>85</td>
<td>8</td>
<td>21</td>
<td>US$14</td>
</tr>
<tr>
<td>Total</td>
<td>2,223</td>
<td>130</td>
<td>276</td>
<td>US$138</td>
</tr>
</tbody>
</table>

Source: NFPA analysis of data reported to NFIRS and the NFPA survey.

To provide some context, these fires represent a one-third addition to the fires, injuries and damages associated with fires beginning with ignition of upholstered furniture, as well as a one-quarter addition to the deaths.

The next step was to add these results to a statistical overview of the upholstered furniture fire problem, subdivided by major scenario. Most analyses of upholstered furniture fires and losses and most standard tests and regulations have treated the fire problem as involving two scenarios: (1) smoldering ignitions, typically by cigarettes or other smoking materials, and (2) small open flame ignitions, typically by lighting implements such as matches or lighters, with some recognition of ignitions by candles and ignition by persons intentionally starting a fire or by children playing with fire.

As part of the recent analysis of the major parts of the fire problem, two other scenarios defined by circumstances of ignition were identified: (3) ignition by operating equipment, where it is not clear whether the mode of heat transfer resembles smoldering ignition by a cigarette or open flame ignition by a small heat source, and (4) ignition by ember, ash, or other or unclassified hot or smoldering object, where again it is not clear whether the ignition process is well represented by the two traditional scenarios.
Table 3 provides an overview of the upholstered furniture fire problem, including the four ignition scenarios, the scenario of upholstered furniture as primary item contributing to fire spread but not item first ignited, and a sixth scenario for fires with no details on manner of ignition. Civilian deaths are highlighted and used to rank the six scenarios, because civilian deaths are by far the most important type of loss in discussions about fire risk and the need to reduce risks for particular products.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Fires (in Millions)</th>
<th>Civilian Deaths (in Millions)</th>
<th>Civilian Injuries (in Millions)</th>
<th>Direct Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighted tobacco product</td>
<td>1,900</td>
<td>270 (45%)</td>
<td>320 (29%)</td>
<td>$97 (17%)</td>
</tr>
<tr>
<td>Open flame from other fire</td>
<td>2,200</td>
<td>130 (21%)</td>
<td>280 (25%)</td>
<td>$138 (24%)</td>
</tr>
<tr>
<td>Operating equipment</td>
<td>1,500</td>
<td>70 (12%)</td>
<td>140 (13%)</td>
<td>$81 (14%)</td>
</tr>
<tr>
<td>Small open flame</td>
<td>1,400</td>
<td>60 (10%)</td>
<td>220 (20%)</td>
<td>$69 (12%)</td>
</tr>
<tr>
<td>Ember, ash or other or unclassified hot or smoldering object</td>
<td>1,300</td>
<td>60 (10%)</td>
<td>130 (11%)</td>
<td>$150 (27%)</td>
</tr>
<tr>
<td>Unclassified, other or multiple heat source</td>
<td>600</td>
<td>20 (3%)</td>
<td>30 (3%)</td>
<td>$31 (5%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8,900</strong></td>
<td><strong>610 (100%)</strong></td>
<td><strong>1,120 (100%)</strong></td>
<td><strong>$566 (100%)</strong></td>
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Source: NFPA analysis of data reported to NFIRS and the NFPA survey.

**Conclusions**

An analysis protocol has been developed, based on extension of established NFIRS national estimates procedures to the data element of item contributing most to fire spread. This protocol offers the opportunity to provide a more complete estimate of fires associated with products that are burnable items.

The new protocol has been applied to the case of upholstered furniture. It has also been applied to some unpublished estimates of fires involving other large fuel packages (e.g., mattresses and bedding), products that serve as avenues of fire spread (e.g., ceiling, wall or floor coverings), and concealed combustibles, which may be difficult or unlikely to ignite until fire from another burning item reaches them through the walls or other barriers that surround them (e.g., thermal insulation, structural elements). All such analyses have been
conducted in the context of prioritizing fire problems for attention by fire safety professionals, especially by strategic advocacy campaigns, and designing strategies to target the largest parts of targeted fire problems.

The implications of the application of this analysis to upholstered furniture should be clear. Strategies that would address the upholstered furniture fire problem solely by increasing resistance to ignition by lighted tobacco products can be seen to target only one-fifth of the fires and less than half of the fire deaths.

Fires involving fire spread to upholstered furniture from other items – the fires that were estimated using the procedure described in this article – represent the second leading fire scenario for fire deaths. Strategies to address such fires would need to test resistance to ignition by a much stronger heat source (representing another burning item) than the test fire used when evaluating resistance to ignition by small open flame. In fact, such strategies might need to abandon the goal of prevention through resistance to ignition in favor of a goal of mitigation through improved fire performance (e.g., slower fire growth, lower peak intensities).

Acknowledgements

Several people contributed to the work reported here. Marty Ahrens of NFPA provided extensive comments on the method and early drafts of this article, and she was the first person to include analysis of the “primary item contributing to fire/flame spread” data element in published analysis reports. Bill Pitts of the National Institute for Standards and Technology, and Alex Furr and Brad Pabody of USFA all provided valuable comments on the method, beginning at the NIST workshop that Bill convened and chaired and continuing to early written versions of the method and its application.

References

HOME FIRES THAT BEGAN WITH
UPHOLSTERED FURNITURE

Marty Ahrens
August 2011
HOME FIRES THAT BEGAN WITH UPHOLSTERED FURNITURE

Marty Ahrens
August 2011

National Fire Protection Association
Fire Analysis and Research Division
Abstract

Based on data from the U.S. Fire Administration’s (USFA’s) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association’s (NFPA’s) annual fire department experience survey, NFPA estimates that during 2005-2009, upholstered furniture was the item first ignited in an average of 7,040 reported home structure fires per year. (Homes include one- and two-family dwellings, apartments or other multiple family dwellings, and manufactured housing.) These fires caused an estimated annual average of 500 civilian deaths, 890 civilian injuries, and $442 million in direct property damage. Upholstered furniture is the leading item first ignited in home fire deaths. Although upholstered furniture fires started by smoking materials have fallen sharply since 1980, smoking materials remain the leading cause of these fires and associated losses.

Keywords: upholstered furniture; small open flame; fires; home fires, fire causes, fire statistics; smoking materials.

Acknowledgements

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA fire experience survey. These firefighters are the original sources of the detailed data that make this analysis possible. Their contributions allow us to estimate the size of the fire problem.

We are also grateful to the U.S. Fire Administration for its work in developing, coordinating, and maintaining NFIRS.

For more information about the National Fire Protection Association, visit www.nfpa.org or call 617-770-3000. To learn more about the One-Stop Data Shop go to www.nfpa.org/osds or call 617-984-7443.

Copies of this analysis are available from:

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Home Structure Fires that Began with Upholstered Furniture

In 2005-2009, U.S. fire departments responded to an average of 7,040 home structure fires per year in which upholstered furniture was the first item ignited. These fires caused an annual average of 500 civilian fire deaths, 890 civilian fire injuries, and $442 million in direct property damage.

On average, one of every 14 reported upholstered furniture fires resulted in death.

Overall, fires beginning with upholstered furniture accounted for 2% of reported home fires but one of every five (19%) home fire deaths.

Major Causes of Upholstered Furniture Fires

Smoking materials remain the leading cause of upholstered furniture fires and losses. One of every six such fires started by smoking materials resulted in death.

Portable and fixed space heaters were involved in 8% of the upholstered furniture fires and 7% of the associated deaths.

Operating equipment was the heat source in 22% of the fires and 15% of the deaths.

Together, candles, matches and lighters were involved in 21% of the fires and 12% of the deaths.

Electrical failures or malfunctions were factors in 14% of the home upholstered furniture fires and 10% of the deaths. These failures were in all types of electrical appliances, not just electrical distribution or lighting equipment.

Upholstered furniture fires started by smoking materials and associated deaths fell sharply since 1980. The declines in upholstered furniture fires started by candles, matches or lighters and by operating equipment were not as sharp. No clear trend was seen for upholstered furniture deaths from candles, matches and lighters or operating equipment.
NFPA’s Fire Safety Resources

NFPA’s wealth of fire-related research includes investigations of technically significant fire incidents, fire data analysis, and the Charles S. Morgan Technical Library, one of the most comprehensive fire literature collections in the world. In addition, NFPA’s Fire Protection Research Foundation is a source of independent fire test data. Find out more at: www.nfpa.org/research

Properly installed and maintained smoke alarms are necessary to provide a warning of any fire to all occupants. You can find out more information about smoke alarms here: NFPA Smoke Alarm Information

Home fire sprinkler systems provide even greater protection. These systems respond quickly to reduce the heat, flames, and smoke from a fire until help arrives. More information about home fire sprinklers may be found at www.firesprinklerinitiative.org

Simply put, smoke alarms and fire sprinklers save lives.

NFPA also develops, publishes, and disseminates more than 300 consensus codes and standards intended to minimize the possibility and effects of fire and other risks. Among these are:

**NFPA 101: Life Safety Code®**

**NFPA1: Fire Code**

**NFPA 260: Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components Upholstered Furniture**

For consumers: NFPA has consumer safety information regarding causes, escape planning, fire & safety equipment, and many other topics.

For Kids: Sparky.org has important information for kids delivered via fun games, activities, and cartoons.

For public educators: Resources on fire safety education programs, educational messaging, grants & awards, and many other topics.
During 2005-2009, upholstered furniture was the item first ignited in an average of 7,040 reported home structure fires per year. These fires caused an estimated annual average of 500 civilian deaths, 890 civilian injuries, and $442 million in direct property damage. Overall, fires beginning with upholstered furniture accounted for 2% of reported home fires but 19% of home fire deaths. These statistics were derived from the detailed information collected by the U.S. Fire Administration’s (USFA’s) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association’s (NFPA’s) annual fire department experience survey.

Upholstered furniture fires in the home environment have fallen sharply, dropping 84% from a high of 36,900 in 1980, the first year of usable data, to a 30-year low of 5,900 in 2009. Even with a 67% drop in the number of associated deaths from highs of 1,360 in 1980 and 1981 to a low of 450 in 2009, upholstered furniture remains the leading item first ignited in home fire deaths. During 2005-2009, upholstered furniture was the item first ignited in 2% of reported home fires. These incidents caused one of every five (19%) home fire deaths.

Smoking materials remain the leading heat source in upholstered furniture fires and associated deaths although their share has fallen dramatically over time. In the early 1980s, almost two-thirds (59-64% in 1980-1984) of home upholstered furniture fires were ignited by smoking materials. These fires caused more than three-quarters (77-82%) of the associated death. During 2005-2009, in contrast, smoking materials caused roughly one-quarter (28%) of the upholstered furniture fires and three of every five (58%) associated deaths. In 2008 and 2009, the two most recent years of available data, only half (49-50%) of the home upholstered furniture deaths resulted from fires started by smoking materials.

More than half (53%) of the victims of upholstered furniture fires started by smoking materials in 2005-2009 were in the area of origin and involved in the ignition. An additional 11% were in the area but not involved.

In 1980-1984, candles, lighters or matches caused almost one of every five (17-19%) upholstered furniture fires and 6-16% of the associated deaths. In 2005-2009, candles (10% of the fires and 6% of the deaths), lighters (8% of the fires and 5% of the deaths), and matches (3% of the fires and 1% of the deaths) together caused more than one in five (22%) upholstered furniture fires and 12% of the associated deaths. Someone playing with the candle, lighter or match was a factor in roughly one-third of these small open flame ignitions and associated deaths. In almost one-third of these ignitions, the candle, lighter or match was too close to something that could catch fire. This would be more common with candles than the other two open flames.
Roughly one-quarter of the small open flame ignitions were intentionally set. However, playing with heat source was a contributing factor in most of these intentional fires.

Almost half (46%) of the victims of upholstered furniture fires started by candles, lighters or matches were in the area of origin and involved in ignition. An additional 12% were in the area but not involved.

In 1980-1984, operating equipment caused 13-16% of these fires and 3-9% of the associated deaths. In 2005-2009, operating equipment caused 22% of the home upholstered furniture fires and 15% of the associated deaths. Electrical distribution or lighting equipment was involved in more than one-third of these operating equipment fires and three out of five associated deaths (9% of all home upholstered furniture fires and 11% of the deaths). Cords or plugs were the leading type of equipment involved in upholstered furniture deaths. Heating equipment was involved in roughly one-third of the operating equipment fires and associated deaths (9% of all home upholstered furniture fires and 7% of the associated deaths), with fixed or portable space heaters, including wood stoves, accounting for the majority of heating equipment involved.

Only 19% of the victims of operating equipment fires were in the area of origin and involved in ignition. An additional 8% were in the area but not involved.

Hot embers or ashes caused 10% of the upholstered furniture fires and resulting deaths. Sleep was a factor in 12% of the ignitions and 28% of the associated deaths.

Assessing the probable impact of any one approach to fire safety is challenging. New materials enter the marketplace. Upholstered furniture is a durable product. New furniture is likely to meet current flammability standards. Over time, things get spilled on the furniture, the fabric may wear out, and the furniture may pass to a different household. It is important to remember that these statistics are based on all upholstered furniture, some of which may be very old.

Changes in the environment also complicate the issue. Homes are much more likely to have smoke alarms today than they were in 1980. This means that more fires may be discovered before fire department assistance is required. The Consumer Product Safety Commission (CPSC) required lighters to be child-resistant beginning in 1994, resulting in a drop in fires started by children playing. The increase in candle sales in the 1990s was accompanied by an increase in candle fires. Laws requiring “fire-safe” cigarettes that extinguish when not inhaled have been passed, and as of July 1, 2011, are in effect in all 50 states. Home fire sprinklers can control a fire until the fire department arrives. More information about home fire sprinklers is available at firesprinklerinitiative.org.
Safety Tips

- If you smoke, smoke outside. Be careful when smoking around upholstered furniture. Use large, deep, sturdy ashtrays and do not rest them on a sofa or chair. When lighting cigars, pipes, or cigarettes, make sure sparks from matches do not land on the couch or chair. In addition, whenever there has been smoking in a room, check under cushions and in cracks for discarded butts before going to bed or leaving the home. If you smoke, only smoke when you feel alert. Do not smoke when drowsy, intoxicated or medicated. Never smoke where medical oxygen is used.

- Cigarette ignition-resistant upholstered furniture is more common now, but be aware of potential higher fire risk when purchasing antique or used furniture.

- Keep heaters and upholstered furniture at least three feet (1 meter) away from each other. See the manufacturer’s instructions for how to operate and install the appliance safely.

- Do not place furniture near a fireplace or wood stove. Leave adequate space for ventilation. The furniture should be at least three feet (1 meter) away from a heat source.

- Eight percent of upholstered furniture fires were begun by someone, usually a child, playing with fire. Keep matches and lighters up high, out of the reach of children, preferably in a locked cabinet. Encourage children to tell an adult when they find matches and lighters.

- Extinguish all candles when leaving the room or going to sleep. Make sure candles are placed on a stable piece of furniture in sturdy holders that won’t tip over.

- Avoid putting cords against or under furniture.

For safety tip sheets on a variety of topics, go to [www.nfpa.org/safetytips](http://www.nfpa.org/safetytips). For all EMAC tips, go to [www.nfpa.org/emac](http://www.nfpa.org/emac).
Home Fires Beginning with Upholstered Furniture

On average, 7,040 home structure fires began with upholstered furniture each year.
During the five-year period of 2005-2009, upholstered furniture was the item first ignited in an estimated average of 7,040 reported home structure fires per year. These fires caused an annual average of 500 civilian deaths, 890 civilian fire injuries, and $442 million in direct property damage. On average, one of every 14 reported upholstered furniture fires resulted in death.

Upholstered furniture plays two major roles in fire scenarios. It may either be the item first ignited, or it may contribute substantially to the growth of a fire that began with the ignition of something else, such as a newspaper, blanket, or trash. This report focuses primarily on the first as the only data available on secondary fuel sources relates to the material contributing most to flame spread.

One of every five home structure fire deaths resulted from fires that began with upholstered furniture.
During 2005-2009, U.S. fire departments responded to an estimated average of 373,900 home structure fires per year. These incidents caused an average of 2,650 civilian deaths, 12,890 reported civilian fire injuries, and $7.1 billion in direct property loss per year. The 7,040 fires that began with upholstered furniture accounted for an average of 2% of the reported home structure fires, 19% of the home civilian structure fire deaths, 7% of the civilian structure fire injuries, and 6% of the structure fire direct property loss per year. Although upholstered furniture was the 15th most common item first ignited in reported home fires, it was the leading item first ignited in home fire deaths.2

Trends

Since 1980, these structure fires fell 84%.
As shown in Table 1 and Figure 1, home structure fires beginning with upholstered furniture fell 84% from a high of 36,900 in 1980 to 5,900 in 2009, the lowest point in the 30 years of data. This is a much larger decrease than the 51% drop seen for total home structure fires over the same period. From 2008 to 2009, upholstered furniture fires fell 13% while total home fires fell only 6%.

Details collected in NFIRS 5.0 were used to derive the estimates from 1999 on. Due to the small portion of fires originally collected in NFIRS 5.0 during 1999-2001, estimates for these years are omitted from the trend graphs.

1 Homes include one- and two-family dwellings, manufactured housing, apartments, tenements, flats, townhouses and row houses, regardless of ownership. The term “civilian” describe anyone who is not part of the fire service.
Upholstered furniture fire deaths declined sharply in the 1980s, then leveled off.
Deaths resulting from home structure fires beginning with upholstered furniture were at their highest in 1980 and 1981, with an estimated 1,360 such deaths both years. Figure 2 shows that deaths hit a plateau in the 1990s at roughly half the 1980 and 1981 highs. The 450 death toll reported in 2009 is 67% lower than the highs in 1980 and 1981 and 8% lower than in 2008. The solid line shows the five-year rolling average, with the first point above 1982, showing the average for 1980-1984 while the last point, above 2007, shows the 2004-2009 average. Averages including the years 1999, 2000, and 2001 are not shown.

Civilian fire deaths from all home structure fires fell 51% from 1980 to 2009 and 7% from 2008 to 2009.
Methodology

Statistics are derived from NFIRS and NFPA’s annual fire department survey. Unless otherwise specified, the statistics in this analysis are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. These estimates are projections based on the detailed information collected in Version 5.0 of the U.S. Fire Administration’s National Fire Incident Reporting System (NFIRS 5.0) and the National Fire Protection Association’s (NFPA’s) annual fire department experience survey. Earlier versions of NFIRS were used to calculate estimates for 1980-1998.

Upholstered furniture was identified by NFIRS item first ignited code 21, which captures upholstered sofas, chairs, and vehicle seats. Structure fires were identified by NFIRS incident types in the 110-129 series and homes were identified by NFIRS property use codes 419 and 429. In the analysis that follows, fires and losses with missing or unknown data were generally allocated proportionally among fires with known data.

NFIRS 5.0 includes six categories of confined structure fires, identified by incident types 113-118. These include cooking fires confined to the cooking vessel, confined chimney or flue fires, confined incinerator fires, confined fuel burner or boiler fires or delayed ignitions, confined commercial compactor fires, and trash or rubbish fires in a structure with no flame damage to the structure or contents. Little more than basic dispatch data and property use is required by the NFIRS 5.0 system for these fires, although full reports are sometimes completed. Other types of structure fires are described as non-confined fires, regardless of the extent of flame damage. Confined fires are included in the estimates of total upholstered furniture fires and overall trends, but due to the small number of fires with known data, excluded from further analysis. For more details on the methodology used, see Appendix A. Tables supporting the text are provided at the end of this analysis.

Rounding
It is important to remember that the statistics presented are estimates, not actual counts. Rounding is a reminder that the estimates are not precise. However, less rounding was sometimes needed to avoid having too many entries of zero. Property damage was always rounded to the nearest million, and except for trend tables, was not adjusted for inflation. In trend tables, fires were rounded to the nearest hundred. Fires were rounded to the nearest ten in all non-trend tables. Civilian deaths and injuries were rounded to the nearest ten in tables on upholstered furniture fires in general and on trends by different heat sources or groups of heat sources. Casualty estimates were rounded to the nearest one on tables showing 2005-2009 averages of details about specific heat sources or groups of heat sources.

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Causes and Circumstances of Home Upholstered Furniture Fires

Not surprisingly, the vast majority of upholstered furniture fires began with fabric. Table 2 shows that fabric, fiber or finished goods made of cotton, blends, rayon, or wool was the type of material first ignited in roughly three-quarters of home structure fires that began with upholstered furniture. The share was similar of the associated losses. In 14% of the fires and 15% of the deaths, unclassified fabric, textile, or fur was first ignited.

More than half of upholstered furniture fire deaths resulted from fires in the living room, family room, or den. Table 3 shows that 39% of these fires started in the living room, family room, or den. These fires caused 56% of the associated civilian deaths, 51% of the civilian injuries, and 32% of the direct property damage. Roughly one-fifth to one-quarter of the fires and associated losses began in an unclassified function area. The 15% that started in a bedroom caused 9% of the deaths.

On average, 2,260 upholstered furniture fires per year were outside or unclassified fires or began on the structure’s exterior. In 2005-2009, an annual average of 1,860 fires on home properties began with upholstered furniture and had incident types identifying the fire as outside or unclassified. In addition, an average of 400 home structure fires per year began in outside or open spaces. Table 3 shows that an annual average of 180 (3%) began on exterior balconies or unenclosed porches; 80 (1%) began on a courtyard, terrace or patio; 60 began at an exterior wall; 50 (1%) started in an unclassified outside area. (Only areas accounting for at least 1% of the fires are shown in the table.) Combined, these 2,260 fires caused an average of two civilian deaths, 42 civilian injuries, and $28 million in direct property damage per year. Such furniture may have been purchased specifically for porch use or old furniture may have been relegated there. The remainder of the analysis focuses on structure fires only.

Confined fires were omitted from rest of analysis
Only non-confined fires were included in the analysis of fire causes and circumstances. During 2005-2009, an average of 6,760 fires with non-confined fire incident types began with upholstered furniture per year, resulting in an average of 500 civilian deaths 890 civilian injuries, and $442 million in direct property damage. Non-confined fires accounted for 96% of reported upholstered furniture fires and 100% of the associated losses. An estimated average of 280 fires with confined fire incident types began with upholstered furniture per year, resulting in an average of two injuries and roughly $40,000 in direct property damage annually. Confined fires were omitted from the following analyses. See the previous box and Appendix A for more details about confined fires.

Causes and Circumstances of Home Upholstered Furniture Fires
Flame damage was limited to the room of origin in almost one-third of home upholstered furniture fire deaths. Figure 3 and Table 4 show that that in more than half (57%) of home structure fires that began with upholstered furniture, flame damage was confined to the object or room of origin. These fires caused one-third (31%) of the associated deaths.

**Figure 3. Home Structure Fires that Began with Upholstered Furniture**

By Extent of Flame Damage: 2005-2009

<table>
<thead>
<tr>
<th>Extent of Flame Damage</th>
<th>2005-2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confined to object of origin</td>
<td>24%</td>
</tr>
<tr>
<td>Confined to room of origin</td>
<td>25%</td>
</tr>
<tr>
<td>Confined to floor of origin</td>
<td>15%</td>
</tr>
<tr>
<td>Confined to building of origin</td>
<td>28%</td>
</tr>
<tr>
<td>Beyond building of origin</td>
<td>3%</td>
</tr>
</tbody>
</table>

Source: NFIRS and NFPA survey.

**Smoking materials are the leading cause of upholstered furniture fires and associated losses.** Smoking materials have historically caused the largest number of upholstered furniture fires and associated losses. This was still the case in 2005-2009. Smoking materials were the heat source in an average of 1,870, or 28%, of the home structure fires that began with upholstered furniture per year. These fires resulted in an annual average of 290 (58%) civilian deaths, 340 (38%) of the civilian injuries, and $104 million (24%) in direct property damage. Smoking materials include cigarettes, cigars or pipes, and undetermined smoking material.4 Matches and lighters are not included in this category. Upholstered furniture fires started by smoking materials are examined in more detail later in this report.

Table 5 and Figure 4 show the leading causes of home structure fires that began with upholstered furniture with data summarized from several NFIRS fields. In some cases, the equipment involved in ignition is most relevant; heat source, the field “cause” (as opposed to this summary of “major causes” from multiple fields) and factor contributing to ignition also provide relevant information. The causal factors shown in this graph are not mutually exclusive when they have been pulled from different fields. When some type of equipment is shown as a cause, it means the equipment was involved in the ignition. It need not mean that the equipment was defective or malfunctioned. In many cases, the equipment was used improperly. See Appendix B for details on how the different categories were calculated.

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4 Estimates for smoking materials, candles, matches and lighters include a proportional source of fires and losses with heat source code 60 “heat from open flame or smoking materials, other.”
Thirteen percent of the home upholstered fires were intentionally set.
On average, 900 (13%) of the home upholstered furniture fires were intentionally set per year. These incidents caused an average of 30 (6%) of the associated civilian deaths, 70 (8%) of the civilian injuries, and $39 million (9%) in direct property damage.

Candles started 10% of these fires.
Candles were the heat source in an average of 710 (10%) home upholstered furniture fires per year, resulting in an average of 30 (6%) civilian deaths, 110 (12%) of the civilian injuries, and $43 million (10%) in direct property damage per year.

Hot embers or ashes also started 10% of these fires.
Hot embers or ashes were the heat source in an average of 660 (10%) home upholstered furniture fires per year, resulting in an average of 30 (7%) civilian deaths, 80 (10%) of the civilian injuries, and $29 million (6%) in direct property damage per year. The source of these embers or ashes is not specified. This issue is discussed in greater detail later in Appendix C.

Portable or fixed space heaters were involved in 7% of the home upholstered furniture fire deaths.
Heating equipment was involved in an estimated average of 640 (9%) home upholstered furniture fires per year. These fires caused an average of 40 (7%) civilian deaths, 50 (6%) civilian injuries, and $27 million (6%) in direct property damage. Portable and fixed space
heaters, including wood stoves, were the most common type of heating equipment involved. These heaters were involved in an annual average of 560 (8%) upholstered furniture fires, resulting in an average of 40 (7%) of the associated deaths, as well as 40 (5%) injuries.

**Electrical distribution or lighting equipment was involved in 9% of the home upholstered furniture fires.**

Electrical distribution or lighting equipment was involved in an annual average of 630 (9%) reported home fires that began with upholstered furniture. These fires caused an average of 50 (11%) civilian deaths, 90 (10%) civilian injuries, and $25 million (6%) in direct property damage. Lamps and other lighting equipment were involved in an average of 200 fires per year and 20 deaths per year. Cords and plugs accounted were involved in an average of 160 of these fires and 40 of the associated deaths per year. Fixed wiring and related equipment was involved in 240 such incidents per year.

**Someone playing with fire started 8% of the home upholstered furniture fires.**

Someone, typically a child, playing with fire or other heat source started an average of 520 (8%) home upholstered furniture fires per year. These fires caused an average of 20 (5%) civilian deaths, 80 (9%) civilian injuries, and $23 million (5%) in direct property damage per year. As mentioned earlier, factors from different fields overlap. Forty-percent of the upholstered furniture fires started by playing were intentionally set.

**Specific Causal Factors**

The previous discussion focused on causal factors that by themselves almost describe general scenarios. In this part of the report, results from specific NFIRS causal data elements are examined. The broad categories of cause of ignition, a field in NFIRS, are shown in Table 6. Factors contributing to ignition are shown in Table 7 and human factors contributing to ignition are shown in Table 8. Table 9 provides more information on heat sources while more detailed information on equipment involved in ignition may be found in Table 10.

**Abandoned or discarded material was the leading factor contributing to ignition.**

The field “factor contributing to ignition” explains how the heat source interacted with the fuel source to start a fire. Figure 5 and Table 7 show that the leading factor for home upholstered furniture fires was abandoned or discarded material or products. The NFIRS Complete Reference Guide notes that this “Includes discarded cigarettes, cigars, tobacco, embers, hot ashes, or other burning matter.” It “excludes outside fires left unattended.”

Upholstered furniture was too close to a heat source such as a candle or heater in roughly one-fifth of the fires and deaths. Electrical failures or malfunctions from all types of equipment powered by electricity, not just electrical distribution or lighting equipment, were factors in 14% of home structure fires that began with upholstered furniture per year as well as 10% of the associated civilian deaths.
Sleep was a factor in 12% of the upholstered furniture fires and 28% of the associated deaths.

Figure 6 and Table 8 show that sleep was a human factor contributing to ignition in 12% of these fires and roughly one-quarter of the associated death and injuries. An unattended or unsupervised person was a factor in 10% of these fires.
A related field on the NFIRS Civilian Casualty Report collects data about human factors contributing to injury. In his 2011 report, Human Factors Contributing to Fatal Injury, Ben Evarts showed that upholstered furniture was the item first ignited in one-quarter (26%) of the home fire deaths in which a possible impairment by alcohol or drugs played a role. His findings are shown in Figure 7.

**Figure 7. Percent of Specific Human Factors Contributing to Fatal Home Fire Injuries in which Upholstered Furniture was the Item First Ignited: 2005-2009**

- Possibly impaired by alcohol or drugs: 26%
- Asleep: 23%
- Unattended or unsupervised child under 10: 20%
- Physically disabled: 18%
- Possibly mentally disabled: 16%
- No human factor: 19%
- All victims: 19%

Source: Evarts, 2011.

**A wide variety of heat sources started these fires.**

Figure 8 and Table 9 show that a wide variety of heat sources are involved in home upholstered furniture fires. Smoking materials, candles, and hot embers or ashes, the three leading heat sources, were discussed earlier.

**Figure 8. Home Structure Fires that Began with Upholstered Furniture by Leading Heat Sources: 2005-2009**

- Smoking materials: 24% (Fires), 38% (Civilian deaths), 22% (Civilian injuries), 5% (Property damage)
- Candle: 10% (Fires), 12% (Civilian deaths), 10% (Civilian injuries), 8% (Property damage)
- Hot ember or ash: 10% (Fires), 10% (Civilian deaths), 10% (Civilian injuries), 8% (Property damage)
- Unclassified hot or smoldering object: 9% (Fires), 10% (Civilian deaths), 10% (Civilian injuries), 8% (Property damage)
- Arcing: 6% (Fires), 7% (Civilian deaths), 7% (Civilian injuries), 6% (Property damage)
- Radiated or conducted heat from operating equipment: 6% (Fires), 8% (Civilian deaths), 12% (Civilian injuries), 6% (Property damage)
- Lighter: 6% (Fires), 6% (Civilian deaths), 5% (Civilian injuries), 4% (Property damage)
- Unclassified heat from powered equipment: 4% (Fires), 3% (Civilian deaths), 2% (Civilian injuries), 4% (Property damage)
- Unclassified heat source: 3% (Fires), 2% (Civilian deaths), 2% (Civilian injuries), 5% (Property damage)
- Match: 3% (Fires), 2% (Civilian deaths), 2% (Civilian injuries), 2% (Property damage)

Source: NFIRS 5.0 and NFPA survey.
Small open flames (candles, lighters, and matches) started 22% of the fires that resulted in 12% of the deaths. Operating equipment, including: arcing equipment; radiated or conducted heat from operating equipment; spark, ember or flame from operating equipment; and unclassified heat from powered equipment; together caused 22% of the fires and 17% of the deaths. Both categories are discussed in greater detail in the next section.

Upholstered Furniture Fires Started by: Smoking Materials; Candles, Matches or Lighters; and Operating Equipment

Fires and associated losses can be prevented in a variety of ways. The furniture can be made harder to ignite or it can be modified so that if it does ignite, it does not release as much heat or toxic fumes. Heat sources can be modified to reduce the likelihood of ignition, as was done with the „fire-safe” cigarette. Behavioral changes, such as limiting smoking, can reduce the likelihood that the heat source will come in contact with the furniture. Existing and proposed flammability requirements for upholstered furniture focus on fires started by either smoking materials or small open flames. This part of the analysis focuses on the circumstances of fires started by three categories of heat sources: smoking materials; candles, matches or lighters (small open flames); and operating equipment. Trends for fires and deaths, respectively, for these heat sources are shown in Tables 11 and 12. Because the number and percentage of upholstered furniture fires started by embers or ashes has increased markedly since the introduction of NFIRS 5.0 in 1999, these have been included in the trend tables. Additional information on upholstered furniture fires started by hot embers or ashes is provided in Appendix C. Tables 13-16 show fire and associated loss trends for each of the four heat source categories.

When considering the impact of new approaches to fire safety, it is important to consider how long it will take for new requirements to be widely adopted. In a 2006 report, CPSC’s Charles Smith noted that discussions with officials from the upholstered furniture industry and the Department of Commerce reported that a piece of upholstered furniture is expected to last about 16 years.⁵ Note that this is an average and that some households have furniture that is much older. Second hand furniture may also be older.

As noted earlier, the 1,870 home upholstered furniture fires started by smoking materials per year resulted in an annual average of 291 deaths in 2005-2009. On average, one of every six such fires resulted in death.

Candles, lighters, and matches started an estimated average of 1,450 home upholstered

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Sixteen times as many upholstered furniture fires were started by smoking materials in 1980 as in 2009.

Figure 9 and Table 14 show that home upholstered furniture fires started by smoking materials fell 94% from a high of 23,300 in 1980 to a low of 1,500 in 2009. In the early 1980s, smoking equipment started almost two-thirds of these fires. In more recent years, smoking materials caused slightly more than one-quarter of these fires. Several factors played a role in this decrease.

**Figure 9. Home Upholstered Furniture Fires Started by:**
Smoking Materials; Candles, Lighters, or Matches; and Operating Equipment; by Year

Source: NFIRS and NFPA survey.
The Upholstered Furniture Action Council (UFAC) developed voluntary flammability standards to prevent cigarette ignitions of the product. Vytenis Babrauskas noted that beginning in the early 1980s, a hangtag on the product told consumers that the item was manufactured according to these standards. Babrauskas also cited a Consumer Product Safety Commission (CPSC) report noting that that 86% of the furniture being sold in the retail market by the mid-1990s met these requirements and that there was an 85% probability that a cigarette placed on furniture from that period would not ignite.\footnote{ Vytenis Babrauskas. “Upholstered Furniture and Mattresses,” Fire Protection Handbook®, 20th Edition, Quincy, MA: National Fire Protection Association, 2008, Section 6, Chapter 6.}

Roughly one-third of the adult population smoked in 1979. From 1990 to 2000, roughly one-quarter smoked, while in recent years, one in five adults were current smokers.\footnote{ National Center for Health Statistics. Table 58. “Current Cigarette Smoking among Adults 18 Years of Age and Over, by Sex, Race, and Age: United States, Selected Years, 1965-2009,” Health, United States, 2010, with Special Feature on Death and Dying, Hyattsville, MD. 2011. Online at \url{http://www.cdc.gov/nchs/data/hus/hus10.pdf#listtables}.}

CPSC”s Charles Smith also noted that upholstered furniture coverings varied over time. Thermoplastics, such as polyester, polyolefin, and nylon, are less prone to cigarette ignition than celluloseics, such as cotton and rayon. He also noted that in 1999-2002, roughly half of the upholstered furniture in use had thermoplastic upholstery, roughly one-third had celluloseic upholstery, and 16% had leather, wool, or vinyl-coated upholstery. The limited laboratory data indicated that leather, wool, and vinyl-coated fabrics were more resistant to cigarette ignition. He cited survey data indicating that leather had increased to about 30% of the upholstered furniture manufactured in 2001.\footnote{ Smith, 2006, p. 21, 32.}

Legislation requiring cigarettes to self-extinguish when not inhaled has been passed in all 50 states. New York was the first state to pass this legislation at the end of 2003 with an effective date of June 28, 2004. As of July 1, 2011, the requirements are in effect in all 50 states and the District of Columbia.\footnote{ Coalition for Fire-Safe Cigarettes. “States that Have Passed Fire-Safe Cigarette Laws,” accessed August 23, 2011.}

Table 15 shows that home upholstered furniture fires started by candles, lighters, or matches fell 84% from a high of 6,900 in 1980 to a low of 1,100 in 2009. Over the years, fires started by these small open flames have generally accounted for one-fifth to one-quarter of the upholstered furniture fires. It is worth noting that home candle fires increased through the 1990s before falling in the early 2000s,\footnote{ Marty Ahrens. Home Candle Fires, Quincy, MA: NFPA, 2010.} while fires and associated losses from children playing with fire declined sharply after CPSC set a mandatory standard for child-resistant lighters. Interestingly, reductions were seen in fires started by both matches and lighters in 1994.\footnote{ John R. Hall, Jr. Children Playing with Fire, Quincy, MA: NFPA, 2010.} CPSC developed a draft flammability standard to address small open flame ignitions of upholstered furniture in 2001 and a second draft standard to address both cigarette and small open flame ignitions. The latter is described in detail in Smith”s 2006 CPSC report.\footnote{ Smith, 2006.}
Table 16 shows that upholstered furniture fires started by operating equipment fell 72% from a high of 4,700 in 1980 to a low of 1,400 in 2009. In 1980 and 1981, roughly one of every eight upholstered furniture fires was started by operating equipment. This increased to one in four in recent years.

Figure 10 shows that the 220 deaths resulting from home upholstered furniture fires started by smoking materials in 2009 was 79% lower than the 1,060 such deaths in 1980. No clear pattern is seen for deaths resulting from upholstered furniture fires started by candles, lighters, or matches or by operating equipment. However, the number of these deaths is much lower than the number from smoking materials.

**Figure 10. Civilian Deaths Resulting from Home Upholstered Furniture Fires Started by Smoking Materials; Candles, Lighters, or Matches; and Operating Equipment; by Year**

Time patterns differ by heat source.

Figure 11 shows that upholstered furniture fires started by smoking materials were more common late at night and in the early morning, while fires started by candles, lighters, or matches and by operating equipment were less common during those hours.

**Figure 11. Home Upholstered Furniture Fires Started by Smoking Materials; Candles, Lighters, or Matches; and Operating Equipment; by Time of Alarm: 2005-2009**
Fatal fire injuries from upholstered furniture fires started by smoking materials peaked between 9:00 p.m. and midnight while the period from midnight to 3:00 a.m. ranked second. Figure 12 shows that deaths from upholstered furniture fires started by candles, lighters, or matches were most common in fires reported between 9:00 a.m. and noon and fatal injuries from fires started by operating equipment peaked between 3:00 and 6:00 a.m.

One-third of smoking material deaths from upholstered furniture fires resulted from fires with flame damage limited to the room of origin.

Tables 17-19 show that upholstered furniture fires started by smoking materials were more likely to have been confined to the object or room of origin (64%) than were fires started by candles, lighters or matches (59%), or fires started by operating equipment (56%). Figure 13 shows that flame damage was confined to the object or room of origin in 35% of the deaths from upholstered furniture fires started by smoking materials compared to only 17% of the deaths resulting from fires started by candles, lighters or matches and 27% of the deaths from fires started by operating equipment.
Causal Factors Vary by Heat Source.

Smoking materials
Table 20 shows that abandoned or discarded materials or products were contributing factors in almost two-thirds (63%) of the home upholstered furniture fires started by smoking materials. Eighteen percent of these fires and 12% of the deaths resulted from an unclassified misuse of material or product. The smoking materials were too close to the furniture in 13% of the fires and 17% of the associated deaths.

Table 21 shows that sleep was a factor in one-quarter (24%) of these ignitions that resulted in 29% of the deaths and 35% of the injuries. A possible impairment by alcohol or drugs was a factor in 15% of these fires and 25% of the associated deaths. Physical disability was a factor in 2% of the fires and 13% of the resulting deaths. Human factors contributing to fatal fire injury are discussed later in this section.

Candles, lighters, or matches
Table 22 shows that one-quarter (25%) of the upholstered furniture fires started by candles, lighters or matches were intentionally set. These fires caused 23% of the associated deaths and 18% of the injuries. However, playing with a heat source was a contributing factor in 61% of these intentional fires and 71% of the associated intentional deaths.

Overall, playing was a factor in one-third (33%) of the upholstered furniture fires started by candles, lighters or matches as well as one-third of the associated deaths (31%) and injuries (35%). Table 23 shows that the candle, lighter or match was too close to the furniture in 29% of these small open flame fires, 31% of the associated deaths, and 35% of the injuries. An unclassified misuse of material or product was a factor in 13% of the fires, and abandoned or discarded materials or products played a role in 11%.

Human factors contributing to ignition are consistent with the large share of fires started by playing with fire. Table 24 shows that an unattended or unsupervised person was a factor in 21% of the fires, 12% of the deaths, and 18% of the injuries. Age was a factor in 19% of the fires, 31% of the deaths, and 43% of the injuries. Sleep contributed to 8% of these fires that resulted in 23% of the associated deaths and 14% of the injuries.

Operating equipment
The types of equipment that ignited upholstered furniture in non-confined home fires in which the heat source was operating equipment are shown in Table 25. Electrical distribution or lighting equipment was involved in 37% of the operating equipment fires, 59% of the associated deaths, and 51% of the injuries. While fixed wiring or related equipment was involved in 14% of operating equipment fires, no deaths were reported from wiring. Lamps, bulbs or lighting were involved in 11% of these fires and 18% of the associated deaths. Cords or plugs were involved in 10% of these fires but 41% of these deaths. Extension cords were the most common type of cord or plug involved. Overall, cords or plugs were the leading type of operating equipment involved in upholstered furniture deaths from operating equipment.
Heating equipment was also involved in 37% of these operating equipment fires, 34% of the associated deaths and 30% of the associated injuries. Portable or fixed space heaters, including wood stoves, accounted for 34% of the operating equipment fires and deaths, as well as 23% of the associated injuries.

The leading factors contributing to ignition are consistent with the equipment involved in ignition. Table 26 shows that electrical failures or malfunctions were factors in roughly half of the upholstered furniture fires started by operating equipment, including 48% of the fires, 58% of the deaths and injuries, and 53% of the direct property damage. The equipment was too close to the furniture in one-third (33%) of the fires, 22% of the deaths and 29% of the injuries.

Table 27 shows that human factors played less of a role than in the fires started by smoking materials or candles, lighters or matches. Sleep was a factor in 7% of the operating equipment fires and 35% of the associated deaths.

Half of those fatally injured in upholstered fires started by smoking materials were in the area or origin and involved in ignition.

Figure 12 shows that the 53% victims of fatal upholstered furniture fires started by smoking materials were both in the area of origin and involved in ignition. An additional 11% were in the area but not involved. The pattern was similar but slightly less pronounced among the victims of fires started by candles, lighters, and matches, with 46% of the victims in the area and involved in ignition. The situation was reversed for fires started by operating equipment. Half (51%) of these victims were not in the area of origin and not involved. An additional 22% were outside the area of origin when the fire started but involved in ignition.

Victims of fires started by smoking materials were more likely to have had other factors that made escape less likely.

Selected human factors contributing to the fatal fire injury are shown in Figure 15. More than one-quarter (28%) of the victims of upholstered furniture fires started by smoking materials were
possibly impaired by alcohol, while one in five (20%) had some type of physical disability. An additional 8% were unconscious. These factors make it much less likely that someone could react quickly to a sounding alarm or even a fire developing in the furniture he or she was sitting or lying on.

**Figure 15. Home Upholstered Furniture Fire Deaths Started by Smoking Materials; Candles, Lighters, or Matches; and Operating Equipment; by Human Factors Contributing to Fatal Injury: 2005-2009**

Source: NFIRS 5.0 and NFPA survey.

**Upholstered Furniture’s Contribution to Flame Spread**

Upholstered furniture ranked second in item contributing most to flame spread for fire deaths resulting from fires that spread beyond the room of origin.

Upholstered furniture is often the largest item in the room and as such can be a secondary fuel source for fires that began in a nearby wastebasket, with clothing, trash, newspapers, etc.

NFPA’s report, *Home Structure Fires*, showed that during 2005-2009, upholstered furniture was the item contributing most to flame spread in annual averages of:

- 4,000 (5%) of the 88,600 fires per year that spread beyond the room of origin,
- 320 (15%) of the 2,080 associated deaths,
- 580 (10%) of the 65,680 associated civilian injuries, and
- $257 million of the $5.9 billion of associated direct property damage.13

When the item first ignited was upholstered furniture, the item contributing most to flame spread beyond the room of origin was also upholstered furniture in annual averages of:

- 1,800, or 62%, of the 1,900 fires,
- 220, or 64%, of the 350 deaths,
- 310, or 64%, of the 470 injuries, and
- $142 million, or 51%, of the $279 million in direct property damage.

When the item contributing most to flame spread was upholstered furniture, the item first ignited was upholstered furniture in two-thirds (66%) of the fires and injuries, three-quarters (75%) of the deaths, and 59% of the direct property damage.

A variety of strategies, including barrier methods, fire retardants, and others, have been proposed to reduce the intensity or slow the growth of fires involving upholstered furniture. Unfortunately, NFIRS does not have enough detail to develop national estimates of fires and losses involving furniture made with different configurations. Some information resources about these strategies are discussed in the next section.

**Additional Information**

Vytenis Babrauskas’ chapter “Upholstered Furniture and Mattresses” in the 20th edition of NFPA’s *Fire Protection Handbook* provides information on materials used in upholstered furniture, flammability standards, smoldering vs. flaming heat sources, and testing.

NFPA has two standards related to flammability testing of upholstered furniture:

- NFPA 260, *Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture*, and


**Incident descriptions show how these fires can happen.**

Appendix D includes a collection of previously published incident descriptions grouped by scenario. Examples are included of fires started by smoking materials, open flames, heating equipment, electrical distribution or lighting equipment, and other causes. In most of these cases, upholstered furniture was the item first ignited. In others, the fire spread to upholstered furniture. These incidents are included to show what *can* happen, not what is typical. The incidents that are included are more likely to be serious than the typical fire. However, narratives can provide more detailed information about how different heat sources actually ignite the furniture.
Safety Tips

- If you smoke, smoke outside. Be careful when smoking around upholstered furniture. Use large, deep, sturdy ashtrays and do not rest them on a sofa or chair. When lighting cigars, pipes, or cigarettes, make sure sparks from matches do not land on the couch or chair. In addition, whenever there has been smoking in a room, check under cushions and in cracks for discarded butts before going to bed or leaving the home. If you smoke, only smoke when you feel alert. Do not smoke when drowsy, intoxicated or medicated. Never smoke where medical oxygen is used.

- Cigarette ignition-resistant upholstered furniture is more common now, but be aware of potential higher fire risk when purchasing antique or used furniture from the mid-1960s or before.

  Keep heaters and upholstered furniture at least three feet (1 meter) away from each other. See the manufacturer’s instructions for how to operate and install the appliance safely.

- Do not place furniture near a fireplace or wood stove. Leave adequate space for ventilation. The furniture should be at least three feet (1 meter) away from a heat source.

- Eight percent of upholstered furniture fires were begun by someone, usually a child, playing with fire. Children should not be left unsupervised – particularly young children, sometimes as young as two, who play with fire but do not understand the consequences of it. Keep matches and lighters up high, out of the reach of children, preferably in a locked cabinet. Encourage children to tell an adult when they find matches and lighters.

- Extinguish all candles when leaving the room or going to sleep. Make sure candles are placed on a stable piece of furniture in sturdy holders that won’t tip over.

For safety tip sheets on a variety of topics, go to [www.nfpa.org/safetytips](http://www.nfpa.org/safetytips). For all EMAC tips, go to [www.nfpa.org/emac](http://www.nfpa.org/emac).
Table 1.
Home Structure Fires that Began with Upholstered Furniture
by Year 1980-2005

<table>
<thead>
<tr>
<th>Reporting Year</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
<th>Adjusted Loss in Millions of 2009 Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>36,900</td>
<td>1,360</td>
<td>2,970</td>
<td>$220</td>
<td>$574</td>
</tr>
<tr>
<td>1981</td>
<td>33,800</td>
<td>1,360</td>
<td>2,630</td>
<td>$218</td>
<td>$514</td>
</tr>
<tr>
<td>1982</td>
<td>27,500</td>
<td>1,190</td>
<td>2,530</td>
<td>$272</td>
<td>$604</td>
</tr>
<tr>
<td>1983</td>
<td>24,600</td>
<td>1,100</td>
<td>2,700</td>
<td>$200</td>
<td>$430</td>
</tr>
<tr>
<td>1984</td>
<td>24,100</td>
<td>1,090</td>
<td>2,310</td>
<td>$217</td>
<td>$448</td>
</tr>
<tr>
<td>1985</td>
<td>23,100</td>
<td>930</td>
<td>2,330</td>
<td>$225</td>
<td>$448</td>
</tr>
<tr>
<td>1986</td>
<td>22,100</td>
<td>1,070</td>
<td>2,200</td>
<td>$234</td>
<td>$458</td>
</tr>
<tr>
<td>1987</td>
<td>20,800</td>
<td>1,030</td>
<td>2,150</td>
<td>$196</td>
<td>$370</td>
</tr>
<tr>
<td>1988</td>
<td>20,200</td>
<td>1,100</td>
<td>2,290</td>
<td>$223</td>
<td>$405</td>
</tr>
<tr>
<td>1989</td>
<td>18,100</td>
<td>880</td>
<td>2,120</td>
<td>$229</td>
<td>$397</td>
</tr>
<tr>
<td>1990</td>
<td>16,400</td>
<td>870</td>
<td>2,050</td>
<td>$257</td>
<td>$422</td>
</tr>
<tr>
<td>1991</td>
<td>16,200</td>
<td>680</td>
<td>2,050</td>
<td>$290</td>
<td>$457</td>
</tr>
<tr>
<td>1992</td>
<td>15,200</td>
<td>630</td>
<td>1,660</td>
<td>$188</td>
<td>$288</td>
</tr>
<tr>
<td>1993</td>
<td>14,300</td>
<td>650</td>
<td>1,960</td>
<td>$231</td>
<td>$343</td>
</tr>
<tr>
<td>1994</td>
<td>14,000</td>
<td>670</td>
<td>1,710</td>
<td>$234</td>
<td>$339</td>
</tr>
<tr>
<td>1995</td>
<td>13,300</td>
<td>660</td>
<td>1,680</td>
<td>$239</td>
<td>$336</td>
</tr>
<tr>
<td>1996</td>
<td>12,800</td>
<td>650</td>
<td>1,610</td>
<td>$249</td>
<td>$341</td>
</tr>
<tr>
<td>1997</td>
<td>11,800</td>
<td>660</td>
<td>1,440</td>
<td>$213</td>
<td>$285</td>
</tr>
<tr>
<td>1998</td>
<td>11,600</td>
<td>540</td>
<td>1,430</td>
<td>$225</td>
<td>$296</td>
</tr>
<tr>
<td>1999</td>
<td>8,200</td>
<td>(8,200)</td>
<td>(880)</td>
<td>$217</td>
<td>($217)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(480)</td>
<td>(880)</td>
<td>$217</td>
<td>($217)</td>
</tr>
<tr>
<td>2000</td>
<td>9,300</td>
<td>(9,100)</td>
<td>(1,390)</td>
<td>$376</td>
<td>($376)</td>
</tr>
<tr>
<td>2001</td>
<td>9,700</td>
<td>(9,500)</td>
<td>(1,100)</td>
<td>$328</td>
<td>($328)</td>
</tr>
<tr>
<td></td>
<td>620</td>
<td>(620)</td>
<td>(1,100)</td>
<td>$328</td>
<td>($328)</td>
</tr>
<tr>
<td>2002</td>
<td>8,800</td>
<td>(8,600)</td>
<td>(980)</td>
<td>$291</td>
<td>($291)</td>
</tr>
<tr>
<td>2003</td>
<td>7,800</td>
<td>(7,500)</td>
<td>(960)</td>
<td>$295</td>
<td>($295)</td>
</tr>
<tr>
<td>2004</td>
<td>7,700</td>
<td>(7,600)</td>
<td>(810)</td>
<td>$289</td>
<td>($289)</td>
</tr>
<tr>
<td>2005</td>
<td>7,400</td>
<td>(7,100)</td>
<td>(940)</td>
<td>$364</td>
<td>($364)</td>
</tr>
<tr>
<td>2006</td>
<td>7,900</td>
<td>(7,500)</td>
<td>(890)</td>
<td>$714</td>
<td>($714)</td>
</tr>
<tr>
<td>2007</td>
<td>7,300</td>
<td>(7,000)</td>
<td>(820)</td>
<td>$366</td>
<td>($366)</td>
</tr>
<tr>
<td>2008</td>
<td>6,700</td>
<td>(6,500)</td>
<td>(960)</td>
<td>$387</td>
<td>($387)</td>
</tr>
<tr>
<td>2009</td>
<td>5,900</td>
<td>(5,600)</td>
<td>(830)</td>
<td>$339</td>
<td>($339)</td>
</tr>
</tbody>
</table>

Note: Numbers in parentheses exclude fires with confined structure fire incident types. Confined fires were first introduced in Version 5.0 of NFIRS in 1999. Estimates for 1999-2009 are based on data collected originally in NFIRS 5.0 only. Due to the smaller share of NFIRS data collected in 1999-2001, statistics for these years should be viewed with caution.

Table 2.
Home Structure Fires that Began with Upholstered Furniture
by Type of Material First Ignited
(Excluding fires with confined structure fire incident types)
2005-2009 Annual Averages

<table>
<thead>
<tr>
<th>Type of Material</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabric, fiber, or finished goods</td>
<td>4,860</td>
<td>380</td>
<td>680</td>
<td>$338</td>
</tr>
<tr>
<td>made of cotton, blends, rayon or wool</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unclassified fabric, textile or fur</td>
<td>940</td>
<td>70</td>
<td>120</td>
<td>$55</td>
</tr>
<tr>
<td>Multiple types of material</td>
<td>210</td>
<td>20</td>
<td>20</td>
<td>$13</td>
</tr>
<tr>
<td>Plastic</td>
<td>160</td>
<td>0</td>
<td>10</td>
<td>$6</td>
</tr>
<tr>
<td>Unclassified type of material</td>
<td>120</td>
<td>10</td>
<td>10</td>
<td>$6</td>
</tr>
<tr>
<td>Plastic-coated fabric</td>
<td>90</td>
<td>0</td>
<td>10</td>
<td>$3</td>
</tr>
<tr>
<td>Sawn wood, including finished lumber</td>
<td>60</td>
<td>0</td>
<td>10</td>
<td>$2</td>
</tr>
<tr>
<td>Unclassified natural product</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>$3</td>
</tr>
<tr>
<td>Unclassified wood or paper</td>
<td>40</td>
<td>0</td>
<td>0</td>
<td>$3</td>
</tr>
<tr>
<td>Other known type of material</td>
<td>240</td>
<td>10</td>
<td>20</td>
<td>$12</td>
</tr>
<tr>
<td>Total</td>
<td>6,760</td>
<td>500</td>
<td>890</td>
<td>$442</td>
</tr>
</tbody>
</table>

Note: Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.
### Table 3.
**Home Structure Fires that Began with Upholstered Furniture**
*by Area of Origin*
*2005-2009 Annual Averages*
*(Excluding fires with confined structure fire incident types)*

<table>
<thead>
<tr>
<th>Area of Origin</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Living room, family room or den</td>
<td>2,630</td>
<td>290 (56%)</td>
<td>450 (51%)</td>
<td>$140 (32%)</td>
</tr>
<tr>
<td>Unclassified function area</td>
<td>1,310</td>
<td>120 (23%)</td>
<td>180 (21%)</td>
<td>$80 (18%)</td>
</tr>
<tr>
<td>Bedroom</td>
<td>1,010</td>
<td>40 (9%)</td>
<td>100 (12%)</td>
<td>$43 (10%)</td>
</tr>
<tr>
<td>Unclassified structural area</td>
<td>190</td>
<td>10 (3%)</td>
<td>10 (1%)</td>
<td>$13 (3%)</td>
</tr>
<tr>
<td>Garage or vehicle storage area</td>
<td>190</td>
<td>0 (0%)</td>
<td>10 (1%)</td>
<td>$10 (2%)</td>
</tr>
<tr>
<td>Exterior balcony, unenclosed porch</td>
<td>180</td>
<td>0 (0%)</td>
<td>10 (2%)</td>
<td>$16 (4%)</td>
</tr>
<tr>
<td>Other</td>
<td>170</td>
<td>10 (2%)</td>
<td>10 (1%)</td>
<td>$9 (2%)</td>
</tr>
<tr>
<td>Kitchen or cooking area</td>
<td>110</td>
<td>10 (2%)</td>
<td>10 (1%)</td>
<td>$4 (1%)</td>
</tr>
<tr>
<td>Lobby or entrance way</td>
<td>90</td>
<td>10 (1%)</td>
<td>10 (1%)</td>
<td>$4 (1%)</td>
</tr>
<tr>
<td>Crawl space or substructure space</td>
<td>90</td>
<td>0 (0%)</td>
<td>10 (1%)</td>
<td>$5 (1%)</td>
</tr>
<tr>
<td>Courtyard, terrace or patio</td>
<td>80</td>
<td>0 (0%)</td>
<td>10 (1%)</td>
<td>$4 (1%)</td>
</tr>
<tr>
<td>Exterior wall surface</td>
<td>60</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$2 (1%)</td>
</tr>
<tr>
<td>Dining room, bar or beverage area, cafeteria</td>
<td>50</td>
<td>0 (1%)</td>
<td>0 (0%)</td>
<td>$3 (1%)</td>
</tr>
<tr>
<td>Multiple areas of origin</td>
<td>50</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$5 (1%)</td>
</tr>
<tr>
<td>Wall assembly or concealed space</td>
<td>50</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$2 (0%)</td>
</tr>
<tr>
<td>Ceiling/floor assembly or concealed space</td>
<td>50</td>
<td>0 (1%)</td>
<td>10 (1%)</td>
<td>$83 (19%)</td>
</tr>
<tr>
<td>Unclassified outside area</td>
<td>50</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$2 (0%)</td>
</tr>
<tr>
<td>Unclassified means of egress</td>
<td>40</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$1 (0%)</td>
</tr>
<tr>
<td>Unclassified storage area</td>
<td>40</td>
<td>0 (0%)</td>
<td>0 (1%)</td>
<td>$1 (0%)</td>
</tr>
<tr>
<td>Other known area</td>
<td>320</td>
<td>30 (3%)</td>
<td>890 (100%)</td>
<td>$14 (3%)</td>
</tr>
<tr>
<td>Total</td>
<td>6,760</td>
<td>500 (100%)</td>
<td>890 (100%)</td>
<td>$442 (100%)</td>
</tr>
</tbody>
</table>

* Does not include dwelling garages coded as a separate property.

Note: Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
### Table 4. Home Structure Fires that Began with Upholstered Furniture
**By Extent of Flame Damage**  
2005-2009 Annual Averages  
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Extent of Flame Damage</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confined to object of origin</td>
<td>1,590</td>
<td>30 (6%)</td>
<td>120 (14%)</td>
<td>$19 (4%)</td>
</tr>
<tr>
<td>Confined to room of origin</td>
<td>2,290</td>
<td>130 (25%)</td>
<td>300 (33%)</td>
<td>$144 (33%)</td>
</tr>
<tr>
<td>Confined to floor of origin</td>
<td>750</td>
<td>70 (15%)</td>
<td>120 (14%)</td>
<td>$52 (12%)</td>
</tr>
<tr>
<td>Confined to building of origin</td>
<td>1,920</td>
<td>240 (48%)</td>
<td>310 (35%)</td>
<td>$191 (43%)</td>
</tr>
<tr>
<td>Beyond building of origin</td>
<td>220</td>
<td>30 (5%)</td>
<td>40 (4%)</td>
<td>$36 (8%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,760</td>
<td>500 (100%)</td>
<td>890 (100%)</td>
<td><strong>$442 (100%)</strong></td>
</tr>
<tr>
<td><strong>Extended beyond the room of origin</strong></td>
<td>2,880</td>
<td>350 (68%)</td>
<td>470 (53%)</td>
<td><strong>$279 (63%)</strong></td>
</tr>
</tbody>
</table>

### Table 5. Home Structure Fires that Began with Upholstered Furniture, by Major Cause  
2005-2009 Annual Averages  
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Major Cause</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking materials</td>
<td>1,870</td>
<td>290 (58%)</td>
<td>340 (38%)</td>
<td>$104 (24%)</td>
</tr>
<tr>
<td>Intentional</td>
<td>900</td>
<td>30 (6%)</td>
<td>70 (8%)</td>
<td>$39 (9%)</td>
</tr>
<tr>
<td>Candle</td>
<td>710</td>
<td>30 (6%)</td>
<td>110 (12%)</td>
<td>$43 (10%)</td>
</tr>
<tr>
<td>Hot ember or ash</td>
<td>660</td>
<td>30 (7%)</td>
<td>80 (10%)</td>
<td>$29 (6%)</td>
</tr>
<tr>
<td>Heating equipment</td>
<td>640</td>
<td>40 (7%)</td>
<td>50 (6%)</td>
<td>$27 (6%)</td>
</tr>
<tr>
<td>Electrical distribution and lighting equipment</td>
<td>630</td>
<td>50 (11%)</td>
<td>90 (10%)</td>
<td>$25 (6%)</td>
</tr>
<tr>
<td>Playing with heat source</td>
<td>520</td>
<td>20 (5%)</td>
<td>80 (9%)</td>
<td>$23 (5%)</td>
</tr>
</tbody>
</table>

Note: The major cause table summarizes causal factors pulled from several fields. In some cases, the equipment involved in ignition is most relevant; heat source, the field “cause,” and factor contributing to ignition also provide relevant information. The causes shown here are not mutually exclusive when they have been pulled from different fields. Causal factors that lack detail (such as unintentional or failure of equipment or heat source in the cause field, or heat from operating or powered equipment or arcing in the heat source field) were not included in this summary table. The causes shown are those that are well defined, account for at least 2% of the fires, and have clear prevention strategies or have historically been of interest. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.
Table 6.
Home Structure Fires that Began with Upholstered Furniture
by Cause of Ignition
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unintentional</td>
<td>5,060</td>
<td>440 (87%)</td>
<td>740 (84%)</td>
<td>$365 (82%)</td>
</tr>
<tr>
<td>Intentional</td>
<td>900</td>
<td>30 (6%)</td>
<td>70 (8%)</td>
<td>$39 (9%)</td>
</tr>
<tr>
<td>Failure of equipment or heat source</td>
<td>600</td>
<td>30 (5%)</td>
<td>60 (7%)</td>
<td>$30 (7%)</td>
</tr>
<tr>
<td>Cause, other</td>
<td>170</td>
<td>10 (1%)</td>
<td>10 (1%)</td>
<td>$7 (2%)</td>
</tr>
<tr>
<td>Act of nature</td>
<td>30</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$1 (0%)</td>
</tr>
<tr>
<td>Total</td>
<td>6,760</td>
<td>500 (100%)</td>
<td>890 (100%)</td>
<td>$442 (100%)</td>
</tr>
</tbody>
</table>

Note: Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
Table 7.
Home Structure Fires that Began with Upholstered Furniture
by Factor Contributing to Ignition
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Factor Contributing</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abandoned or discarded material or product</td>
<td>1,830</td>
<td>210</td>
<td>280</td>
<td>$99 (22%)</td>
</tr>
<tr>
<td>Heat source too close to combustible</td>
<td>1,500</td>
<td>100</td>
<td>210</td>
<td>$70 (16%)</td>
</tr>
<tr>
<td>Electrical failure or malfunction</td>
<td>910</td>
<td>50</td>
<td>100</td>
<td>$50 (11%)</td>
</tr>
<tr>
<td>Unclassified misuse of material or product</td>
<td>900</td>
<td>70</td>
<td>130</td>
<td>$32 (7%)</td>
</tr>
<tr>
<td>Playing with heat source</td>
<td>520</td>
<td>20</td>
<td>80</td>
<td>$23 (5%)</td>
</tr>
<tr>
<td>Unclassified factor contributed to ignition</td>
<td>520</td>
<td>40</td>
<td>60</td>
<td>$138 (31%)</td>
</tr>
<tr>
<td>Equipment unattended</td>
<td>130</td>
<td>0</td>
<td>0</td>
<td>$6 (1%)</td>
</tr>
<tr>
<td>Unclassified mechanical failure or malfunction</td>
<td>90</td>
<td>0</td>
<td>0</td>
<td>$4 (1%)</td>
</tr>
<tr>
<td>Exposure fire</td>
<td>90</td>
<td>0</td>
<td>0</td>
<td>$4 (1%)</td>
</tr>
<tr>
<td>Unclassified fire spread or control</td>
<td>80</td>
<td>10</td>
<td>10</td>
<td>$5 (1%)</td>
</tr>
<tr>
<td>Collision, knock down, or turn over</td>
<td>60</td>
<td>0</td>
<td>10</td>
<td>$3 (1%)</td>
</tr>
<tr>
<td>Rekindle</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>$1 (0%)</td>
</tr>
<tr>
<td>Flammable liquid used to kindle fire</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>$2 (1%)</td>
</tr>
<tr>
<td>Equipment overloaded</td>
<td>40</td>
<td>10</td>
<td>10</td>
<td>$3 (1%)</td>
</tr>
<tr>
<td>Unclassified operational deficiency</td>
<td>40</td>
<td>0</td>
<td>10</td>
<td>$2 (0%)</td>
</tr>
<tr>
<td>Unintentionally turned on or not turned off</td>
<td>40</td>
<td>0</td>
<td>0</td>
<td>$3 (1%)</td>
</tr>
<tr>
<td>Flammable liquid or gas spilled</td>
<td>40</td>
<td>10</td>
<td>10</td>
<td>$2 (0%)</td>
</tr>
<tr>
<td>Other known factor</td>
<td>260</td>
<td>10</td>
<td>30</td>
<td>$16 (4%)</td>
</tr>
<tr>
<td>Total fires</td>
<td>6,760</td>
<td>500</td>
<td>890</td>
<td>$442 (100%)</td>
</tr>
<tr>
<td>Total entries*</td>
<td>7,130</td>
<td>540</td>
<td>960</td>
<td>$464 (105%)</td>
</tr>
</tbody>
</table>

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: Sums may not equal due to rounding errors. Fires in which the factor contributing to ignition was coded as “none,” unknown, or not reported have been allocated proportionally among fires with known factor contributing to ignition. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
Table 8.
Home Structure Fires that Began with Upholstered Furniture
by Human Factor Contributing to Ignition
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Human Factor</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asleep</td>
<td>800</td>
<td>140</td>
<td>210</td>
<td>$46</td>
</tr>
<tr>
<td>Unattended or unsupervised person</td>
<td>670</td>
<td>30</td>
<td>70</td>
<td>$31</td>
</tr>
<tr>
<td>Possibly impaired by alcohol or drugs</td>
<td>460</td>
<td>90</td>
<td>110</td>
<td>$27</td>
</tr>
<tr>
<td>Age was a factor</td>
<td>340</td>
<td>50</td>
<td>70</td>
<td>$20</td>
</tr>
<tr>
<td>Possibly mentally disabled</td>
<td>140</td>
<td>20</td>
<td>30</td>
<td>$7</td>
</tr>
<tr>
<td>Multiple persons involved</td>
<td>90</td>
<td>10</td>
<td>10</td>
<td>$5</td>
</tr>
<tr>
<td>Physically disabled</td>
<td>80</td>
<td>40</td>
<td>40</td>
<td>$6</td>
</tr>
<tr>
<td>No human factor</td>
<td>4,500</td>
<td>210</td>
<td>440</td>
<td>$322</td>
</tr>
</tbody>
</table>

Total fires 6,760 (100%) 500 (100%) 890 (100%) $442 (100%)

Total entries* 7,080 (105%) 590 (117%) 970 (110%) $464 (105%)

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
### Table 9.
Home Structure Fires That Began with Upholstered Furniture, by Heat Source
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Heat Source</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking materials</td>
<td>1,870</td>
<td>290 (58%)</td>
<td>340 (38%)</td>
<td>$104 (24%)</td>
</tr>
<tr>
<td>Candle</td>
<td>710</td>
<td>30 (6%)</td>
<td>110 (12%)</td>
<td>$43 (10%)</td>
</tr>
<tr>
<td>Hot ember or ash</td>
<td>660</td>
<td>30 (7%)</td>
<td>80 (10%)</td>
<td>$29 (6%)</td>
</tr>
<tr>
<td>Unclassified hot or smoldering object</td>
<td>600</td>
<td>20 (4%)</td>
<td>40 (5%)</td>
<td>$119 (27%)</td>
</tr>
<tr>
<td>Arcing</td>
<td>570</td>
<td>40 (7%)</td>
<td>70 (8%)</td>
<td>$31 (7%)</td>
</tr>
<tr>
<td>Radiated or conducted heat from operating equipment</td>
<td>520</td>
<td>20 (5%)</td>
<td>50 (5%)</td>
<td>$27 (6%)</td>
</tr>
<tr>
<td>Lighter</td>
<td>520</td>
<td>30 (5%)</td>
<td>100 (12%)</td>
<td>$24 (6%)</td>
</tr>
<tr>
<td>Unclassified heat from powered equipment</td>
<td>310</td>
<td>10 (2%)</td>
<td>30 (4%)</td>
<td>$17 (4%)</td>
</tr>
<tr>
<td>Unclassified heat source</td>
<td>260</td>
<td>10 (2%)</td>
<td>10 (2%)</td>
<td>$15 (3%)</td>
</tr>
<tr>
<td>Match</td>
<td>230</td>
<td>10 (1%)</td>
<td>20 (3%)</td>
<td>$8 (2%)</td>
</tr>
<tr>
<td>Spark, ember or flame from operating equipment</td>
<td>110</td>
<td>0 (1%)</td>
<td>10 (1%)</td>
<td>$6 (1%)</td>
</tr>
<tr>
<td>Multiple heat sources including multiple ignitions</td>
<td>70</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$4 (1%)</td>
</tr>
<tr>
<td>Flame or torch used for lighting</td>
<td>50</td>
<td>0 (1%)</td>
<td>10 (1%)</td>
<td>$5 (1%)</td>
</tr>
<tr>
<td>Incendiary device</td>
<td>40</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$1 (0%)</td>
</tr>
<tr>
<td>Fireworks</td>
<td>40</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$2 (0%)</td>
</tr>
<tr>
<td>Molten or hot material</td>
<td>40</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$2 (0%)</td>
</tr>
<tr>
<td>Other known heat source</td>
<td>160</td>
<td>10 (1%)</td>
<td>10 (1%)</td>
<td>$6 (1%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,760</td>
<td>500 (100%)</td>
<td>890 (100%)</td>
<td>$442 (100%)</td>
</tr>
</tbody>
</table>

Note: Sums may not equal due to rounding errors. The statistics on matches, lighters, smoking materials and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
Table 10.
Home Structure Fires That Began with Upholstered Furniture, by Equipment Involved in Ignition
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Equipment Involved</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No equipment involved</td>
<td>4,850</td>
<td>(72%)</td>
<td>380 (75%)</td>
<td>660 (75%)</td>
</tr>
<tr>
<td>Portable or fixed space heater</td>
<td>560</td>
<td>(8%)</td>
<td>40 (7%)</td>
<td>40 (5%)</td>
</tr>
<tr>
<td>Fixed wiring and related equipment</td>
<td>240</td>
<td>(4%)</td>
<td>0 (1%)</td>
<td>20 (2%)</td>
</tr>
<tr>
<td>Lamp, bulb or lighting</td>
<td>200</td>
<td>(3%)</td>
<td>20 (3%)</td>
<td>40 (4%)</td>
</tr>
<tr>
<td>Cord or plug</td>
<td>160</td>
<td>(2%)</td>
<td>40 (7%)</td>
<td>20 (3%)</td>
</tr>
<tr>
<td>Cigarette or pipe lighter</td>
<td>100</td>
<td>(1%)</td>
<td>0 (1%)</td>
<td>20 (2%)</td>
</tr>
<tr>
<td>Air conditioner</td>
<td>90</td>
<td>(1%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Unclassified equipment involved in ignition</td>
<td>60</td>
<td>(1%)</td>
<td>0 (0%)</td>
<td>10 (1%)</td>
</tr>
<tr>
<td>Unclassified portable appliance designed to produce heat</td>
<td>50</td>
<td>(1%)</td>
<td>0 (1%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Heating pad</td>
<td>30</td>
<td>(1%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Other known equipment</td>
<td>430</td>
<td>(6%)</td>
<td>30 (6%)</td>
<td>70 (7%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,760</td>
<td>(100%)</td>
<td>500 (100%)</td>
<td>890 (100%)</td>
</tr>
</tbody>
</table>

Oxygen administration equipment was involved less than 1% of these fires but an average of 20 (4%) of these deaths per year.

Note: Fires in which the equipment involved in ignition was unknown or not reported have been allocated proportionally among fires with known equipment involved. Fires in which the equipment involved in ignition was entered as none but the heat source indicated equipment involvement or the heat source was unknown were also treated as unknown and allocated proportionally among fires with known equipment involved. Fires in which the equipment was partially unclassified (i.e., unclassified kitchen or cooking equipment, unclassified heating, cooling or air condition equipment, etc.) were allocated proportionally among fires that grouping (kitchen or cooking equipment; heating, cooling or air conditioning equipment, etc.). Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.
Table 11.
Home Structure Fires That Began with Upholstered Furniture, by Leading Heat Source and Year
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Year</th>
<th>Smoking Materials</th>
<th>Candle, Lighter or Match</th>
<th>Operating Equipment</th>
<th>Ember or Ash</th>
<th>Subtotal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>23,300 (63%)</td>
<td>6,900 (19%)</td>
<td>4,700 (13%)</td>
<td>400 (1%)</td>
<td>35,300 (96%)</td>
<td>36,900 (100%)</td>
</tr>
<tr>
<td>1981</td>
<td>21,800 (64%)</td>
<td>6,000 (18%)</td>
<td>4,200 (13%)</td>
<td>300 (1%)</td>
<td>32,400 (96%)</td>
<td>33,800 (100%)</td>
</tr>
<tr>
<td>1982</td>
<td>17,100 (62%)</td>
<td>4,800 (17%)</td>
<td>3,700 (14%)</td>
<td>200 (1%)</td>
<td>25,900 (94%)</td>
<td>27,500 (100%)</td>
</tr>
<tr>
<td>1983</td>
<td>14,500 (59%)</td>
<td>4,700 (19%)</td>
<td>3,900 (16%)</td>
<td>200 (1%)</td>
<td>23,300 (95%)</td>
<td>24,600 (100%)</td>
</tr>
<tr>
<td>1984</td>
<td>14,100 (59%)</td>
<td>4,600 (19%)</td>
<td>3,600 (15%)</td>
<td>200 (1%)</td>
<td>22,500 (93%)</td>
<td>24,100 (100%)</td>
</tr>
<tr>
<td>1985</td>
<td>12,800 (55%)</td>
<td>4,700 (20%)</td>
<td>3,700 (16%)</td>
<td>200 (1%)</td>
<td>21,400 (93%)</td>
<td>23,100 (100%)</td>
</tr>
<tr>
<td>1986</td>
<td>12,300 (56%)</td>
<td>4,500 (20%)</td>
<td>3,300 (15%)</td>
<td>300 (1%)</td>
<td>20,400 (92%)</td>
<td>22,100 (100%)</td>
</tr>
<tr>
<td>1987</td>
<td>11,400 (55%)</td>
<td>4,500 (22%)</td>
<td>3,200 (16%)</td>
<td>300 (1%)</td>
<td>19,400 (93%)</td>
<td>20,800 (100%)</td>
</tr>
<tr>
<td>1988</td>
<td>11,000 (54%)</td>
<td>4,300 (21%)</td>
<td>3,300 (16%)</td>
<td>300 (1%)</td>
<td>18,900 (93%)</td>
<td>20,200 (100%)</td>
</tr>
<tr>
<td>1989</td>
<td>9,400 (52%)</td>
<td>3,900 (22%)</td>
<td>3,300 (18%)</td>
<td>200 (1%)</td>
<td>16,800 (93%)</td>
<td>18,100 (100%)</td>
</tr>
<tr>
<td>1990</td>
<td>8,500 (52%)</td>
<td>3,500 (21%)</td>
<td>3,000 (18%)</td>
<td>200 (1%)</td>
<td>15,200 (93%)</td>
<td>16,400 (100%)</td>
</tr>
<tr>
<td>1991</td>
<td>8,200 (51%)</td>
<td>3,400 (21%)</td>
<td>3,200 (20%)</td>
<td>200 (1%)</td>
<td>15,000 (93%)</td>
<td>16,200 (100%)</td>
</tr>
<tr>
<td>1992</td>
<td>7,100 (47%)</td>
<td>3,800 (25%)</td>
<td>3,000 (20%)</td>
<td>200 (1%)</td>
<td>14,100 (93%)</td>
<td>15,200 (100%)</td>
</tr>
<tr>
<td>1993</td>
<td>6,900 (48%)</td>
<td>3,400 (24%)</td>
<td>2,900 (21%)</td>
<td>200 (1%)</td>
<td>13,400 (94%)</td>
<td>14,300 (100%)</td>
</tr>
<tr>
<td>1994</td>
<td>6,400 (46%)</td>
<td>3,600 (26%)</td>
<td>2,700 (19%)</td>
<td>200 (2%)</td>
<td>12,900 (92%)</td>
<td>14,000 (100%)</td>
</tr>
<tr>
<td>1995</td>
<td>6,200 (47%)</td>
<td>3,300 (25%)</td>
<td>2,600 (20%)</td>
<td>200 (2%)</td>
<td>12,300 (93%)</td>
<td>13,300 (100%)</td>
</tr>
<tr>
<td>1996</td>
<td>5,900 (46%)</td>
<td>3,000 (23%)</td>
<td>2,600 (21%)</td>
<td>200 (1%)</td>
<td>11,700 (92%)</td>
<td>12,800 (100%)</td>
</tr>
<tr>
<td>1997</td>
<td>5,300 (45%)</td>
<td>3,000 (25%)</td>
<td>2,500 (21%)</td>
<td>200 (1%)</td>
<td>10,900 (93%)</td>
<td>11,800 (100%)</td>
</tr>
<tr>
<td>1998</td>
<td>5,100 (44%)</td>
<td>3,000 (26%)</td>
<td>2,500 (22%)</td>
<td>200 (2%)</td>
<td>10,800 (93%)</td>
<td>11,600 (100%)</td>
</tr>
<tr>
<td>1999</td>
<td>3,100 (38%)</td>
<td>2,500 (30%)</td>
<td>1,500 (19%)</td>
<td>400 (5%)</td>
<td>7,600 (92%)</td>
<td>8,200 (100%)</td>
</tr>
<tr>
<td>2000</td>
<td>3,100 (35%)</td>
<td>1,900 (21%)</td>
<td>1,600 (18%)</td>
<td>800 (9%)</td>
<td>7,500 (82%)</td>
<td>9,100 (100%)</td>
</tr>
<tr>
<td>2001</td>
<td>3,100 (33%)</td>
<td>2,100 (22%)</td>
<td>1,900 (20%)</td>
<td>900 (10%)</td>
<td>8,000 (84%)</td>
<td>9,500 (100%)</td>
</tr>
<tr>
<td>2002</td>
<td>2,600 (30%)</td>
<td>1,900 (22%)</td>
<td>1,700 (20%)</td>
<td>900 (10%)</td>
<td>7,000 (82%)</td>
<td>8,600 (100%)</td>
</tr>
<tr>
<td>2003</td>
<td>2,200 (29%)</td>
<td>1,600 (22%)</td>
<td>1,600 (21%)</td>
<td>700 (9%)</td>
<td>6,100 (81%)</td>
<td>7,500 (100%)</td>
</tr>
<tr>
<td>2004</td>
<td>2,300 (30%)</td>
<td>1,700 (22%)</td>
<td>1,600 (21%)</td>
<td>700 (10%)</td>
<td>6,300 (83%)</td>
<td>7,600 (100%)</td>
</tr>
<tr>
<td>2005</td>
<td>2,000 (28%)</td>
<td>1,600 (23%)</td>
<td>1,500 (21%)</td>
<td>700 (10%)</td>
<td>5,800 (81%)</td>
<td>7,100 (100%)</td>
</tr>
<tr>
<td>2006</td>
<td>2,100 (28%)</td>
<td>1,700 (22%)</td>
<td>1,600 (21%)</td>
<td>800 (10%)</td>
<td>6,200 (82%)</td>
<td>7,500 (100%)</td>
</tr>
<tr>
<td>2007</td>
<td>1,900 (28%)</td>
<td>1,500 (21%)</td>
<td>1,700 (24%)</td>
<td>600 (9%)</td>
<td>5,800 (82%)</td>
<td>7,000 (100%)</td>
</tr>
<tr>
<td>2008</td>
<td>1,800 (28%)</td>
<td>1,300 (20%)</td>
<td>1,500 (23%)</td>
<td>600 (10%)</td>
<td>5,200 (80%)</td>
<td>6,500 (100%)</td>
</tr>
<tr>
<td>2009</td>
<td>1,500 (27%)</td>
<td>1,100 (20%)</td>
<td>1,400 (24%)</td>
<td>600 (10%)</td>
<td>4,500 (81%)</td>
<td>5,600 (100%)</td>
</tr>
</tbody>
</table>

Note: Sums may not equal due to rounding errors. The statistics on smoking materials and candles, lighters, or matches include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. The category “operating equipment” includes fires with four heat sources: arcing; radiated or conducted heat from operating equipment; spark, ember or flame from operating equipment; and unclassified heat from operating equipment. Estimates for 1999-2009 are based on data collected originally in NFIRS 5.0 only. Due to the smaller share of NFIRS data collected in 1999-2001, statistics for these years should be viewed with caution. The subtotal column shows the sum of the fires started by: smoking materials; candles, lighters or matches; operating equipment; and ember or ash. Fires with confined fire incident types were excluded from the totals and percent calculation.

Source: NFIRS and NFPA survey.
Table 12.
Home Structure Fire Deaths That Began with Upholstered Furniture, by Leading Heat Source and Year
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Year</th>
<th>Smoking Materials</th>
<th>Candle, Lighter or Match</th>
<th>Operating Equipment</th>
<th>Ember or Ash</th>
<th>Subtotal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(78%)</td>
<td>(15%)</td>
<td>(3%)</td>
<td>(0%)</td>
<td>(96%)</td>
<td>(100%)</td>
</tr>
<tr>
<td>1980</td>
<td>1,060</td>
<td>200</td>
<td>39</td>
<td>0</td>
<td>1,300</td>
<td>1,360</td>
</tr>
<tr>
<td>1981</td>
<td>1,120</td>
<td>80</td>
<td>91</td>
<td>30</td>
<td>1,320</td>
<td>1,360</td>
</tr>
<tr>
<td>1982</td>
<td>980 (82%)</td>
<td>100 (8%)</td>
<td>66 (6%)</td>
<td>10 (1%)</td>
<td>1,160</td>
<td>1,190</td>
</tr>
<tr>
<td>1983</td>
<td>850 (77%)</td>
<td>180 (16%)</td>
<td>33 (3%)</td>
<td>0 (0%)</td>
<td>1,060</td>
<td>1,100</td>
</tr>
<tr>
<td>1984</td>
<td>860 (79%)</td>
<td>110 (10%)</td>
<td>95 (9%)</td>
<td>20 (2%)</td>
<td>1,080</td>
<td>1,090</td>
</tr>
<tr>
<td>1985</td>
<td>720 (77%)</td>
<td>110 (12%)</td>
<td>62 (7%)</td>
<td>0 (0%)</td>
<td>890</td>
<td>930</td>
</tr>
<tr>
<td>1986</td>
<td>770 (72%)</td>
<td>130 (12%)</td>
<td>107 (10%)</td>
<td>0 (0%)</td>
<td>1,010</td>
<td>1,070</td>
</tr>
<tr>
<td>1987</td>
<td>700 (68%)</td>
<td>140 (14%)</td>
<td>128 (12%)</td>
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</tr>
<tr>
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<td>810 (74%)</td>
<td>130 (12%)</td>
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<tr>
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<td>68 (8%)</td>
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<td>880</td>
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<td>110 (13%)</td>
<td>103 (12%)</td>
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<tr>
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<td>84 (13%)</td>
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<td>650</td>
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<td>660</td>
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<td>650</td>
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<tr>
<td>1997</td>
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<td>80 (12%)</td>
<td>92 (14%)</td>
<td>10 (2%)</td>
<td>630</td>
<td>660</td>
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<td>480</td>
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<tr>
<td>2000</td>
<td>330 (58%)</td>
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<td>540</td>
<td>580</td>
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<tr>
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<td>380 (62%)</td>
<td>90 (15%)</td>
<td>130 (21%)</td>
<td>0 (0%)</td>
<td>600</td>
<td>620</td>
</tr>
<tr>
<td>2002</td>
<td>230 (43%)</td>
<td>80 (15%)</td>
<td>110 (20%)</td>
<td>50 (10%)</td>
<td>470</td>
<td>530</td>
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<td>2004</td>
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<td>120 (17%)</td>
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<td>80 (16%)</td>
<td>50 (10%)</td>
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<tr>
<td>2006</td>
<td>310 (64%)</td>
<td>30 (6%)</td>
<td>80 (17%)</td>
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<td>450</td>
<td>490</td>
</tr>
<tr>
<td>2007</td>
<td>320 (59%)</td>
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<td>30 (5%)</td>
<td>490</td>
<td>550</td>
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<tr>
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<td>70 (15%)</td>
<td>60 (12%)</td>
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<td>450</td>
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</table>

Note: Sums may not equal due to rounding errors. The statistics on smoking materials and candles, lighters, or matches include a proportional share of fire deaths in which the heat source was heat from an unclassified open flame or smoking material. The category “operating equipment” includes deaths from fires with four heat sources: arcing; radiated or conducted heat from operating equipment; spark; ember or flame from operating equipment; and unclassified heat from operating equipment. Estimates for 1999-2009 are based on data collected originally in NFIRS 5.0 only. Due to the smaller share of NFIRS data collected in 1999-2001, statistics for these years should be viewed with caution. The subtotal column shows the sum of the deaths from fires started by: smoking materials; candles, lighters or matches; operating equipment; and ember or ash.

Source: NFIRS and NFPA survey.
Table 13.
Home Structure Fires That Began with Upholstered Furniture, by Smoking Materials
by year 1980-2009
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Year</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>In 2009 Dollars</td>
<td></td>
<td></td>
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<td>2,050</td>
<td>$127</td>
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<td>1,890</td>
<td>$136</td>
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<tr>
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<td>1,710</td>
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<tr>
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<td>1,800</td>
<td>$110</td>
</tr>
<tr>
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<td>1,480</td>
<td>$124</td>
</tr>
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</tr>
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<td>1,370</td>
<td>$100</td>
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<td>590</td>
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<td>1,140</td>
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<td>850</td>
<td>$74</td>
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<tr>
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<td>440</td>
<td>1,060</td>
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<td>410</td>
<td>920</td>
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<tr>
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<tr>
<td>1996</td>
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<td>470</td>
<td>920</td>
<td>$95</td>
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<td>1,500</td>
<td>220</td>
<td>310</td>
<td>$90</td>
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</table>

Note: The statistics include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Estimates for 1999-2009 are based on data collected originally in NFIRS 5.0 only. Due to the smaller share of NFIRS data collected in 1999-2001, statistics for these years should be viewed with caution.

Table 14.
Home Upholstered Furniture, Fires Started by Candles, Lighters, or Matches
By Year 1980-2009
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Year</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>As Reported</th>
<th>Direct Property Damage (in Millions)</th>
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</thead>
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<td>$94</td>
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<td>430</td>
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<td>$64</td>
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<td>180</td>
<td>500</td>
<td>$36</td>
<td>$77</td>
</tr>
<tr>
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<td>4,600</td>
<td>110</td>
<td>480</td>
<td>$39</td>
<td>$80</td>
</tr>
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<td>450</td>
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<td>$92</td>
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<td>450</td>
<td>$45</td>
<td>$85</td>
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<td>430</td>
<td>$43</td>
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<td>120</td>
<td>480</td>
<td>$46</td>
<td>$80</td>
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<td>110</td>
<td>520</td>
<td>$48</td>
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<td>560</td>
<td>$63</td>
<td>$99</td>
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<tr>
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<td>80</td>
<td>480</td>
<td>$43</td>
<td>$66</td>
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<tr>
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<td>90</td>
<td>470</td>
<td>$53</td>
<td>$79</td>
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<td>80</td>
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<td>$65</td>
<td>$65</td>
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</table>

Note: The statistics include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Estimates for 1999-2009 are based on data collected originally in NFIRS 5.0 only. Due to the smaller share of NFIRS data collected in 1999-2001, statistics for these years should be viewed with caution.

Table 15.
Home Upholstered Furniture Fires Started, by Operating Equipment
by Year: 1980-2009
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Year</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>As Reported</th>
<th>In 2009 Dollars</th>
</tr>
</thead>
<tbody>
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<td>1,500</td>
<td>50</td>
<td>160</td>
<td>$74</td>
<td>$81</td>
</tr>
<tr>
<td>2006</td>
<td>1,600</td>
<td>80</td>
<td>150</td>
<td>$65</td>
<td>$70</td>
</tr>
<tr>
<td>2007</td>
<td>1,700</td>
<td>80</td>
<td>130</td>
<td>$91</td>
<td>$94</td>
</tr>
<tr>
<td>2008</td>
<td>1,500</td>
<td>90</td>
<td>110</td>
<td>$103</td>
<td>$103</td>
</tr>
<tr>
<td>2009</td>
<td>1,400</td>
<td>70</td>
<td>190</td>
<td>$85</td>
<td>$85</td>
</tr>
</tbody>
</table>

Note: The category “operating equipment” includes fires with four heat sources: arcing; radiated or conducted heat from operating equipment; spark, ember, or flame from operating equipment; and unclassified heat from operating equipment. Estimates for 1999-2009 are based on data collected originally in NFIRS 5.0 only. Due to the smaller share of NFIRS data collected in 1999-2001, statistics for these years should be viewed with caution.

Table 16.  
Home Upholstered Furniture Fires Started, by Hot Embers or Ashes by Year: 1980-2009  
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Year</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>As Reported</th>
<th>In 2009 Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>400</td>
<td>0</td>
<td>30</td>
<td>$2</td>
<td>$4</td>
</tr>
<tr>
<td>1981</td>
<td>300</td>
<td>30</td>
<td>10</td>
<td>$2</td>
<td>$5</td>
</tr>
<tr>
<td>1982</td>
<td>200</td>
<td>10</td>
<td>10</td>
<td>$6</td>
<td>$14</td>
</tr>
<tr>
<td>1983</td>
<td>200</td>
<td>0</td>
<td>30</td>
<td>$3</td>
<td>$6</td>
</tr>
<tr>
<td>1984</td>
<td>200</td>
<td>20</td>
<td>10</td>
<td>$1</td>
<td>$3</td>
</tr>
<tr>
<td>1985</td>
<td>200</td>
<td>0</td>
<td>0</td>
<td>$2</td>
<td>$4</td>
</tr>
<tr>
<td>1986</td>
<td>300</td>
<td>0</td>
<td>20</td>
<td>$2</td>
<td>$5</td>
</tr>
<tr>
<td>1987</td>
<td>300</td>
<td>20</td>
<td>20</td>
<td>$3</td>
<td>$5</td>
</tr>
<tr>
<td>1988</td>
<td>300</td>
<td>10</td>
<td>70</td>
<td>$2</td>
<td>$4</td>
</tr>
<tr>
<td>1989</td>
<td>200</td>
<td>0</td>
<td>80</td>
<td>$3</td>
<td>$6</td>
</tr>
<tr>
<td>1990</td>
<td>200</td>
<td>0</td>
<td>30</td>
<td>$3</td>
<td>$5</td>
</tr>
<tr>
<td>1991</td>
<td>200</td>
<td>0</td>
<td>30</td>
<td>$3</td>
<td>$4</td>
</tr>
<tr>
<td>1992</td>
<td>200</td>
<td>0</td>
<td>20</td>
<td>$3</td>
<td>$5</td>
</tr>
<tr>
<td>1993</td>
<td>200</td>
<td>10</td>
<td>20</td>
<td>$2</td>
<td>$3</td>
</tr>
<tr>
<td>1994</td>
<td>200</td>
<td>10</td>
<td>10</td>
<td>$2</td>
<td>$3</td>
</tr>
<tr>
<td>1995</td>
<td>200</td>
<td>0</td>
<td>30</td>
<td>$3</td>
<td>$5</td>
</tr>
<tr>
<td>1996</td>
<td>200</td>
<td>0</td>
<td>20</td>
<td>$3</td>
<td>$4</td>
</tr>
<tr>
<td>1997</td>
<td>200</td>
<td>10</td>
<td>0</td>
<td>$3</td>
<td>$4</td>
</tr>
<tr>
<td>1998</td>
<td>200</td>
<td>10</td>
<td>20</td>
<td>$3</td>
<td>$4</td>
</tr>
<tr>
<td>1999</td>
<td>400</td>
<td>60</td>
<td>60</td>
<td>$5</td>
<td>$7</td>
</tr>
<tr>
<td>2000</td>
<td>800</td>
<td>30</td>
<td>160</td>
<td>$18</td>
<td>$22</td>
</tr>
<tr>
<td>2001</td>
<td>900</td>
<td>0</td>
<td>80</td>
<td>$14</td>
<td>$17</td>
</tr>
<tr>
<td>2002</td>
<td>900</td>
<td>50</td>
<td>80</td>
<td>$24</td>
<td>$28</td>
</tr>
<tr>
<td>2003</td>
<td>700</td>
<td>20</td>
<td>120</td>
<td>$20</td>
<td>$23</td>
</tr>
<tr>
<td>2004</td>
<td>700</td>
<td>30</td>
<td>70</td>
<td>$19</td>
<td>$22</td>
</tr>
<tr>
<td>2005</td>
<td>700</td>
<td>30</td>
<td>100</td>
<td>$26</td>
<td>$29</td>
</tr>
<tr>
<td>2006</td>
<td>800</td>
<td>20</td>
<td>80</td>
<td>$20</td>
<td>$21</td>
</tr>
<tr>
<td>2007</td>
<td>600</td>
<td>30</td>
<td>60</td>
<td>$35</td>
<td>$36</td>
</tr>
<tr>
<td>2008</td>
<td>600</td>
<td>30</td>
<td>140</td>
<td>$20</td>
<td>$20</td>
</tr>
<tr>
<td>2009</td>
<td>600</td>
<td>60</td>
<td>60</td>
<td>$48</td>
<td>$48</td>
</tr>
</tbody>
</table>

Note: Estimates for 1999-2009 are based on data collected originally in NFIRS 5.0 only. Due to the smaller share of NFIRS data collected in 1999-2001, statistics for these years should be viewed with caution.

Table 17.
Home Upholstered Furniture Fires Started, by Smoking Materials, by Extent of Flame Damage
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Extent of Flame Damage</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confined to object of origin</td>
<td>600</td>
<td>29 (10%)</td>
<td>57 (17%)</td>
<td>$4 (4%)</td>
</tr>
<tr>
<td>Confined to room of origin</td>
<td>600</td>
<td>74 (25%)</td>
<td>111 (33%)</td>
<td>$19 (18%)</td>
</tr>
<tr>
<td>Confined to floor of origin</td>
<td>190</td>
<td>48 (16%)</td>
<td>44 (13%)</td>
<td>$15 (14%)</td>
</tr>
<tr>
<td>Confined to building of origin</td>
<td>440</td>
<td>132 (45%)</td>
<td>112 (33%)</td>
<td>$56 (54%)</td>
</tr>
<tr>
<td>Beyond building of origin</td>
<td>50</td>
<td>9 (3%)</td>
<td>12 (4%)</td>
<td>$11 (10%)</td>
</tr>
<tr>
<td>Total</td>
<td>1,870</td>
<td>291 (100%)</td>
<td>337 (100%)</td>
<td>$104 (100%)</td>
</tr>
</tbody>
</table>

Table 18.
Home Upholstered Furniture Fires Started by Candles, Lighters, or Matches
by Extent of Flame Damage
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Extent of Flame Damage</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confined to object of origin</td>
<td>340</td>
<td>0 (0%)</td>
<td>29 (12%)</td>
<td>$3 (4%)</td>
</tr>
<tr>
<td>Confined to room of origin</td>
<td>510</td>
<td>11 (17%)</td>
<td>77 (33%)</td>
<td>$13 (17%)</td>
</tr>
<tr>
<td>Confined to floor of origin</td>
<td>150</td>
<td>16 (27%)</td>
<td>32 (14%)</td>
<td>$10 (13%)</td>
</tr>
<tr>
<td>Confined to building of origin</td>
<td>410</td>
<td>29 (47%)</td>
<td>87 (37%)</td>
<td>$43 (56%)</td>
</tr>
<tr>
<td>Beyond building of origin</td>
<td>40</td>
<td>5 (9%)</td>
<td>11 (5%)</td>
<td>$7 (9%)</td>
</tr>
<tr>
<td>Total</td>
<td>1,450</td>
<td>61 (100%)</td>
<td>237 (100%)</td>
<td>$76 (100%)</td>
</tr>
</tbody>
</table>

Note: Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
Table 19.  
Home Upholstered Furniture Fires  
Started by Operating Equipment, by Extent of Flame Damage  
2005-2009 Annual Averages  
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Extent of Flame Damage</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confined to object of origin</td>
<td>280</td>
<td>2</td>
<td>15</td>
<td>$4 (5%)</td>
</tr>
<tr>
<td>Confined to room of origin</td>
<td>570</td>
<td>17</td>
<td>57</td>
<td>$17 (20%)</td>
</tr>
<tr>
<td>Confined to floor of origin</td>
<td>170</td>
<td>14</td>
<td>22</td>
<td>$15 (18%)</td>
</tr>
<tr>
<td>Confined to building of origin</td>
<td>440</td>
<td>38</td>
<td>47</td>
<td>$41 (51%)</td>
</tr>
<tr>
<td>Beyond building of origin</td>
<td>50</td>
<td>2</td>
<td>8</td>
<td>$4 (5%)</td>
</tr>
<tr>
<td>Total</td>
<td>1,520</td>
<td>74</td>
<td>149</td>
<td>$81 (100%)</td>
</tr>
</tbody>
</table>

Note: Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
Table 20.
Home Upholstered Furniture Fires
Started by Smoking Materials, by Factor Contributing to Ignition
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Factor Contributing to Ignition</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abandoned or discarded material or product</td>
<td>1,190</td>
<td>179 (61%)</td>
<td>194 (58%)</td>
<td>$74 (71%)</td>
</tr>
<tr>
<td>Unclassified misuse of material or product</td>
<td>340</td>
<td>35 (12%)</td>
<td>69 (20%)</td>
<td>$14 (14%)</td>
</tr>
<tr>
<td>Heat source too close to combustibles</td>
<td>240</td>
<td>49 (17%)</td>
<td>57 (17%)</td>
<td>$10 (10%)</td>
</tr>
<tr>
<td>Unclassified factor contributed to ignition</td>
<td>110</td>
<td>26 (9%)</td>
<td>20 (6%)</td>
<td>$4 (4%)</td>
</tr>
<tr>
<td>Playing with heat source</td>
<td>20</td>
<td>0 (0%)</td>
<td>2 (1%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Unclassified fire spread or control</td>
<td>10</td>
<td>7 (2%)</td>
<td>3 (1%)</td>
<td>$1 (1%)</td>
</tr>
<tr>
<td>Improper container or storage</td>
<td>10</td>
<td>0 (0%)</td>
<td>2 (1%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Other known factor</td>
<td>50</td>
<td>12 (4%)</td>
<td>12 (3%)</td>
<td>$4 (4%)</td>
</tr>
<tr>
<td>Total fires</td>
<td>1,870</td>
<td>291 (100%)</td>
<td>337 (100%)</td>
<td>$104 (100%)</td>
</tr>
<tr>
<td>Total entries*</td>
<td>1,950</td>
<td>307 (106%)</td>
<td>358 (106%)</td>
<td>$107 (103%)</td>
</tr>
</tbody>
</table>

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: Sums may not equal due to rounding errors. Fires in which the factor contributing to ignition was coded as “none,” unknown, or not reported have been allocated proportionally among fires with known factor contributing to ignition. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
### Table 21.
Home Upholstered Furniture Fires Started by Smoking Materials, by Human Factor Contributing to Ignition
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Human Factor Contributing</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asleep</td>
<td>440</td>
<td>(24%)</td>
<td>86 (29%)</td>
<td>116 (35%)</td>
</tr>
<tr>
<td>Possibly impaired by alcohol or drugs</td>
<td>280</td>
<td>(15%)</td>
<td>72 (25%)</td>
<td>74 (22%)</td>
</tr>
<tr>
<td>Unattended or unsupervised person</td>
<td>170</td>
<td>(9%)</td>
<td>17 (6%)</td>
<td>17 (5%)</td>
</tr>
<tr>
<td>Age was a factor</td>
<td>70</td>
<td>(4%)</td>
<td>35 (12%)</td>
<td>16 (5%)</td>
</tr>
<tr>
<td>Possibly mentally disabled</td>
<td>60</td>
<td>(3%)</td>
<td>13 (5%)</td>
<td>16 (5%)</td>
</tr>
<tr>
<td>Physically disabled</td>
<td>50</td>
<td>(2%)</td>
<td>38 (13%)</td>
<td>19 (6%)</td>
</tr>
<tr>
<td>Multiple persons involved</td>
<td>20</td>
<td>(1%)</td>
<td>4 (1%)</td>
<td>8 (2%)</td>
</tr>
<tr>
<td>No human factor involved</td>
<td>950</td>
<td>(51%)</td>
<td>103 (36%)</td>
<td>127 (38%)</td>
</tr>
</tbody>
</table>

Total fires: 1,870 (100%) 291 (100%) 337 (100%) $104 (100%)

Total entries*: 2,040 (109%) 367 (126%) 395 (117%) $115 (111%)

*Multiple entries are allowed, resulting in more factor entries than fires.

### Table 22.
Home Upholstered Furniture Fires Started by Candles, Lighters, or Matches
by Cause: 2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unintentional</td>
<td>1,080</td>
<td>(71%)</td>
<td>57 (77%)</td>
<td>119 (79%)</td>
</tr>
<tr>
<td>Intentional</td>
<td>380</td>
<td>(25%)</td>
<td>17 (23%)</td>
<td>27 (18%)</td>
</tr>
<tr>
<td>Unclassified cause of ignition</td>
<td>40</td>
<td>(2%)</td>
<td>0 (0%)</td>
<td>3 (2%)</td>
</tr>
<tr>
<td>Failure of equipment or heat source</td>
<td>10</td>
<td>(1%)</td>
<td>0 (0%)</td>
<td>2 (1%)</td>
</tr>
</tbody>
</table>

Total: 1,520 (100%) 74 (100%) 149 (100%) $81 (100%)

Note: Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
Table 23.
Home Upholstered Furniture Fires Started by Candles, Lighters, or Matches
by Factor Contributing to Ignition: 2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Factor Contributing to Ignition</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Playing with heat source</td>
<td>470</td>
<td>22 (37%)</td>
<td>74 (31%)</td>
<td>$23 (30%)</td>
</tr>
<tr>
<td>Heat source too close to combustibles</td>
<td>430</td>
<td>19 (31%)</td>
<td>82 (35%)</td>
<td>$24 (32%)</td>
</tr>
<tr>
<td>Unclassified misuse of material or product</td>
<td>180</td>
<td>7 (12%)</td>
<td>40 (17%)</td>
<td>$10 (13%)</td>
</tr>
<tr>
<td>Abandoned or discarded material or product</td>
<td>160</td>
<td>5 (8%)</td>
<td>28 (12%)</td>
<td>$8 (11%)</td>
</tr>
<tr>
<td>Unclassified factor contributed to ignition</td>
<td>100</td>
<td>3 (5%)</td>
<td>15 (6%)</td>
<td>$4 (5%)</td>
</tr>
<tr>
<td>Equipment unattended</td>
<td>30</td>
<td>0 (0%)</td>
<td>3 (1%)</td>
<td>$2 (2%)</td>
</tr>
<tr>
<td>Collision, knock down, or overturn</td>
<td>30</td>
<td>3 (5%)</td>
<td>2 (1%)</td>
<td>$1 (2%)</td>
</tr>
<tr>
<td>Unclassified fire spread or control</td>
<td>20</td>
<td>0 (0%)</td>
<td>1 (0%)</td>
<td>$3 (4%)</td>
</tr>
<tr>
<td>Animal</td>
<td>20</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$2 (2%)</td>
</tr>
<tr>
<td>Flammable liquid used to kindle fire</td>
<td>20</td>
<td>0 (0%)</td>
<td>1 (0%)</td>
<td>$1 (1%)</td>
</tr>
<tr>
<td>Exposure fire</td>
<td>10</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$1 (1%)</td>
</tr>
<tr>
<td>Flammable liquid or gas spilled</td>
<td>10</td>
<td>3 (5%)</td>
<td>2 (1%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Unclassified operational deficiency</td>
<td>10</td>
<td>0 (0%)</td>
<td>4 (2%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Other known factor</td>
<td>40</td>
<td>0 (0%)</td>
<td>8 (3%)</td>
<td>$3 (3%)</td>
</tr>
<tr>
<td>Total fires</td>
<td>1,450</td>
<td>61 ((100%)</td>
<td>237 (100%)</td>
<td>$76 (100%)</td>
</tr>
<tr>
<td>Total entries*</td>
<td>1,530</td>
<td>63 (103%)</td>
<td>260 (110%)</td>
<td>$81 (107%)</td>
</tr>
</tbody>
</table>

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: Sums may not equal due to rounding errors. Fires in which the factor contributing to ignition was coded as “none,” unknown, or not reported have been allocated proportionally among fires with known factor contributing to ignition. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
Table 24.  
Home Upholstered Furniture Fires Started by Candles, Lighters, or Matches by Human Factor Contributing to Ignition: 2005-2009 Annual Averages (Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Human Factor Contributing</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unattended or unsupervised person</td>
<td>300</td>
<td>7 (12%)</td>
<td>42 (18%)</td>
<td>$16 (22%)</td>
</tr>
<tr>
<td>Age was a factor</td>
<td>270</td>
<td>19 (31%)</td>
<td>48 (20%)</td>
<td>$16 (21%)</td>
</tr>
<tr>
<td>Asleep</td>
<td>120</td>
<td>14 (23%)</td>
<td>33 (14%)</td>
<td>$8 (10%)</td>
</tr>
<tr>
<td>Possibly impaired by alcohol or drugs</td>
<td>70</td>
<td>5 (8%)</td>
<td>15 (6%)</td>
<td>$3 (4%)</td>
</tr>
<tr>
<td>Possibly mentally disabled</td>
<td>50</td>
<td>2 (4%)</td>
<td>10 (4%)</td>
<td>$3 (4%)</td>
</tr>
<tr>
<td>Multiple persons involved</td>
<td>30</td>
<td>0 (0%)</td>
<td>3 (1%)</td>
<td>$2 (3%)</td>
</tr>
<tr>
<td>Physically disabled</td>
<td>20</td>
<td>3 (4%)</td>
<td>8 (3%)</td>
<td>$2 (2%)</td>
</tr>
<tr>
<td>No human factor</td>
<td>700</td>
<td>19 (31%)</td>
<td>102 (43%)</td>
<td>$35 (46%)</td>
</tr>
</tbody>
</table>

Total fires                                   | 1,450 | 61 (100%)       | 237 (100%)        | $76 (100%)                         |
Total entries*                                 | 1,560 | 69 (113%)       | 262 (111%)        | $84 (111%)                         |

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
Table 25.
Home Upholstered Furniture Fires Started by Operating Equipment
by Equipment Involved in Ignition
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Equipment Involved in Ignition</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical distribution or lighting equipment</td>
<td>570</td>
<td>44 (59%)</td>
<td>75 (51%)</td>
<td>$27 (33%)</td>
</tr>
<tr>
<td>Fixed wiring and related equipment</td>
<td>220</td>
<td>0 (0%)</td>
<td>204 (13%)</td>
<td>$11 (13%)</td>
</tr>
<tr>
<td>Lamp, bulb or lighting</td>
<td>160</td>
<td>13 (8%)</td>
<td>27 (18%)</td>
<td>$7 (8%)</td>
</tr>
<tr>
<td>Cord or plug</td>
<td>150</td>
<td>13 (8%)</td>
<td>22 (15%)</td>
<td>$8 (10%)</td>
</tr>
<tr>
<td>Transformer and power supplies</td>
<td>30</td>
<td>0 (0%)</td>
<td>6 (4%)</td>
<td>$1 (2%)</td>
</tr>
<tr>
<td>Heating equipment</td>
<td>560</td>
<td>26 (34%)</td>
<td>45 (30%)</td>
<td>$28 (35%)</td>
</tr>
<tr>
<td>Fixed or portable space heater, including wood stoves</td>
<td>510</td>
<td>26 (34%)</td>
<td>35 (23%)</td>
<td>$26 (32%)</td>
</tr>
<tr>
<td>Heat lamp</td>
<td>20</td>
<td>0 (0%)</td>
<td>2 (1%)</td>
<td>$0 (1%)</td>
</tr>
<tr>
<td>Fireplace or chimney</td>
<td>10</td>
<td>0 (0%)</td>
<td>6 (4%)</td>
<td>$1 (1%)</td>
</tr>
<tr>
<td>Central heat</td>
<td>10</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$1 (1%)</td>
</tr>
<tr>
<td>Water heater</td>
<td>10</td>
<td>0 (0%)</td>
<td>2 (1%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Heat tape</td>
<td>0</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Electronic, office or entertainment equipment</td>
<td>60</td>
<td>0 (0%)</td>
<td>7 (5%)</td>
<td>$5 (6%)</td>
</tr>
<tr>
<td>Cooking equipment</td>
<td>20</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Portable cooking or warming equipment</td>
<td>10</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Other known cooking equipment</td>
<td>10</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Shop tools or industrial equipment, including torches</td>
<td>20</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$2 (2%)</td>
</tr>
<tr>
<td>Air conditioner</td>
<td>80</td>
<td>0 (0%)</td>
<td>2 (1%)</td>
<td>$2 (2%)</td>
</tr>
<tr>
<td>Unclassified portable appliance designed to produce heat</td>
<td>40</td>
<td>2 (3%)</td>
<td>2 (1%)</td>
<td>$4 (4%)</td>
</tr>
<tr>
<td>Fan</td>
<td>40</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$1 (2%)</td>
</tr>
<tr>
<td>Heating pad</td>
<td>30</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$3 (3%)</td>
</tr>
<tr>
<td>Electric blanket</td>
<td>20</td>
<td>0 (0%)</td>
<td>7 (5%)</td>
<td>$1 (1%)</td>
</tr>
<tr>
<td>Unclassified equipment involved in ignition</td>
<td>10</td>
<td>0 (0%)</td>
<td>2 (1%)</td>
<td>$4 (5%)</td>
</tr>
<tr>
<td>Hair dryer</td>
<td>10</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$1 (1%)</td>
</tr>
<tr>
<td>Curling iron or curler warmer</td>
<td>10</td>
<td>0 (0%)</td>
<td>4 (3%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Clothes iron</td>
<td>10</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$0 (1%)</td>
</tr>
</tbody>
</table>
Table 25.
Home Upholstered Furniture Fires Started by Operating Equipment
by Equipment Involved in Ignition
2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)
(Continued)

<table>
<thead>
<tr>
<th>Equipment Involved in Ignition</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other known equipment</td>
<td>50</td>
<td>3 (4%)</td>
<td>5 (3%)</td>
<td>$3 (3%)</td>
</tr>
<tr>
<td>Total</td>
<td>1,520</td>
<td>74 (100%)</td>
<td>149 (100%)</td>
<td>$81 (100%)</td>
</tr>
</tbody>
</table>

Note: Fires in which the equipment involved in ignition was unknown or not reported have been allocated proportionally among fires with known equipment involved. Fires in which the equipment involved in ignition was entered as none but the heat source indicated equipment involvement or the heat source was unknown were also treated as unknown and allocated proportionally among fires with known equipment involved. Fires in which the equipment was partially unclassified (i.e., unclassified kitchen or cooking equipment, unclassified heating, cooling or air condition equipment, etc.) were allocated proportionally among fires that grouping (kitchen or cooking equipment; heating, cooling or air conditioning equipment, etc.). Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
Table 26.
Home Upholstered Furniture Fires Started by Operating Equipment
by Factor Contributing to Ignition: 2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Factor Contributing</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical failure or malfunction</td>
<td>730(48%)</td>
<td>43 (58%)</td>
<td>87 (58%)</td>
<td>$43 (53%)</td>
</tr>
<tr>
<td>Heat source too close to combustibles</td>
<td>500 (33%)</td>
<td>17 (22%)</td>
<td>44 (29%)</td>
<td>$23 (29%)</td>
</tr>
<tr>
<td>Unclassified mechanical failure or malfunction</td>
<td>70 (4%)</td>
<td>0 (0%)</td>
<td>4 (3%)</td>
<td>$3 (4%)</td>
</tr>
<tr>
<td>Equipment unattended</td>
<td>60 (4%)</td>
<td>2 (2%)</td>
<td>2 (1%)</td>
<td>$2 (3%)</td>
</tr>
<tr>
<td>Unclassified misuse of material or product</td>
<td>40 (3%)</td>
<td>5 (6%)</td>
<td>3 (2%)</td>
<td>$2 (2%)</td>
</tr>
<tr>
<td>Equipment overloaded</td>
<td>40 (3%)</td>
<td>9 (13%)</td>
<td>8 (6%)</td>
<td>$2 (3%)</td>
</tr>
<tr>
<td>Unclassified factor contributed to ignition</td>
<td>30 (2%)</td>
<td>2 (2%)</td>
<td>1 (0%)</td>
<td>$3 (4%)</td>
</tr>
<tr>
<td>Unintentionally turned on or not turned off</td>
<td>30 (2%)</td>
<td>0 (0%)</td>
<td>1 (0%)</td>
<td>$3 (3%)</td>
</tr>
<tr>
<td>Equipment not being operated properly</td>
<td>20 (1%)</td>
<td>0 (0%)</td>
<td>1 (1%)</td>
<td>$2 (3%)</td>
</tr>
<tr>
<td>Worn out</td>
<td>20 (1%)</td>
<td>0 (0%)</td>
<td>3 (2%)</td>
<td>$2 (2%)</td>
</tr>
<tr>
<td>Collision, knock down, or overturn</td>
<td>10 (1%)</td>
<td>0 (0%)</td>
<td>4 (3%)</td>
<td>$1 (1%)</td>
</tr>
<tr>
<td>Abandoned or discarded material or product</td>
<td>10 (1%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Unclassified operational deficiency</td>
<td>10 (1%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Leak or break</td>
<td>10 (1%)</td>
<td>0 (0%)</td>
<td>1 (1%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>Playing with heat source</td>
<td>10 (1%)</td>
<td>2 (2%)</td>
<td>2 (1%)</td>
<td>$1 (1%)</td>
</tr>
<tr>
<td>Other known equipment</td>
<td>50 (4%)</td>
<td>2 (2%)</td>
<td>5 (3%)</td>
<td>$2 (3%)</td>
</tr>
<tr>
<td>Total fires</td>
<td>1,520 (100%)</td>
<td>74 (100%)</td>
<td>149 (100%)</td>
<td>$81 (100%)</td>
</tr>
<tr>
<td>Total entries*</td>
<td>1,630 (107%)</td>
<td>81 (109%)</td>
<td>165 (110%)</td>
<td>$89 (110%)</td>
</tr>
</tbody>
</table>

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: Sums may not equal due to rounding errors. Fires in which the factor contributing to ignition was coded as “none,” unknown, or not reported have been allocated proportionally among fires with known factor contributing to ignition. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
Table 27.
Home Upholstered Furniture Fires Started by Operating Equipment
by Human Factor Contributing to Ignition: 2005-2009 Annual Averages
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Human Factor Contributing</th>
<th>Fires</th>
<th>Civilian Deaths</th>
<th>Civilian Injuries</th>
<th>Direct Property Damage (in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asleep</td>
<td>110</td>
<td>26 (35%)</td>
<td>30 (20%)</td>
<td>$7 (8%)</td>
</tr>
<tr>
<td>Unattended or unsupervised person</td>
<td>100</td>
<td>2 (3%)</td>
<td>4 (3%)</td>
<td>$4 (5%)</td>
</tr>
<tr>
<td>Possibly impaired by alcohol or drugs</td>
<td>20</td>
<td>3 (4%)</td>
<td>2 (1%)</td>
<td>$1 (1%)</td>
</tr>
<tr>
<td>Age was a factor</td>
<td>20</td>
<td>2 (3%)</td>
<td>5 (3%)</td>
<td>$2 (2%)</td>
</tr>
<tr>
<td>Possibly mentally disabled</td>
<td>10</td>
<td>1 (2%)</td>
<td>2 (2%)</td>
<td>$1 (1%)</td>
</tr>
<tr>
<td>Physically disabled</td>
<td>0</td>
<td>2 (3%)</td>
<td>5 (3%)</td>
<td>$1 (1%)</td>
</tr>
<tr>
<td>Multiple persons involved</td>
<td>0</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>$0 (0%)</td>
</tr>
<tr>
<td>No human factor</td>
<td>1,270</td>
<td>44 (59%)</td>
<td>103 (69%)</td>
<td>$67 (83%)</td>
</tr>
</tbody>
</table>

Total entries 1,520 (100%) 74 (100%) 149 (100%) $81 (100%)

Total factors 1,530 (101%) 80 (108%) 151 (101%) $82 (101%)

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: Sums may not equal due to rounding errors. Estimates of zero mean that the actual number rounded to zero – it may or may not actually be zero.

Source: NFIRS 5.0 and NFPA survey.
Appendix A.
How National Estimates Statistics Are Calculated

The statistics in this analysis are estimates derived from the U.S. Fire Administration’s (USFA’s) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association’s (NFPA’s) annual survey of U.S. fire departments. NFIRS is a voluntary system by which participating fire departments report detailed factors about the fires to which they respond. Roughly two-thirds of U.S. fire departments participate, although not all of these departments provide data every year. Fires reported to federal or state fire departments or industrial fire brigades are not included in these estimates.

NFIRS provides the most detailed incident information of any national database not limited to large fires. NFIRS is the only database capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. NFIRS also captures information on the extent of flame spread, and automatic detection and suppression equipment. For more information about NFIRS visit [http://www.nfirs.fema.gov/](http://www.nfirs.fema.gov/). Copies of the paper forms may be downloaded from [http://www.nfirs.fema.gov/documentation/design/NFIRS_Paper_Forms_2008.pdf](http://www.nfirs.fema.gov/documentation/design/NFIRS_Paper_Forms_2008.pdf).

NFIRS has a wide variety of data elements and code choices. The NFIRS database contains coded information. Many code choices describe several conditions. These cannot be broken down further. For example, area of origin code 83 captures fires starting in vehicle engine areas, running gear areas or wheel areas. It is impossible to tell the portion of each from the coded data.

**Methodology may change slightly from year to year.**
NFPA is continually examining its methodology to provide the best possible answers to specific questions, methodological and definitional changes can occur. *Earlier editions of the same report may have used different methodologies to produce the same analysis, meaning that the estimates are not directly comparable from year to year.*

**NFPA’s fire department experience survey provides estimates of the big picture.**
Each year, NFPA conducts an annual survey of fire departments which enables us to capture a summary of fire department experience on a larger scale. Surveys are sent to all municipal departments protecting populations of 50,000 or more and a random sample, stratified by community size, of the smaller departments. Typically, a total of roughly 3,000 surveys are returned, representing about one of every ten U.S. municipal fire departments and about one third of the U.S. population.

The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities have fewer people protected per department and are less likely to respond to the survey. A larger number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city
departments are so few in number and protect such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined in NFIRS; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; 3) the number and nature of non-fire incidents; and (4) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results. The results of the survey are published in the annual report *Fire Loss in the United States*. To download a free copy of the report, visit [http://www.nfpa.org/assets/files/PDF/OS.fireloss.pdf](http://www.nfpa.org/assets/files/PDF/OS.fireloss.pdf).

**Projecting NFIRS to National Estimates**

As noted, NFIRS is a voluntary system. Different states and jurisdictions have different reporting requirements and practices. Participation rates in NFIRS are not necessarily uniform across regions and community sizes, both factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second database -- the NFPA survey -- is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

Scaling ratios are obtained by comparing NFPA’s projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific fire problems and circumstances are obtained by multiplying the NFIRS data by the scaling ratios. Reports for incidents in which mutual aid was given are excluded from NFPA’s analyses.

Analysts at the NFPA, the USFA and the Consumer Product Safety Commission developed the specific basic analytical rules used for this procedure. “The National Estimates Approach to U.S. Fire Statistics,” by John R. Hall, Jr. and Beatrice Harwood, provides a more detailed explanation of national estimates. A copy of the article is available online at [http://www.nfpa.org/osds](http://www.nfpa.org/osds) or through NFPA’s One-Stop Data Shop.

Version 5.0 of NFIRS, first introduced in 1999, used a different coding structure for many data elements, added some property use codes, and dropped others. The essentials of the approach described by Hall and Harwood are still used, but some modifications have been necessary to accommodate the changes in NFIRS 5.0.
Figure A.1 shows the percentage of fires originally collected in the NFIRS 5.0 system. Each year’s release version of NFIRS data also includes data collected in older versions of NFIRS that were converted to NFIRS 5.0 codes.

![Figure A.1. Fires Originally Collected in NFIRS 5.0 by Year](image)

From 1999 data on, analyses are based on scaling ratios using only data originally collected in NFIRS 5.0:

- **NFPA survey projections**
- **NFIRS totals (Version 5.0)**

For 1999 to 2001, the same rules may be applied, but estimates for these years in this form will be less reliable due to the smaller amount of data originally collected in NFIRS 5.0; they should be viewed with extreme caution.

NFIRS 5.0 introduced six categories of confined structure fires, including:

- cooking fires confined to the cooking vessel,
- confined chimney or flue fires,
- confined incinerator fire,
- confined fuel burner or boiler fire or delayed ignition,
- confined commercial compactor fire, and
- trash or rubbish fires in a structure with no flame damage to the structure or its contents.

Although causal and other detailed information is typically not required for these incidents, it is provided in some cases. Because the confined fire incident types describe certain scenarios, the distribution of unknown data differs from that of all fires. Consequently, allocation of unknowns must be done separately.
Fires with unknown data are allocated proportionally.
For most fields other than Property Use and Incident Type, NFPA allocates unknown data proportionally among known data. This approach assumes that if the missing data were known, it would be distributed in the same manner as the known data. NFPA makes additional adjustments to several fields. *Casualty and loss projections can be heavily influenced by the inclusion or exclusion of unusually serious fire.*

In the formulas that follow, the term “all fires” refers to all fires in NFIRS on the dimension studied. The percentages of fires with known or unknown data are provided for non-confined fires and associated losses, and for confined fires only.

Estimates of upholstered furniture fires were created using scaling ratios and allocation of unknowns or missing data.
Over the five-year period of 2005-2009, a total of 14,535 raw non-confined home structure fires that began with upholstered furniture were reported to NFIRS 5.0. These fires resulted in raw totals of 571 civilian deaths, 1,680 civilian injuries, and $602.5 million in direct property damage. These totals were multiplied by

a) the residential scaling ratios derived from NFPA survey totals divided by NFIRS totals, and then

b) total non-confined home structure fires divided by the total such fires with known item first ignited,

of 6,760 home upholstered furniture fires per year, resulting in average of 500 civilian deaths, 890 civilian injuries and $447 million in direct property damage annually.

The same procedure was applied to confined fires. During 2005-2009, 119 confined upholstered furniture fires were reported to the raw NFIRS database per year, resulting in no deaths, two civilian injuries, and $45,000 direct property damage. With unknowns and missing data allocated proportionally, confined upholstered furniture fires averaged 280 per year with minimal associated losses. These confined fires were included in trend estimates but excluded from all further analyses.

Cause of Ignition: This field is used chiefly to identify intentional fires. “Unintentional” in this field is a specific entry and does not include other fires that were not intentionally set: failure of equipment or heat source, act of nature, or “other” (unclassified).” The last should be used for exposures but has been used for other situations as well. Fires that were coded as under investigation and those that were coded as undetermined after investigation were treated as unknown. The cause of ignition was known in 75% of the non-confined upholstered furniture fires, 72% of the civilian deaths, 74% of the civilian injuries, and 78% of the direct property damage.

Factor Contributing to Ignition: In this field, the code “none” is treated as an unknown and allocated proportionally. For Human Factor Contributing to Ignition, NFPA enters a code for “not reported” when no factors are recorded. “Not reported” is treated as an unknown, but the code “none” is treated as a known code and not allocated. Multiple entries are allowed in both of these fields. Percentages are calculated on the total number of fires, not entries, resulting in
sums greater than 100%. Although Factor Contributing to Ignition is only required when the cause of ignition was coded as: 2) unintentional, 3) failure of equipment or heat source; or 4) act of nature, data is often present when not required. Consequently, any fire in which no factor contributing to ignition was entered was treated as unknown. Factor contributing to ignition was unknown or not reported in 41% of the non-confined upholstered furniture fires, 44% of the civilian deaths, 34% of the civilian injuries, and 33% of the direct property damage.

In some analyses, all entries in the category of mechanical failure, malfunction (factor contributing to ignition 20-29) are combined and shown as one entry, “mechanical failure or malfunction.” This category includes:

Entries in “electrical failure, malfunction” (factor contributing to ignition 30-39) may also be combined into one entry, “electrical failure or malfunction.” This category includes:

31. Water-caused short circuit arc;
32. Short-circuit arc from mechanical damage;
33. Short-circuit arc from defective or worn insulation;
34. Unspecified short circuit arc;
35. Arc from faulty contact or broken connector, including broken power lines and loose connections;
36. Arc or spark from operating equipment, switch, or electric fence;
37. Fluorescent light ballast; and
38. Electrical failure or malfunction, other.

Heat Source. In NFIRS 5.0, one grouping of codes encompasses various types of open flames and smoking materials. In the past, these had been two separate groupings. A new code was added to NFIRS 5.0, which is code 60: “Heat from open flame or smoking material, other.” NFPA treats this code as a partial unknown and allocates it proportionally across the codes in the 61-69 range, shown below.

61. Cigarette;
62. Pipe or cigar;
63. Heat from undetermined smoking material;
64. Match;
65. Lighter: cigarette lighter, cigar lighter;
66. Candle;
67. Warning or road flare, fuse;
68. Backfire from internal combustion engine. Excludes flames and sparks from an exhaust system, (11); and
69. Flame/torch used for lighting. Includes gas light and gas-/liquid-fueled lantern.

In addition to the conventional allocation of missing and undetermined fires, NFPA multiplies fires with codes in the 61-69 range by

\[
\frac{\text{All fires in range 60-69}}{\text{All fires in range 61-69}}
\]
The downside of this approach is that heat sources that are truly a different type of open flame or smoking material are erroneously assigned to other categories. The grouping “smoking materials” includes codes 61-63 (cigarettes, pipes or cigars, and heat from undetermined smoking material, with a proportional share of the code 60s and true unknown data. Heat source code 60 was used with 4% of the non-confined upholstered furniture fires, deaths, injuries, and property damage. The heat source was completely unknown or not reported in 24% of the non-confined upholstered furniture fires, 29% of the civilian deaths, 20% of the civilian injuries, and 20% of the direct property damage.

**Equipment Involved in Ignition (EII).** NFIRS 5.0 originally defined EII as the piece of equipment that provided the principal heat source to cause ignition if the equipment malfunctioned or was used improperly. In 2006, the definition was modified to “the piece of equipment that provided the principal heat source to cause ignition.” However, much of the data predates the change. Individuals who have already been trained with the older definition may not change their practices. To compensate, NFPA treats fires in which EII = NNN and heat source is not in the range of 40-99 as an additional unknown.

To allocate unknown data for EII, the known data is multiplied by

<table>
<thead>
<tr>
<th>All fires</th>
</tr>
</thead>
<tbody>
<tr>
<td>(All fires – blank – undetermined – [fires in which EII = NNN and heat source &lt;&gt; 40-99])</td>
</tr>
</tbody>
</table>

In addition, the partially unclassified codes for broad equipment groupings (i.e., code 100 - heating, ventilation, and air conditioning, other; code 200 - electrical distribution, lighting and power transfer, other; etc.) were allocated proportionally across the individual code choices in their respective broad groupings (heating, ventilation, and air conditioning; electrical distribution, lighting and power transfer, other; etc.). Equipment that is totally unclassified is not allocated further. This approach has the same downside as the allocation of heat source 60 described above. Equipment that is truly different is erroneously assigned to other categories.

In some analyses, various types of equipment are grouped together.

<table>
<thead>
<tr>
<th>Code Grouping</th>
<th>EII Code</th>
<th>NFIRS definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central heat</td>
<td>132</td>
<td>Furnace or central heating unit</td>
</tr>
<tr>
<td></td>
<td>133</td>
<td>Boiler (power, process or heating)</td>
</tr>
<tr>
<td>Fixed or portable space heater</td>
<td>131</td>
<td>Furnace, local heating unit, built-in</td>
</tr>
<tr>
<td></td>
<td>123</td>
<td>Fireplace with insert or stove</td>
</tr>
<tr>
<td></td>
<td>124</td>
<td>Heating stove</td>
</tr>
<tr>
<td></td>
<td>141</td>
<td>Heater, excluding catalytic and oil-filled</td>
</tr>
<tr>
<td></td>
<td>142</td>
<td>Catalytic heater</td>
</tr>
<tr>
<td></td>
<td>143</td>
<td>Oil-filled heater</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>Fireplace or chimney</td>
<td></td>
</tr>
<tr>
<td>121</td>
<td>Fireplace, masonry</td>
<td></td>
</tr>
<tr>
<td>122</td>
<td>Fireplace, factory-built</td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>Chimney connector or vent connector</td>
<td></td>
</tr>
<tr>
<td>126</td>
<td>Chimney – brick, stone or masonry</td>
<td></td>
</tr>
<tr>
<td>127</td>
<td>Chimney-metal, including stovepipe or flue</td>
<td></td>
</tr>
<tr>
<td>210</td>
<td>Unclassified electrical wiring</td>
<td></td>
</tr>
<tr>
<td>211</td>
<td>Electrical power or utility line</td>
<td></td>
</tr>
<tr>
<td>212</td>
<td>Electrical service supply wires from utility</td>
<td></td>
</tr>
<tr>
<td>213</td>
<td>Electric meter or meter box</td>
<td></td>
</tr>
<tr>
<td>214</td>
<td>Wiring from meter box to circuit breaker</td>
<td></td>
</tr>
<tr>
<td>215</td>
<td>Panel board, switch board or circuit breaker board</td>
<td></td>
</tr>
<tr>
<td>216</td>
<td>Electrical branch circuit</td>
<td></td>
</tr>
<tr>
<td>217</td>
<td>Outlet or receptacle</td>
<td></td>
</tr>
<tr>
<td>218</td>
<td>Wall switch</td>
<td></td>
</tr>
<tr>
<td>219</td>
<td>Ground fault interrupter</td>
<td></td>
</tr>
<tr>
<td>221</td>
<td>Distribution-type transformer</td>
<td></td>
</tr>
<tr>
<td>222</td>
<td>Overcurrent, disconnect equipment</td>
<td></td>
</tr>
<tr>
<td>223</td>
<td>Low-voltage transformer</td>
<td></td>
</tr>
<tr>
<td>224</td>
<td>Generator</td>
<td></td>
</tr>
<tr>
<td>225</td>
<td>Inverter</td>
<td></td>
</tr>
<tr>
<td>226</td>
<td>Uninterrupted power supply (UPS)</td>
<td></td>
</tr>
<tr>
<td>227</td>
<td>Surge protector</td>
<td></td>
</tr>
<tr>
<td>228</td>
<td>Battery charger or rectifier</td>
<td></td>
</tr>
<tr>
<td>229</td>
<td>Battery (all types)</td>
<td></td>
</tr>
<tr>
<td>230</td>
<td>Unclassified lamp or lighting</td>
<td></td>
</tr>
<tr>
<td>231</td>
<td>Lamp-tabletop, floor or desk</td>
<td></td>
</tr>
<tr>
<td>232</td>
<td>Lantern or flashlight</td>
<td></td>
</tr>
<tr>
<td>233</td>
<td>Incandescent lighting fixture</td>
<td></td>
</tr>
<tr>
<td>234</td>
<td>Fluorescent light fixture or ballast</td>
<td></td>
</tr>
<tr>
<td>235</td>
<td>Halogen light fixture or lamp</td>
<td></td>
</tr>
</tbody>
</table>
The equipment involved in ignition was known in 25% of the non-confined upholstered furniture fires, 28% of the civilian deaths, 32% of the civilian injuries, and 40% of the direct property damage.

**Area of Origin.** Two areas of origin: bedroom for more than five people (code 21) and bedroom for less than five people (code 22) are combined and shown as simply “bedroom.” Chimney is no longer a valid area of origin code for non-confined fires. The area of origin was known in 99% of the non-confined upholstered furniture fires and associated losses.
**Rounding and percentages.** The data shown are estimates and generally rounded. An entry of zero may be a true zero or it may mean that the value rounds to zero. Percentages are calculated from unrounded values. It is quite possible to have a percentage entry of up to 100% even if the rounded number entry is zero. The same rounded value may account for a slightly different percentage share. Because percentages are expressed in integers and not carried out to several decimal places, percentages that appear identical may be associated with slightly different values.
Appendix B.  
Methodology and Definitions Used in “Leading Cause” Tables

The cause table reflects relevant causal factors that accounted for at least 2% of the fires in a given occupancy. Only those causes that seemed to describe a scenario are included. Because the causal factors are taken from different fields, some double counting is possible. Percentages are calculated against the total number of structure fires, including both confined and non-confined fires. Bear in mind that every fire has at least three “causes” in the sense that it could have been prevented by changing behavior, heat source, or ignitability of first fuel, the last an aspect not reflected in any of the major cause categories. For example, several of the cause categories in this system refer to types of equipment (cooking, heating, electrical distribution and lighting, clothes dryers and washers, torches). However, the problem may be not with the equipment but with the way it is used. The details in national estimates are derived from the U.S. Fire Administration’s National Fire Incident Reporting System (NFIRS). This methodology is based on the coding system used in Version 5.0 of NFIRS. The NFIRS 5.0 Reference Guide, containing all of the codes, can be downloaded from http://www.nfirs.fema.gov/documentation/reference/.

Cooking equipment and heating equipment are calculated by summing fires identified by equipment involved in ignition and relevant confined fires. Confined fires will be shown if they account for at least 2% of the incidents. Confined cooking fires (cooking fires involving the contents of a cooking vessel without fire extension beyond the vessel) are identified by NFIRS incident type 113.

Confined heating equipment fires include confined chimney or flue fires (incident type 114) and confined fuel burner or boiler fires (incident type 116). The latter includes delayed ignitions and incidents where flames caused no damage outside the fire box. The two types of confined heating fires may be combined or listed separately, depending on the numbers involved.

Intentional fires are identified by fires with a “1” (intentional) in the field “cause.” The estimate includes a proportional share of fires in which the cause was undetermined after investigation, under investigation, or not reported. All fires with intentional causes are included in this category regardless of the age of the person involved. Earlier versions of NFIRS included codes for incendiary and suspicious. Intentional fires were deliberately set; they may or may not be incendiary in a legal sense. No age restriction is applied.

Fires caused by playing with heat source (typically matches or lighters) are identified by code 19 in the field “factor contributing to ignition.” Fires in which the factor contribution to ignition was undetermined (UU), entered as none (NN) or left blank are considered unknown and allocated proportionally. Because factor contributing to ignition is not required for intentional fires, the share unknown, by these definitions, is somewhat larger than it should be.

The heat source field is used to identify fires started by: smoking materials (cigarette, code 61; pipe or cigar, code 62; and heat from undetermined smoking material, code 63); candles (code 66), lightning (code 73); and spontaneous combustion or chemical reaction (code 72). Fires
started by heat from unclassified open flame or smoking materials (code 60) are allocated proportionally among the “other open flame or smoking material” codes (codes 61-69) in an allocation of partial unknown data. This includes smoking materials and candles. This approach results in any true unclassified smoking or open flame heat sources such as incense being inappropriately allocated. However, in many fires, this code was used as an unknown.

The equipment involved in ignition field is used to find several cause categories. This category includes equipment that functioned properly and equipment that malfunctioned.

**Cooking equipment in non-confined fire** refers to equipment used to cook, heat or warm food (codes 620-649 and 654). Fire in which ranges, ovens or microwave ovens, food warming appliances, fixed or portable cooking appliances, deep fat fryers, open fired charcoal or gas grills, grease hoods or ducts, or other cooking appliances) were involved in the ignition are said to be caused by cooking equipment. Food preparation devices that do not involve heating, such as can openers or food processors, are not included here. As noted in Appendix A, a proportional share of unclassified kitchen and cooking equipment (code 600) is included here.

**Heating equipment in non-confined fire** (codes 120-199) includes central heat, portable and fixed heaters (including wood stoves), fireplaces, chimneys, hot water heaters, and heat transfer equipment such as hot air ducts or hot water pipes. Heat pumps are not included. As noted in Appendix A, a proportional share of unclassified heating, ventilation and air condition equipment (code 100) is included here.

**Electrical distribution and lighting equipment** (codes 200-299) include: fixed wiring; transformers; associated overcurrent or disconnect equipment such as fuses or circuit breakers; meters; meter boxes; power switch gear; switches, receptacles and outlets; light fixtures, lamps, bulbs or lighting; signs; cords and plugs; generators, transformers, inverters, batteries and battery charges.

**Torch, burner or soldering iron** (codes 331-334) includes welding torches, cutting torches, Bunsen burners, plumber furnaces, blowtorches, and soldering equipment. As noted in Appendix A, a proportional share of shop tools and industrial equipment (code 300) is included here.

**Clothes dryer or washer** (codes 811, 813 and 814) includes clothes dryers alone, washer and dryer combinations within one frame, and washing machines for clothes. As noted in Appendix A, a proportional share of unclassified personal and household equipment (code 800) is included here.

**Electronic, office or entertainment equipment** (codes 700-799) includes: computers and related equipment; calculators and adding machines; telephones or answering machines; copiers; fax machines; paper shredders; typewriters; postage meters; other office equipment; musical instruments; stereo systems and/or components; televisions and cable TV converter boxes, cameras, excluding professional television studio cameras, video equipment and other
electronic equipment. Older versions of NFIRS had a code for electronic equipment that included radar, X-rays, computers, telephones, and transmitter equipment.

**Shop tools and industrial equipment excluding torches, burners or soldering irons**
(codes 300-330, 335-399) includes power tools; painting equipment; compressors; atomizing equipment; pumps; wet/dry vacuums; hoists, lifts or cranes; powered jacking equipment; water or gas drilling equipment; unclassified hydraulic equipment; heat-treating equipment; incinerators, industrial furnaces, ovens or kilns; pumps; compressors; internal combustion engines; conveyors; printing presses; casting, molding; or forging equipment; heat treating equipment; tar kettles; working or shaping machines; coating machines; chemical process equipment; waste recovery equipment; power transfer equipment; power takeoff; powered valves; bearings or brakes; picking, carding or weaving machines; testing equipment; gas regulators; separate motors; non-vehicular internal combustion engines; and unclassified shop tools and industrial equipment. As noted in Appendix A, a proportional share of shop tools and industrial equipment (code 300) is included here.

**Medical equipment** (codes 410-419) includes: dental, medical or other powered bed, chair or wheelchair; dental equipment; dialysis equipment; medical monitoring and imaging equipment; oxygen administration equipment; radiological equipment; medical sterilizers, therapeutic equipment and unclassified medical equipment. As noted in Appendix A, a proportional share of commercial and medical equipment (code 400) is included here.

**Mobile property (vehicle)** describes fires in which some type of mobile property was involved in ignition, regardless of whether the mobile property itself burned (mobile property involved codes 2 and 3).

**Exposures** are fires that are caused by the spread of or from another fire. These were identified by factor contributing to ignition code 71. This code is automatically applied when the exposure number is greater than zero.
Appendix C.
Home Upholstered Furniture Fires Started by Hot Embers or Ashes

Frequency of fires started by hot embers or ashes increased in NFIRS 5.0
During 2005-2009, hot embers or ashes started an average of 660 (10%) home upholstered furniture fires per year, causing an average of 34 (7%) deaths annually. On average, one of every 19 such fires resulted in death. The NFIRS 5.0 Complete Reference Guide notes that the category of hot ember or ash includes hot coals, coke and charcoal as well as sparks or embers from a chimney that ignite the roof of the same structure. It excludes flying brands, embers, sand sparks, and embers accidentally escaping from operating equipment. Unfortunately, we do not know the source of these sparks or embers.

In earlier versions of NFIRS, cigarettes and other smoking materials (form of heat of ignition 30-39) occurred in the code choice list before embers or ashes (form of heat of ignition 53). Through most of the 1980s and 1990s, hot embers or ashes started 1-20% of the home upholstered furniture fires and were the heat source in 0-2% of the associated deaths. These percentages increased at about the same time that NFIRS 5.0 was adopted. In NFIRS 5.0, hot ember or ash is heat source 43 while smoking materials are captured by heat source 61-63.

It is possible that some portion of the embers or ashes in these fires were from smoking materials, whether directly off a cigarette or coming from an ashtray or related receptacle. Table A.C-1 and Figure A.C-1 show the trend for home structure fires started by embers or ashes. Table A-2 and Figure A.C.-2 show the associated fire death trend. The totals in both tables represent the sum of the two categories. The percentages are the percent of the upholstered furniture fires started by these heat sources.

Figure A.C.-1 Home Structure Fires Started by Embers or Ashes, by Year: 1980-2009

Source: NFIRS and NFPA survey.
If fires started by embers or ashes are added to fires started by smoking materials, the total number of home upholstered furniture fire started by these heat sources fell by 91% from 23,700 in 1980 to 2,100 in 2009.

**Figure A.C.-2. Civilian Deaths from Home Structure Fires Started by Embers or Ashes by Year: 1980-2009**

If hot embers or ashes do frequently come from smoking materials, the totals in Tables A.C.-1 and A.C.-2 could be considered upper bounds for fires started by smoking materials, including all embers or ashes. This is almost certainly an overestimate.
### Table A.C.-1.
**Home Upholstered Furniture Fires Started by Smoking Materials and Embers or Ashes by Year 1980-2009**
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Year</th>
<th>Smoking Materials</th>
<th>Embers or Ashes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>23,300 (63%)</td>
<td>400 (1%)</td>
<td>23,700 (64%)</td>
</tr>
<tr>
<td>1981</td>
<td>21,800 (64%)</td>
<td>300 (1%)</td>
<td>22,100 (65%)</td>
</tr>
<tr>
<td>1982</td>
<td>17,100 (62%)</td>
<td>200 (1%)</td>
<td>17,300 (63%)</td>
</tr>
<tr>
<td>1983</td>
<td>14,500 (59%)</td>
<td>200 (1%)</td>
<td>14,700 (60%)</td>
</tr>
<tr>
<td>1984</td>
<td>14,100 (59%)</td>
<td>200 (1%)</td>
<td>14,300 (59%)</td>
</tr>
<tr>
<td>1985</td>
<td>12,800 (55%)</td>
<td>200 (1%)</td>
<td>13,000 (56%)</td>
</tr>
<tr>
<td>1986</td>
<td>12,300 (56%)</td>
<td>300 (1%)</td>
<td>12,600 (57%)</td>
</tr>
<tr>
<td>1987</td>
<td>11,400 (55%)</td>
<td>300 (1%)</td>
<td>11,700 (56%)</td>
</tr>
<tr>
<td>1988</td>
<td>11,000 (54%)</td>
<td>300 (1%)</td>
<td>11,300 (56%)</td>
</tr>
<tr>
<td>1989</td>
<td>9,400 (52%)</td>
<td>200 (1%)</td>
<td>9,600 (53%)</td>
</tr>
<tr>
<td>1990</td>
<td>8,500 (52%)</td>
<td>200 (1%)</td>
<td>8,700 (53%)</td>
</tr>
<tr>
<td>1991</td>
<td>8,200 (51%)</td>
<td>200 (1%)</td>
<td>8,400 (52%)</td>
</tr>
<tr>
<td>1992</td>
<td>7,100 (47%)</td>
<td>200 (1%)</td>
<td>7,300 (48%)</td>
</tr>
<tr>
<td>1993</td>
<td>6,900 (48%)</td>
<td>200 (1%)</td>
<td>7,100 (49%)</td>
</tr>
<tr>
<td>1994</td>
<td>6,400 (46%)</td>
<td>200 (2%)</td>
<td>6,600 (47%)</td>
</tr>
<tr>
<td>1995</td>
<td>6,200 (47%)</td>
<td>200 (2%)</td>
<td>6,400 (48%)</td>
</tr>
<tr>
<td>1996</td>
<td>5,900 (46%)</td>
<td>200 (1%)</td>
<td>6,100 (48%)</td>
</tr>
<tr>
<td>1997</td>
<td>5,300 (45%)</td>
<td>200 (1%)</td>
<td>5,500 (46%)</td>
</tr>
<tr>
<td>1998</td>
<td>5,100 (44%)</td>
<td>200 (2%)</td>
<td>5,300 (46%)</td>
</tr>
<tr>
<td>1999</td>
<td>3,100 (38%)</td>
<td>400 (5%)</td>
<td>3,600 (43%)</td>
</tr>
<tr>
<td>2000</td>
<td>3,100 (34%)</td>
<td>800 (9%)</td>
<td>4,000 (43%)</td>
</tr>
<tr>
<td>2001</td>
<td>3,100 (32%)</td>
<td>900 (10%)</td>
<td>4,100 (42%)</td>
</tr>
<tr>
<td>2002</td>
<td>2,600 (29%)</td>
<td>900 (10%)</td>
<td>3,400 (39%)</td>
</tr>
<tr>
<td>2003</td>
<td>2,200 (28%)</td>
<td>700 (9%)</td>
<td>2,900 (37%)</td>
</tr>
<tr>
<td>2004</td>
<td>2,300 (29%)</td>
<td>700 (10%)</td>
<td>3,000 (38%)</td>
</tr>
<tr>
<td>2005</td>
<td>2,000 (26%)</td>
<td>700 (9%)</td>
<td>2,700 (36%)</td>
</tr>
<tr>
<td>2006</td>
<td>2,100 (27%)</td>
<td>800 (10%)</td>
<td>2,900 (36%)</td>
</tr>
<tr>
<td>2007</td>
<td>1,900 (27%)</td>
<td>600 (9%)</td>
<td>2,600 (36%)</td>
</tr>
<tr>
<td>2008</td>
<td>1,800 (27%)</td>
<td>600 (9%)</td>
<td>2,500 (36%)</td>
</tr>
<tr>
<td>2009</td>
<td>1,500 (27%)</td>
<td>600 (10%)</td>
<td>2,100 (37%)</td>
</tr>
</tbody>
</table>

Note: Percentes are based on non-confined home upholstered furniture fires of all causes. Sums may not equal due to rounding errors. The statistics on smoking materials include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Estimates for 1999-2009 are based on data collected originally in NFIRS 5.0 only. Due to the smaller share of NFIRS data collected in 1999-2001, statistics for these years should be viewed with caution.

Source: NFIRS and NFPA survey.
## Table A.C.-2
Deaths from Home Upholstered Furniture Fires Started by Smoking Materials and Embers or Ashes by Year 1980-2009
(Excluding fires with confined structure fire incident types)

<table>
<thead>
<tr>
<th>Year</th>
<th>Smoking Materials</th>
<th>Embers or Ashes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>1,060 (78%)</td>
<td>0 (0%)</td>
<td>1,060 (78%)</td>
</tr>
<tr>
<td>1981</td>
<td>1,120 (82%)</td>
<td>30 (2%)</td>
<td>1,150 (84%)</td>
</tr>
<tr>
<td>1982</td>
<td>980 (82%)</td>
<td>10 (1%)</td>
<td>990 (83%)</td>
</tr>
<tr>
<td>1983</td>
<td>850 (77%)</td>
<td>0 (0%)</td>
<td>850 (77%)</td>
</tr>
<tr>
<td>1984</td>
<td>860 (79%)</td>
<td>20 (2%)</td>
<td>880 (81%)</td>
</tr>
<tr>
<td>1985</td>
<td>720 (77%)</td>
<td>0 (0%)</td>
<td>720 (77%)</td>
</tr>
<tr>
<td>1986</td>
<td>770 (72%)</td>
<td>0 (0%)</td>
<td>770 (72%)</td>
</tr>
<tr>
<td>1987</td>
<td>700 (68%)</td>
<td>20 (2%)</td>
<td>720 (70%)</td>
</tr>
<tr>
<td>1988</td>
<td>810 (74%)</td>
<td>10 (1%)</td>
<td>820 (75%)</td>
</tr>
<tr>
<td>1989</td>
<td>670 (76%)</td>
<td>0 (0%)</td>
<td>670 (77%)</td>
</tr>
<tr>
<td>1990</td>
<td>590 (68%)</td>
<td>0 (0%)</td>
<td>590 (68%)</td>
</tr>
<tr>
<td>1991</td>
<td>450 (66%)</td>
<td>0 (0%)</td>
<td>450 (66%)</td>
</tr>
<tr>
<td>1992</td>
<td>480 (76%)</td>
<td>0 (1%)</td>
<td>480 (77%)</td>
</tr>
<tr>
<td>1993</td>
<td>440 (68%)</td>
<td>10 (2%)</td>
<td>450 (69%)</td>
</tr>
<tr>
<td>1994</td>
<td>410 (61%)</td>
<td>10 (2%)</td>
<td>420 (63%)</td>
</tr>
<tr>
<td>1995</td>
<td>490 (74%)</td>
<td>0 (0%)</td>
<td>490 (74%)</td>
</tr>
<tr>
<td>1996</td>
<td>470 (72%)</td>
<td>0 (0%)</td>
<td>470 (72%)</td>
</tr>
<tr>
<td>1997</td>
<td>450 (68%)</td>
<td>10 (2%)</td>
<td>460 (70%)</td>
</tr>
<tr>
<td>1998</td>
<td>350 (65%)</td>
<td>10 (1%)</td>
<td>360 (66%)</td>
</tr>
<tr>
<td>1999</td>
<td>360 (75%)</td>
<td>60 (13%)</td>
<td>420 (88%)</td>
</tr>
<tr>
<td>2000</td>
<td>330 (58%)</td>
<td>30 (6%)</td>
<td>360 (63%)</td>
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<tr>
<td>2001</td>
<td>380 (62%)</td>
<td>0 (0%)</td>
<td>380 (62%)</td>
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<td>230 (43%)</td>
<td>50 (10%)</td>
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<td>310 (47%)</td>
<td>20 (3%)</td>
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<td>2004</td>
<td>370 (53%)</td>
<td>30 (4%)</td>
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<td>310 (64%)</td>
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<td>250 (50%)</td>
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<tr>
<td>2009</td>
<td>220 (49%)</td>
<td>60 (12%)</td>
<td>280 (62%)</td>
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Note: Percents are based on deaths from home upholstered furniture fires of all causes. Sums may not equal due to rounding errors. The statistics on smoking materials include a proportional share of fire deaths in which the heat source was heat from an unclassified open flame or smoking material. Estimates for 1999-2009 are based on data collected originally in NFIRS 5.0 only. Due to the smaller share of NFIRS data collected in 1999-2001, statistics for these years should be viewed with caution.

Source: NFIRS and NFPA survey.
Published incidents provide information about what can happen, not what is typical. Articles from NFPA publications about specific incidents illustrate some of the ways in which upholstered fire catches fire or is involved in fire. These incidents were taken from the “Firewatch” Columns and annual studies of catastrophic fires in NFPA Journal. These incidents tend to be more serious than the typical fire.

**Smoking Materials**

**No Batteries Found in Smoke Alarms in Fatal Fire, Florida**
A man in his 60s died of smoke inhalation when a fire that started in the living room filled his single-family house with smoke as he slept. His body was discovered by a deputy sheriff who responded to a 911 call from a Meals-on-Wheels driver who’d become worried because the man had not answered his door in two days.

The one-story, single-family house was constructed of wood and concrete and had a wood-framed roof covered by asphalt shingles. There were no sprinklers, and the three smoke alarms installed in the kitchen, the hallway, and the master bedroom had no batteries.

Fire department investigators discovered a distinctive V-pattern burn that clearly showed that the fire started in an upholstered couch and burned until it burned itself out. They also noted that high heat left the walls very dark from about the 5-foot (2-meter) level to the ceiling and stained the floor throughout the house. When they found an ashtray with cigarette butts and open beer cans around the couch, they determined that the victim had dropped a lit cigarette on the couch before going to bed.

The house, which was valued at $100,000, and its contents, valued at $20,000, sustained an estimated $5,000 in damage.


**Smoking Material Fire Kills Two, Utah**
Two women, one 90 years old and the other 55, died when a fire started by smoking materials that had been improperly disposed of ignited a recliner, filling their single-family home with smoke.

The single-story, wood-frame house, which was 40 feet (12 meters) long and 30 feet (9 meters) wide, had concrete block walls and a pitched wooden roof covered with asphalt shingles. A battery-operated smoke alarm had been installed in the first-floor hallway, but firefighters said they did not hear it operating during their initial search and rescue operations. There were no sprinklers.
The former husband of one of the women, who visited frequently and acted as their caretaker, arrived around 10:15 a.m. When he opened the door, he found smoke filling the house. He called 911 and told the arriving crews that the two women, who were both physically disabled, were probably inside.

Firefighters found the first victim in the bathroom off the master bedroom on the first floor and quickly took her outside for emergency medical treatment. A second crew found the other woman in a basement bedroom on the floor next to the bed. She was pronounced dead at the scene.

Investigators determined that the fire started in the basement family room in an upholstered recliner, on the arm of which they found a full ashtray that was leaning in a bit toward the seat. After the fire consumed the available oxygen, it almost self-extinguished. Firefighters put out the smoldering remains.

The women died of smoke inhalation. The house, valued at $100,000, and its contents, valued at $30,000, sustained undetermined damages.


**Alcohol a Factor in Death, Texas**

A 58-year-old man died of smoke inhalation in a house fire that investigators believe was caused by a discarded cigarette.

The one-story, wood-frame, single-family home, built on a concrete slab foundation, had a brick veneer and an asphalt-shingled roof. Firefighters found a battery-operated smoke alarm on the wall in the hallway, but it had no battery. There were no sprinklers.

A neighbor who smelled smoke called 911 at 11:05 p.m., and the single engine the fire department sent to investigate called for a full first-alarm assignment. Responding firefighters, who forced the front door after seeing fire venting from the rear of the home, discovered that the fire was confined to the living room and extinguished it before it spread any further. They discovered the victim during a primary search and took him to the hospital, where he was pronounced dead.

Investigators determined that a discarded cigarette started the fire in an upholstered chair. Near the chair, they discovered several coffee cans holding cigarette butts, as well as several alcohol containers. Alcohol was a contributing factor in the victim’s death.

The house and its contents, together valued at $85,000, sustained damage estimated at $75,000.

Cigarette Starts Fatal Fire, Minnesota
A 67-year-old woman died as a result of a fire in her apartment that began when a cigarette she dropped ignited paper on the floor. The three-story, wood-frame apartment building, which was 325 feet (99 meters) long and 75 feet (23 meters) wide, had a wood truss roof that was covered by asphalt shingles.

A central station alarm company monitored smoke detectors in the common hallways and heat detectors in all the units. The heat detection system operated properly. Hardwired smoke detectors had also been installed in the apartments, but they did not have battery backup. The building had a standpipe connection but no sprinklers.

Firefighters responding to a 5:27 a.m. call from the alarm company found smoke coming from a rear-facing balcony on the third floor. The first-due engine company connected to a hydrant to support the standpipe system, while other crews attached a hose line to the standpipe and advanced to the apartment of origin. Forcing the door, they entered the one-bedroom unit and found flames travelling across the ceiling. They played the hose stream on the flames and extinguished the fire.

Firefighters found the victim lying on the floor against her bed, unconscious but still breathing. They took her to the hospital, where doctors discovered she had suffered smoke inhalation and second- and third-degree burns to her right side, upper torso, and face. She was transferred to a burn center but died a week later.

Investigators determined that the fire began in the living room near an upholstered chair when the woman dropped a cigarette on paper on the floor nearby. The resulting fire spread to the chair and other items before it was extinguished.

Autopsy results indicated that the woman had a blood alcohol level of .189, which may have contributed to her death. The investigators believe she fell asleep, dropped her cigarette, awoke during the fire, and tried unsuccessfully to escape. The apartment’s smoke alarm may not have operated, since investigators found that the circuit to which it was wired had tripped.

The building was valued at $3 million, and its contents were valued at $1 million. Damage to the building is estimated at $20,000, while damage to the contents is estimated at $10,000. There were no other deaths or injuries.


Smoking on Oxygen Causes Deadly Fire, Colorado
A 72-year-old woman who often smoked, even though she was on a home-assisted oxygen breathing apparatus, died in her home in an early-morning fire caused by her smoking materials.

The ranch-style, wood-frame house, which was 30 feet (9 meters) long and 28 feet (8 meters) wide, had exterior brick walls and an asphalt roof. It had neither smoke alarms nor sprinklers. The single-family home was occupied by the victim and two other adults.
One of the occupants awoke to the fire and called 911 at 4:12 a.m. Arriving police officers tried to enter through the front door, but they were driven back by high concentrations of heat and smoke.

However, one officer was able to remove a number of oxygen cylinders stored near the doorway, while others helped two occupants get out of the house through a front bedroom window. The fire quickly filled the living room window and the front door.

Fire crews arrived within five minutes of alarm and found heavy flames coming from the front and rear of the building. Just as an engine company was preparing to enter the front door with a hose line, they saw a white flash, heard a “whoosh” sound, and were driven back. A firefighter who fell on the ice while stepping away from the house injured his knee.

Meanwhile, knocking down the blaze as they went through the house, the interior fire crew found the body of the 72-year-old woman, who had obvious burn injuries.

Investigators discovered that the fire started in the living room where the victim often slept and where they found an oxygen concentrator, a lift chair, a wheel chair, and other items the victim used. They determined that a cigarette ignited her upholstered chair and that the fire spread from the living room to the kitchen and bedrooms.

The woman, who was terminally ill, often smoked in the living room and had occasional episodes of unconsciousness during which she dropped her cigarette on the furniture, resulting in burn marks. She normally lit her first cigarette of the day around 4:00 a.m., which is consistent with the fire’s time frame.

As the victim often watched television with the volume turned up, the other two occupants slept with their doors closed, a barrier that provided enough time for their rescue.

The home, valued at $140,000, and its contents, valued at $20,000, sustained damages estimated at $70,000 and $16,000, respectively.


**Occupants Trying to Remove Burning Sofa Blocks Exit, Massachusetts**

Instead of calling the fire department and then escaping from a fire, occupants of an apartment decided to remove a burning couch. The fire eventually blocked the exits, the home filled with smoke. Two of the four occupants were visitors and unfamiliar with the home’s layout. The visitors died in the fire, while the two others escaped.

The fire occurred within a three-story, five-unit apartment building constructed of wood framing with an asphalt-shingled roof. The building had a hardwired smoke-detection system, but no sprinklers.

A discarded cigarette started a smoldering fire within an upholstered sofa in the first-floor unit’s living room. Smoke triggered the detector and it alerted the occupants who tried to remove the
burning sofa from the home. Reaching the kitchen, smoke from the fire became too much and two of the occupants exited through a front door. A female visitor, 23, had her obvious exit blocked and unfamiliar with the layout was overcome by smoke. Firefighters found her in an open closet. The second victim, a 24-year-old male visitor, attempted to escape through a bathroom but was also overcome by smoke.

The delay in alerting the fire department allowed the fire to grow. Arriving firefighters found heavy fire venting from the windows. The fire was rapidly controlled after two hose lines for fire attack were deployed. Other crews completed ventilation, and conducted a search and rescue.

The building suffered $75,000 in loss with contents having an estimated loss of $35,000. There were no other injuries during the incident.


**Cigar Ignites Upholstered Chair in Fatal Fire, Maryland**

An 80-year-old man whose upholstered chair ignited shortly after he lit a cigar suffered burns that led to his death nearly a month later.

The fire occurred in an 11-story, fire-resistive apartment building measuring 100 feet (30 meters) by 100 feet (30 meters). The structure, which had concrete floors and walls and a masonry exterior, was protected by a wet-pipe sprinkler system and a smoke detection system.

The victim said he lit a cigar while sitting in the chair in his eighth-floor apartment, and the next thing he saw was a flash. When the fire spread from the chair to the victim’s shirt, he took off the burning shirt and dropped it to the floor, allowing the fire spread to the carpet. Although burned, he managed to go to a neighbor’s apartment for help.

Responding firefighters, who received the 911 call at 4:19 p.m., found that a sprinkler had already extinguished the fire by the time they arrived. Investigators determined that dropped or discarded smoking materials ignited the inside of the chair.

The victim suffered second- and third-degree burns to his upper torso, face, and head. He lived for almost a month before succumbing to his injuries. The apartment, valued at $200,000, sustained a $30,000 loss; its contents, valued at $30,000, sustained damages of $10,000

Carelessly Discarded Cigarette Leads to Fatal Fire, Nebraska
A cigarette carelessly discarded in an overstuffed chair started a fire that killed a 46-year-old woman in her apartment.

The two-story, four-unit apartment building, which was 60 feet (18 meters) long and 30 feet (9 meters) wide, had brick exterior walls. There were smoke alarms in each unit, but they weren’t part of a monitored fire-detection system. There were no sprinklers.

At 10:12 p.m., firefighters received a call from a neighbor who thought she heard a smoke detector sounding. Fire crews arrived minutes later and were directed to a smoke-filled, second-floor unit, where they found the unconscious woman. Paramedics transported her to the local hospital.

The fire was confined to the living room chair, although smoke damaged other parts of the apartment. Investigators found cigarette butts, empty cigarette packages, and burn marks throughout the apartment and determined that the victim had dropped a cigarette, which ignited the chair. The woman, who died of smoke inhalation, had a chronic illness that may have prevented her from escaping.

Although the unit of origin suffered heavy smoke damage, the rest of the building had only moderate smoke and heat damage. Losses to the building, valued at $160,000, were estimated at $5,000. Its contents, valued at $10,000, sustained a $5,000 loss.


Cigarette Started Catastrophic Upholstered Furniture Fire, Michigan
In May 1999, a Michigan fire department was alerted at 4:45 a.m. to a fire in a two-story, single-family dwelling of unprotected wood-frame construction. Six people died in this fire.

A discarded cigarette ignited a couch in an enclosed porch that was used as a family room. The occupants thought they’d extinguished the fire, but it continued to smolder, burst into flames, and spread throughout the house.

The house had smoke alarms that worked on all levels. There was no alarm in the room of fire origin, though it wasn’t required. Two of the victims were disabled and three others, who were visitors, were asleep and intoxicated.

**Open Flame or Intentional**

**Candles Ignite Deadly Fire, New Jersey**  
Several candles used for illumination and located throughout the home are believed to have started a deadly fire that killed a woman and two children. The utility company disconnected electrical power to the home earlier in the afternoon due to non-payment. The homeowner stated they were using candles about the house, but that all were extinguished before they retired for the evening. The single-family, one-story home did not have smoke alarms or sprinklers.

A dog woke an occupant who opened her bedroom door and found smoke and heat within the home. She called her daughter who responded and then exited the home using a rear door. The daughter called back to her mother that she couldn’t make it out, as the mother tried to re-enter the home.

The fire department received the alarm at 2:11 a.m. and responded within nine minutes to find the home well involved, especially the living area. After the fire was controlled they found a 9-year old boy in one bedroom, a 28-year old female, and a 2-year old boy together in another bedroom.

Investigators believe that a candle on a wall-mounted holder fell and ignited a couch. Fire traveled horizontally throughout the house and trapped three of the occupants who succumbed of smoke inhalation. Three firefighters also received injuries during suppression. The estimated losses and the home’s value were not reported.


**Child Ignites Fire in Apartment that Kills Four People, Georgia**  
Four people died in a fire that started when a child playing with a lighter ignited a sofa. The first-floor apartment fire quickly involved the entire unit when the fire department arrived. Firefighters entered a bedroom, performed a search, and quickly left when the fire got worse.

The two-story apartment building measured 30 feet (9 meters) by 60 feet (18 meters) and contained four units. It was a wooden-frame building with a brick veneer and a wooden-decked roof covered by asphalt shingles. Investigators were unable to locate any smoke detection equipment. There were no sprinklers.

The fire was detected by an occupant who called 911 at 7:56 p.m. Firefighters arrived five minutes later and found fire coming from windows and doors at the front and rear of the building. Witnesses reported several people trapped, as the first arriving crew entered a front bedroom window to do a quick search. Two 1-3/4-inch hose lines were advanced into the front door to extinguish the fire.

During the overhaul, firefighters found the bodies of two boys, 8 and 5, and a 9-year-old girl. Details of an adult who also died at the scene are unavailable. There were no firefighter injuries.

Candle Fire in Basement Apartment Kills Man, Nebraska
A candle left burning on the floor in a rented basement room that had no smoke alarm started a fire that eventually burned itself out, but not before fatally injuring the room’s occupant.

The fire occurred in a single-story, wood framed house with two living units on the first floor. Each unit also had a bedroom in the basement that was rented out to a single occupant. The only smoke alarm in the unsprinklered house, which measured 50 feet (15.2 meters) by 20 feet (6 meters), was in the first-floor hallway near sleeping areas. One of the basement renters smelled smoke and alerted the other occupants before calling the fire department at 6:08 a.m. He did not know whether the other basement renter, a 28-year-old man, was home at the time but told first responders he might be.

Fire crews arriving six minutes later found light smoke coming from the building but could see no fire. When they searched the lower level, they found that the blaze in the victim’s room had nearly extinguished itself. Searching further, they found the man leaning against a clothes dryer in his room, overcome by smoke.

Investigators determined that the candle ignited a sofa and that the fire spread to a table and other combustibles, producing heavy smoke. The coroner’s report stated that the victim died of severe carbon monoxide poisoning and had levels of an illegal substance and alcohol in his blood at the time of his death. All the house’s other occupants, who were sleeping at the time, escaped unharmed.

Damage to the $200,000 structure was approximately $6,000.


Child-Playing Fire Kills Two Family Members, New York
A 6-year-old playing with fire ignited a couch, and the resulting blaze trapped his mother and two younger siblings in their apartment. Although the fire was primarily confined to the foam-filled sofa, it created enough smoke to block their exit. The child who started the fire got out of the apartment unharmed.

The fire occurred in a seven-story, 80-unit apartment building of fire resistive construction that measured 250 feet by 150 feet (76 by 46 meters). The building had a hardwired fire detection system that provided only a local alarm.

A call to 911 at 6:44 p.m. alerted the fire department, and firefighters were advancing hose lines to the unit of origin on the sixth floor within a few minutes of their arrival. They quickly controlled the fire and rescued the 41-year-old mother and her 3- and 5-year-old children within 8 to 10 minutes of dispatch or an estimated 16 to 18 minutes after ignition. Firefighters were able to revive the mother, but the two children died of smoke inhalation.

The fire began when the 6-year-old ignited some toilet paper while playing with the kitchen stove and carried it into the living room. When his mother entered the apartment from the rear, the boy hid the burning paper, either under a sofa cushion or under the sofa. The flames ignited
the couch. The boy ran from the apartment, as his mother went to try to rescue her two younger children, who were trapped in a back room.

Damage to the building, valued at $2.5 million, was estimated at $10,000. Damage to its contents came to $2,000. Two firefighters were injured fighting the fire. One suffered a knee injury and the other a back injury.


**Heating Equipment**

**Heater Starts Fatal Fire, Ohio**
A six-year-old boy died of smoke inhalation in a fire that began when a heater ignited a couch on the screened porch of his single-family, wood-frame home. The two-story house, which had an asphalt roof, was 50 feet (15 meters) long and 30 feet (9 meters) wide. It had no smoke alarms.

The residents awoke at some point during the fire and tried to extinguish the flames using water from the kitchen before someone finally called 911 at 3:25 a.m. Firefighters arrived to find the room of origin totally involved in flames.

The location of the boy was not reported. The house, valued at $65,000, and its contents, valued at $10,000, were nearly destroyed.


**Portable Heater Fire Kills Occupant, New York**
A 65-year-old man died when a portable electric heater placed too close to the recliner in which he was sleeping ignited the chair or his blanket.

The two-story, wood-frame single family home, which was 36 feet (11 meters) long and 25 feet high (8 meters), had no smoke alarms or sprinklers.

At 4 a.m. a passerby called 911 after seeing flames 4 feet (1.2 meters) long coming from the windows of the house.

At some point during the fire, the victim tried to escape. He was found on the floor behind a door where he had succumbed to smoke inhalation and burns.

The house, valued at $9,000, and its contents, valued at $20,000, were destroyed.

Furniture on Floor Furnace Ignites Fatal Fire, California
A 29-year-old man died and a woman was injured in an early-morning fire that began after a sofa placed over a floor furnace in the man’s single-family home ignited and burned undetected. The one-story, wood-frame house, which measured 36 feet (11 meters) by 40 feet (12 meters), had no smoke alarms or sprinklers.

Firefighters responding to the 3:34 a.m. 911 call found the woman outside the burning house from which she had escaped by crawling through a bedroom window, sustaining numerous lacerations. Fire crews who entered the house in search of the other occupant found him in the bathtub, dead of smoke inhalation. Apparently, he had become aware of the fire but went to look for his cat rather than escape. The cat was found dead in one of the bedrooms.

Investigators found that the furnace’s thermostat had been turned up and determined that the heat had caused the sofa to ignite. The fire burned in a V-pattern from the living room to other areas of the home and down to a crawl space below.

Damage to the house, valued at $700,000, was estimated at $200,000. Its contents, valued at $400,000, were destroyed.


Smoke Alarm Alerts Occupant, Rhode Island
Smoke from a fast-moving fire in the living room of an apartment in a three-family house activated a smoke alarm, alerting the structure's occupant.

The three-story, wood-frame dwelling measured 30 feet (9 meters) by 26 feet (8 meters). Battery-operated smoke alarms had been installed in the apartment of origin, but there were no fire sprinklers.

The fire began around 10 a.m. when radiant heat from a portable electric space heater on a living room coffee table ignited the fabric of two couches. A smoke alarm alerted the occupant, who tried to control the fire with a portable fire extinguisher until smoke forced him from the room. The fire caused the apartment's windows to fail, and the exterior wood siding ignited before the fire department arrived.

Fire companies used master streams to knock down the heavy fire, then completed extinguishment using several hose lines on each floor. The $200,000 building and its contents, valued at $40,000, were destroyed. There were no injuries.

Kerosene heater ignited upholstered chair in catastrophic fire, North Carolina
In April 1999, a North Carolina fire department was notified at 11:55 a.m. of a fire in a single-family manufactured home of unprotected wood-frame construction. Five people died in this fire, including one child under age six.

An unvented kerosene heater ignited an upholstered chair in the living room, and the resulting fire spread throughout the home. There were no smoke alarms to warn the victims, who were all asleep when the fire broke out.


Electrical Distribution or Lighting Equipment

Extension Cord Involved in Sofa Ignition Catastrophic Fire, North Carolina
In March 2006, a North Carolina fire department was notified at 4:00 a.m. of a fire in a 1½-story, single-family home of unprotected ordinary construction. Five people died in this fire, including one child under age six.

The fire originated in the living room. A couch was positioned against an extension cord plug. Pressure from the arm support flattened the plug causing a short circuit in the wiring. The short circuit ignited the couch. Fire burned into the fabric and foam cushion, producing heavy black smoke. Four of the victims were located in a first-story bedroom with doors closed. The fifth victim was found near the doorway. He had attempted to extinguish the fire with water from a sink.

There was a delay in reporting the fire, and one occupant attempted to extinguish the fire rather than evacuate. The remains of a smoke alarm was found, with battery installed, but it is undetermined if it activated.


Damaged Extension Cord Started Catastrophic Fire, Pennsylvania
In March 2006, a Pennsylvania fire department was notified at 2:30 a.m. of a fire in a two-story, single-family row house of unprotected ordinary construction. Five people died in this fire, including two children under age six. No smoke alarms or sprinklers were present.

An extension cord to a space heater was under a chair and was damaged by the weight of the chair. The damaged overloaded cord ignited the chair. The fire spread to a nearby sofa then vented out the first-story front room. The fire also extended up an open stairway to the second-story hallway.

A heavy security screen and security storm door hindered escape of the victims and delayed the firefighters in their fire attack and rescue. The only exit was a front door. One victim had jumped and was found outside, while another was located on the first-story, and the other three were in a second-story bedroom.

Overheated Power Strip Ignited Couch in Catastrophic Fire, Michigan
In July 2003, a Michigan fire department was notified at 10:00 p.m. of a fire in a two-story single-family dwelling of unprotected ordinary construction. The fire killed six people, including four children under the age of six. No smoke alarms or sprinklers were present.

A power strip for a window air-conditioning unit was pinned between a wall and couch. It overheated and ignited the couch, window treatments, and penetrated the joist space. The victims were in bed in second-story bedrooms and had no warning of the fire.


Other or Undetermined Sources of Upholstered Furniture Ignition or Fire Spread to Upholstered Furniture

Fireplace Starts Fatal Fire, California
A 91-year-old woman died and her 89-year-old husband was injured in a fire that began as the man burned newspapers, old mail, and trash in the fireplace of their second-floor apartment.

The walls of the six-unit, wood-frame apartment building, which was 50 feet (15 meters) wide and 75 feet (23 meters) long, consisted of plaster over wood lath. Stairwells at the front and rear of the building provided egress to two apartments on each level. Smoke alarms had been installed in the common stairwells and the individual units. There were no sprinklers.

The fire department received the alarm at 11:52 a.m. and arrived minutes later to find fire blowing out of the windows and threatening exposures and the floor above. The man, who had managed to escape from the unit, met firefighters and reported that his wife was still in the apartment.

Advancing hose lines to the second floor, firefighters knocked the spreading fire down and entered the apartment, where they found the body of the victim in the hallway by the front door near the room of origin.

The woman’s husband told investigators that he was burning paper and trash in his fireplace when some of the burning paper spilled onto the floor and ignited nearby combustibles. He tried to extinguish the fire with wet towels and water, but it grew quickly, spreading to upholstered furniture. Calling for his wife, he left the building by the rear staircase.

The building, valued at $4.5 million, sustained $800,000 in damage. The contents were valued at $600,000, and sustained $400,000 damage. The victim’s husband was burned, but no one else was injured.

**Heating Pad Starts Fatal Fire, Kansas**
A woman died in an early morning fire that began in an upholstered recliner in the family room of her single-family house.

The single-story, wood-frame dwelling had three bedrooms, a kitchen, a living room and a garage that had been converted into a family room. Its hardwired smoke detectors with battery backup operated as designed. There were no sprinklers.

A passerby discovered the fire and alerted police officers at a convenience store around 1:20 a.m. The officers responded to the scene and notified the 911 dispatcher of the situation. The officers then forced the front door open and removed the woman, who was lying on the living room love seat just inside the door. By that time, however, she had sustained fatal smoke inhalation injuries.

Within minutes, fire crews arrived to find fire coming from the home and police outside with the victim. While some firefighters advanced a 1 3/4-inch (4-centimeter) hose line through the front door, others tended to the victim, established a water supply, and ventilated the building. Crews searching for additional victims reported high heat and heavy smoke.

Investigators determined that portions of an electric heating pad that the woman had used in the recliner to soothe her chronic back pain had been forced into the folds of the chair's padding. The bent pad overheated and eventually ignited, and the fire burned until all combustible items in the room reached ignition temperature, flashing over before the fire department arrived.

The home sustained an $80,000 loss, and its contents, valued at $40,000, were destroyed.


**House fire kills one child, injures another, Idaho**
A 2-year-old girl and her 18-month-old brother who had been left alone in their home were unable to help themselves when a fire that started on the front porch burned through the single-family house.

The wood-frame dwelling, which was 46 feet (14 meters) long and 28 feet (8.5 meters) wide, had a battery-operated smoke alarm in a hallway, but investigators could not determine whether it operated. There were no sprinklers.

Firefighters received the alarm from a passerby at 2:21 p.m. While en route, they received follow-up reports from dispatch stating the house was fully involved.

Three minutes after they were dispatched, the first-arriving engine company noted heavy fire on the outside front of the home and reported that the windows were just starting to fail, allowing the fire into the structure. Firefighters advanced a hose line and knocked down the heavy fire at the front of the building before repositioning their hose line to the rear of the building. Forcing entry through the locked kitchen door, they approached the fire from the unburned side of the living room and quickly extinguished the blaze.
Interior crews conducting a primary search found the boy in a crib in a first-floor bedroom, and another company found the girl in a crib in a second bedroom. Both were treated for smoke inhalation, but the girl died of her injuries. Several teams of firefighters searched the house several more times for an adult who was reported to have been inside, but found none. Neither parent was home at the time of the fire.

Investigators determined that the blaze began near two upholstered chairs on the porch where the children's parents went to smoke but could not discover the cause.

Most of the fire damage was limited to the front of the house and front rooms on the first floor, although there was smoke damage throughout. Damage to the house, valued at $80,000, was estimated at $50,000. The contents, valued at $7,000, were destroyed. Both of the children's parents were charged with involuntary manslaughter in the little girl's death.


Sprinklers Douse High-Rise Fire, Minnesota
Two sprinklers activated and extinguished a fire in an apartment in a 20-story apartment building. At the time of the fire, the occupant of the second-floor apartment was not at home.

Each floor of the 149-unit building covered about 15,000 square feet (4,572 square meters) and was protected by a sprinkler system and fire detection system.

Firefighters received the alarm at 5:54 a.m. and responded to the apartment to find that the fire had already been extinguished. A small burned area in the living room contained the melted remains of a portable box-type fan and an upholstered swivel chair.

The apartment’s occupant told investigators that the fan had been operating normally when he left the apartment about five hours earlier. The investigator determined that it malfunctioned and tipped over, igniting the carpeting and chair.

Losses were estimated at $10,000. There were no injuries.


Smoke Detectors Save Occupants From Fast-Moving Fire, Pennsylvania
Seven people owe their lives to an automatic fire detection system installed in a single-family home used for student housing. An intentionally set fire on the first floor quickly traveled up the stairs to the second and third floors, blocking the primary exit for the occupants. Four occupants on the second floor had no choice but to fall from second floor windows to escape. Two third-floor occupants were trapped and suffered smoke inhalation injuries.

The three-story wooden-frame dwelling measured 55 feet (16 meters) by16 feet (4 meters) and had an asphalt-shingle roof. An automatic smoke detection system provided coverage in the bedrooms and common hallways. There were no sprinklers.
An occupant used an open flame device to ignite a blanket resting on top of an upholstered couch. The fire spread to the couch and throughout the living room before advancing vertically to upper floors. Two occupants of the second floor suffered trauma; two others from the same floor had smoke inhalation. The first-floor occupant also suffered smoke inhalation. The building, valued at $100,000, was a total loss.


**Porch Fire Spreads into House, Massachusetts**

Smoking materials dropped on a couch on the porch of a single-family house started a fire that spread into the home, trapping and killing an 89-year-old man. A passerby rescued three other occupants, and firefighters responding to a 911 call from the house saved a fourth.

The two-story, wood-frame house, which was 34 feet (10.4 meters) long and 24 feet (7.3 meters) wide, was unsprinklered. Smoke alarms had been installed in the basement and on the second floor, but their operation during the fire was not reported.

Investigators determined that the carelessly disposed of smoking materials ignited a couch on the porch. The fire then spread to other furnishings, aerosol cans, and a 20-pound (9-kilogram) propane cylinder, the contents of which contributed to the fire spread into the house.

The house, valued at $125,000, sustained structural losses of $80,000, and damage to its contents, valued at $80,000, came to $40,000.

The man firefighters rescued died of burns and smoke injuries about two months after the fire. The passerby who rescued the three occupants suffered smoke inhalation and burns, as did two firefighters.


**Intentional Porch Fire Spreads through Window to Ignite an Upholstered Couch in Catastrophic Fire, Pennsylvania**

In November 2003, a Pennsylvania fire department was notified at 3:42 a.m. of a fire in a two-story single-family dwelling of unprotected ordinary construction. The fire killed five people, including one child under six. Two smoke alarms were present, but one had a dead battery and the other had no battery.

This fire was set on a porch at the front door and extended to the porch roof and into the house via a front window where it ignited a foam-padded sofa. Smoke and flames extended via the stairway to the second story. Four victims were found on the second story.

Fireworks inside a Residence Ignite Deadly Fire, Missouri
A 6-year old boy and a 40-year old male died when fireworks ignited the interior of their home. Investigators believe hot embers from fireworks ignited an upholstered sofa and quickly spread, trapping the occupants. Firefighters fought through the fire and heavy smoke coming from the front door and quickly found one victim and later a second, but both had succumbed to smoke inhalation and burn injuries.

The single-family home was constructed of wood framing with a wooden roof and asphalt shingles. The 1,200-square-foot (111-square-meter) home lacked smoke alarms and sprinklers.

The fire department received a call from a passerby at 11:50 p.m. and arrived five minutes later to find police on scene reporting a person possibly trapped. As flames came out the front door and window, firefighters advanced a hose line into the front door knocking down the heavy fire as they went.

Within 10 feet (3 meters) of the door, the first victim was found and removed to the front lawn. Firefighters suppressed the fire and continued the primary search. A second victim was found in the kitchen and removed. The fire was contained to the first floor and the dwelling ventilated as the investigation began. Damages to the home were not reported.


Four Die in House Fire, West Virginia
A family of four died in an early-morning fire that spread from the first-floor living room to the upper floors. By the time firefighters arrived, the house was engulfed in flames, and the fire was threatening the houses on either side.

The single-family, wood-framed home was two stories high with wood siding and a metal roof. It was 30 feet (9 meters) wide. No smoke detection equipment was found, and there were no fire sprinklers.

A passerby discovered the fire, and woke the neighbors, and tried to get the occupants out of the house. The fire department received the 911 call at 3:08 a.m. Arriving firefighters established a water supply and used two 1 ¼-inch hose lines to protect the exposures. A second engine company also established a water supply and advanced additional hose lines to back up the first responders. They tried to enter the house, but heavy fire drove them out, and the incident commander ordered a defensive approach.

Investigators determined that the fire began in the living room couch, but they couldn’t determine what started it.

A man and a woman, both 44, and two boys, ages 14 and 11, succumbed to smoke inhalation. The house, valued at $40,000 and its contents, valued at $15,000 were destroyed.

**No Injuries in Early Morning Apartment Fire, Michigan**

Seventy-five residents of an apartment building for older adults were evacuated safely even though smoke and flames spread to two floors and the attic during an early morning fire. Firefighters and sprinklers were able to limit fire spread to one interior fire division.

The L-shaped, 72-unit apartment building contained 24 units per floor, and the two wings were connected by a central common area. Each wing had a center corridor nearly 142 feet (43 meters) long by 58 feet (18 meters) wide. The common areas, which measured 94 feet by 58 feet (29 meters by 18 meters), included a day room, a lobby, a mechanical room, and storage rooms. The apartments and common area had hard-wired smoke detectors monitored by a central station alarm company. Standpipes and a partial wet-pipe sprinkler system protected the hallways and common areas.

At 1:56 a.m., the fire department received a 911 call reporting smoke on the second floor. Arriving three minutes later, firefighters noted smoke coming from the roof and second floor and, with the help of police officers, began evacuating the building and rescuing occupants from balconies.

The first five responding firefighters were joined by roughly 270 other emergency workers. They provided numerous ambulances and dry school buses that transported the residents from a temporary staging area in a nearby parking lot to the hospital, where the cafeteria was used as a temporary processing center. Five residents were treated for smoke inhalation.

The blaze began in an unoccupied second-floor apartment, where an unknown heat source ignited an upholstered chair. The fire spread to nearby curtains and out the open patio door, allowing the flames to spread up the building's wall to a third-floor apartment and the attic.

Using numerous resources, including a fire partition in the attic and a pre-incident plan, firefighters stopped the blaze from spreading into the common area and the building's other wing. The activation of 20 sprinklers also helped prevent the fire from spreading and protected the hallways for evacuation.

The $1.6 million building suffered $850,000 in damage. Contents, valued at $1.5 million, sustained a $750,000 loss. No firefighters were injured.


**Sprinklers Extinguish Fire in Home Oxygen Unit, Arizona**

Careless disposal of smoking materials contributed to the smoke-inhalation death of a woman in her single-family home, despite the activation of two sprinklers that extinguished the flames.

The single-story, wood-frame house, which measured 50 feet (15 meters) by 40 feet (12 meters), had a stucco exterior and a tile roof. The home had a wet-pipe residential sprinkler system and a local smoke alarm, but neither system was monitored, and the smoke alarm may not have activated during the fire.
Investigators believe that smoking materials carelessly disposed of in a wastebasket ignited paper. When the occupant discovered the fire, she moved the wastebasket to the sink to extinguish it, but not before the fire burned through plastic oxygen tubing running under the basket. Flames spread along the oxygen-enriched tubing, igniting an upholstered stool and the oxygen generator in the first-floor living room. The fire was finally extinguished by two sprinklers, which operated above each burning item.

Water flowing from under the garage alerted a neighbor, who called the fire department at 9:30 a.m. Responding firefighters discovered the woman in the bathroom, where she had succumbed to smoke inhalation.

The house and its contents, valued at $200,000, suffered an estimated loss of $40,000

Report:

Home Upholstered Furniture Fires
Marty Ahrens
Fire Analysis and Research Division
National Fire Protection Association
August 2011

Errata No.: USS56-August 2011-01

Reference: page 17, 3rd paragraph,

When the item first ignited was upholstered furniture, the item contributing most to flame spread beyond the room of origin was also upholstered furniture in annual averages of:

- 1,800, or 62%, of the 1,800-1900 fires,
- 220, or 64%, of the 350 deaths,
- 310, or 64%, of the 470 injuries, and
- $142 million, or 51%, of the $279 million in direct property damage.

Issue date: August 12, 2013

Fire Analysis and Research Division
Phone: 617-984-7443
E-mail: osds@nfpa.org

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NATIONAL FIRE PROTECTION ASSOCIATION
Home Structure Fires that Began with Upholstered Furniture

In 2005-2009, U.S. fire departments responded to an average of 7,040 home structure fires per year in which upholstered furniture was the first item ignited. These fires caused an annual average of 500 civilian fire deaths, 890 civilian fire injuries, and $442 million in direct property damage.

On average, one of every 14 reported upholstered furniture fires resulted in death.

Overall, fires beginning with upholstered furniture accounted for 2% of reported home fires but one of every five (19%) home fire deaths.

Major Causes of Upholstered Furniture Fires

Smoking materials remain the leading cause of upholstered furniture fires and losses. One of every six such fires started by smoking materials resulted in death.

Portable and fixed space heaters were involved in 8% of the upholstered furniture fires and 7% of the associated deaths.

Operating equipment was the heat source in 22% of the fires and 15% of the deaths.

Together, candles, matches and lighters were involved in 21% of the fires and 12% of the deaths.

Electrical failures or malfunctions were factors in 14% of the home upholstered furniture fires and 10% of the deaths. These failures were in all types of electrical appliances, not just electrical distribution or lighting equipment.

Upholstered furniture fires started by smoking materials and associated deaths fell sharply since 1980. The declines in upholstered furniture fires started by candles, matches or lighters and by operating equipment were not as sharp. No clear trend was seen for upholstered furniture deaths from candles, matches and lighters or operating equipment.
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TO:        Technical Committee on Forest and Rural Fire Protection
FROM:     Linda Fuller
DATE:   November 13, 2013
SUBJECT: Request for Reorganization of Project

I am transmitting to you herewith the following action of the Standards Council (October 22-23, 2013):

The Council reviewed the request of the Forest and Rural Fire Protection Committee to reorganize the Project into two committees, Wildland Fire Management and Wildland and Rural Fire Protection. After review of all the material before it, the Council voted to publish a notice to solicit comments from the public regarding restructuring the Forest and Rural Fire Protection Committee into two committees. The input received will then be reviewed by the Council at the March 2014 meeting of the Council.

c:  K. Willette, R. Depew, D. Baio, C. Cronin, P. Foley, C. Peterson, Y. Smith

13-10-14
Standards Council Secretary

The Forest and Rural Committee (FRU-AAA) is requesting to reorganize into two new committees with narrow, well-defined scopes. The new committees will separate the current document workload, increase the number of wildland fire protection experts involved, and increase the capacity for taking on new projects. In accordance with the attached information ballot, FRU-AAA is requesting to reorganize into the following two new committees and document assignments:

**Technical Committee on Wildland and Rural Fire Protection**

**Committee Scope**
This committee shall have the primary responsibility for documents on fire protection in wildland, rural, and suburban areas.

**Committee Responsibilities**
- NFPA 1141 Standard for Fire Protection Infrastructure for Land Development in Wildland, Rural, and Suburban Areas
- NFPA 1142 Standard for Water Supplies for Suburban and Rural Firefighting
- NFPA 1144 Standard for Reducing Structure Ignition Hazards from Wildland Fire

**Technical Committee on Wildland Fire Management**

**Committee Scope**
This committee shall have the primary responsibility for documents on wildland fire management.

**Committee Responsibilities**
- NFPA 1143 Standard for Wildland Fire Management
- NFPA 1145 Guide for the Use of Class A Foams in Manual Structural Fire Fighting
  NOTE: intending to withdraw NFPA 1145 in next revision cycle and incorporate information into other PFP documents

Please add these items to the October Standards Council agenda and let me know if there are any questions.

Regards,

Ryan Depew FF/EMT-B
National Fire Protection Association
Public Fire Protection Division
1 Batterymarch Park
Quincy, Ma. 02169-7471
617-984-7485- Office
TO: The Technical Committee on Forest and Rural Fire Protection
FROM: Yvonne Smith, Project Administrator
DATE: June 3, 2013
SUBJECT: Informational Ballot on Committee Reorganization, New Committees, Scopes, and Document Assignments

The proposal below is being submitted to you as an Informational Ballot. At the most recent meeting of the Technical Committee on Forest and Rural Fire Protection (FRU-AAA) the committee discussed a reorganization of the technical committee. The discussion evolved out of concerns surrounding the broad spectrum of the committee’s current scope, the workload associated with being responsible for six NFPA documents, and the ability of the committee to take on new projects. The current committee scope and responsibilities are as follows:

**TC on Forest and Rural Fire Protection (FRU-AAA)**

**Committee Scope**

This Committee shall have primary responsibility for documents on fire protection for rural, suburban, forest, grass, brush, and tundra areas. This Committee shall also have primary responsibility for documents on Class A foam and water enhancing gels, and their utilization for all wildland and structural fire fighting. This excludes fixed fire protection systems.

**Committee Responsibilities**

- NFPA 1141 Standard for Fire Protection Infrastructure for Land Development in Wildland, Rural, and Suburban Areas
- NFPA 1142 Standard for Water Supplies for Suburban and Rural Firefighting
- NFPA 1143 Standard for Wildland Fire Management
- NFPA 1144 Standard for Reducing Structure Ignition Hazards from Wildland Fire
- NFPA 1145 Guide for the Use of Class A Foams in Manual Structural Fire Fighting
- NFPA 1150 Standard on Foam Chemicals for Fires in Class A Fuels

On May 8, 2013, the committee voted to create two new committees with narrow, well-defined scopes. The new committees will separate the current document workload, increase the number of wildland fire protection experts involved, and increase the capacity for taking on new projects. The proposal passed unanimously in a meeting vote. This Informational Ballot will act as your official position on the proposed committees. The proposed technical committee titles, scopes and document assignments are as follows:
Technical Committee on Wildland and Rural Fire Protection
Committee Scope
This committee shall have the primary responsibility for documents on fire protection in wildland, rural, and suburban areas.

Committee Responsibilities
NFPA 1141 Standard for Fire Protection Infrastructure for Land Development in Wildland, Rural, and Suburban Areas
NFPA 1142 Standard for Water Supplies for Suburban and Rural Firefighting
NFPA 1144 Standard for Reducing Structure Ignition Hazards from Wildland Fire

Technical Committee on Wildland Fire Management
Committee Scope
This committee shall have the primary responsibility for documents on wildland fire management.

Committee Responsibilities
NFPA 1143 Standard for Wildland Fire Management

NOTE:
NFPA 1150 Standard on Foam Chemicals for Fires in Class A Fuels
-Information Ballot to Reassign in Process

NFPA 1145 Guide for the Use of Class A Foams in Manual Structural Fire Fighting
-Meeting Proposal to Reevaluate at Later Date

Please complete and return your ballot as soon as possible but no later than **Thursday, June 13, 2013**. As noted on the ballot form, please return the ballot to Yvonne Smith either via e-mail to ysmith@nfpa.org or via fax to 617-984-7056.
MEMORANDUM

To: NFPA Technical Committee on Forest and Rural Fire Protection
From: Yvonne Smith, Project Administrator
Date: June 25, 2013
Subject: FRU-AAA Information Ballot on Reorganization/TC FINAL Ballot Results

According to the final ballot results, the ballot item received the necessary affirmative votes to pass ballot.

28 Members Eligible to Vote
5 Not Returned (Keller, Lang, Spitzer, Tsui, Wooters)
18 Affirmative on All
5 Negatives/Disagree: (Fischer, Freyer, George, Johnson, Smalley)
0 Abstentions:

The attached report shows the number of affirmative, negative, and abstaining votes as well as the explanation of the vote for each first/second revision.

There are two criteria necessary for each first/second revision to pass ballot: (1) simple majority and (2) affirmative $\frac{2}{3}$ vote. The mock examples below show how the calculations are determined.

(1) Example for Simple Majority: Assuming there are 20 vote eligible committee members, 11 affirmative votes are required to pass ballot. (Sample calculation: 20 members eligible to vote $\div 2 = 10 + 1 = 11$)

(2) Example for Affirmative $\frac{2}{3}$: Assuming there are 20 vote eligible committee members and 1 member did not return their ballot and 2 members abstained, the number of affirmative votes required would be 12. (Sample calculation: 20 members eligible to vote $- 1$ not returned $- 2$ abstentions $= 17 \times 0.66 = 11.22 = 12$)

As always please feel free to contact me if you have any questions.
Technical Committee on Forest and Rural Fire Protection
Informational Ballot for Committee Reorganization, New Committees, Scopes, and Document Assignments

Please record me as voting:

_____; I Agree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explaination of Vote – Please type or print your comments:
_________________________________________________________________________________

_________________________________________________________________________________

X: I Disagree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explaination of Vote – Please type or print your comments:
I am concerned where 1145 will end up. Until that is resolved it is hard to vote on this proposal.

Signature

[Signature]

Name (Please Print)

Don Fischer

Date

6/19/13

Please return your ballots not later than Thursday, June 13, 2013.

RETURN TO:
Yvonne Smith, Project Administrator
NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
E-Mail: ysmith@nfpa.org FAX: 617-984-7056
Please record me as voting:

[ ] ; I Agree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

[ ] ; I Disagree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

Leave 1143 with F&K - our documents deal with development and planning. 1143 should also be included with that group of documents (1141, 1142, 1144) in the development and planning.

Signature

[Signature]

Name (Please Print)

[Name]

Date

[Date]

Please return your ballots not later than Thursday, June 13, 2013.

RETURN TO:

Yvonne Smith, Project Administrator

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471

E-Mail: ysmith@nfpa.org  FAX: 617-984-7056
Note of mine.

It go way back when we remembered and combined two old standbys to become 1143. It was basic that should be used in conjunction with 1141, 1142.

1144

Dm frog
Technical Committee on Forest and Rural Fire Protection
Informational Ballot for Committee Reorganization, New Committees, Scopes, and Document Assignments

Please record me as voting:

______; I Agree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

__________________________________________________________________________________________

__________________________________________________________________________________________

__________________________________________________________________________________________

✓ ______; I Disagree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

__________________________________________________________________________________________

__________________________________________________________________________________________

__________________________________________________________________________________________

Chemicals used in wildland fire protection and suppression are an integral part of Wildland Fire Management, the responsibility of the committee on WFM and better belongs in that committee as opposed to a separate committee and lumped with potential chemicals for other than Wildland applications. Experience has demonstrated this through attempts to handle specifically gels used for exposure protection and suppression (uses similar to those of Class A foams (1150)) by NFPA 18 committee.

Signature

Charles W George

Name (Please Print)

Charles W George

6/7/2013

Date

Please return your ballots not later than Thursday, June 13, 2013.

RETURN TO:

Yvonne Smith, Project Administrator

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471

E-Mail: ysmith@nfpa.org  FAX: 617-984-7056
Please record me as voting:

______: I Agree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

X______: I Disagree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

I agree that splitting the responsibility so that infrastructure requirements and issues are kept together and that the wildland fire management could reasonably be put into a separate committee. However, I do not agree that Class A foam should be separate from wildland fire management considerations. Class A foam is one of several tools used in wildland and urban interface fire management. Its effectiveness is a combination of the product and the manner in which it is used. Those things should be covered by the same group with expertise in fire management. 1145 may reasonably be included in a committee that is responsible for municipal and structural firefighting, which is where is currently resides if you consider WUI areas. I believe that task groups with careful inclusion of members from other committees when that expertise is needed is a more reasonable approach. WAB has the potential to become a very diverse group with limited expertise with any product type and even less expertise in the appropriate uses of the products described in the specifications. It potentially covers too wide a range of products and purposes.

Cecilia Johnson

Signature

Cecilia Johnson

Name (Please Print)

6/11/13

Date

Please return your ballots not later than Thursday, June 13, 2013.

RETURN TO:
Yvonne Smith, Project Administrator
NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
E-Mail: ysmith@nfpa.org  FAX: 617-984-7056
Technical Committee on Forest and Rural Fire Protection
Informational Ballot for Committee Reorganization, New Committees, Scopes, and Document Assignments

Please record me as voting:

Text: I Agree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

Explanation of Vote – Please type or print your comments:
The proposed division of documents is a reasonable consideration, but it does not address a basic issue that has faced the committee over the years: is the line between rural, suburban, and wildland fire issues distinct and, if not, where do the responsibilities blend? The decades long struggle with WUI fire suppression and mitigation (as demonstrated in the existing mix of documents) has compounded the difficulty of dividing the committee. For this, I support retaining the committee as is. However, as a former Exec Secretary of the committee, I found the real challenge was the committee-wide promulgation and support of the two chemical documents. It might be more reasonable to assign those to a separate committee (but not the larger NFPA Foam committee).

Signature

Name (Please Print)

Date

Please return your ballots not later than Thursday, June 13, 2013.
RETURN TO:
Yvonne Smith, Project Administrator
NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
E-Mail: ysmith@nfpa.org  FAX: 617-984-7056
Technical Committee on Forest and Rural Fire Protection
Informational Ballot for Committee Reorganization, New Committees, Scopes, and Document Assignments

Please record me as voting:
X; I Agree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

Seems to be a logical break and will help recruit new members

☐; I Disagree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:


Signature

Name (Please Print)

Date

Please return your ballots not later than Thursday, June 13, 2013.
RETURN TO:
Yvonne Smith, Project Administrator
NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
E-Mail: ysmith@nfpa.org  FAX: 617-984-7056
Technical Committee on Forest and Rural Fire Protection

Informational Ballot for Committee Reorganization, New Committees, Scopes, and Document Assignments

Please record me as voting:

X: I Agree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

This should allow each committee to run more efficient and deal with less paperwork.

: I Disagree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

Signature

Bill Hendricks

Name (Please Print)

6-19-13

Date

Please return your ballots not later than Thursday, June 13, 2013.

RETURN TO:

Yvonne Smith, Project Administrator

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471

E-Mail: ysmith@nfpa.org  FAX: 617-984-7056
Technical Committee on Forest and Rural Fire Protection
Informational Ballot for Committee Reorganization, New Committees, Scopes, and Document Assignments

Please record me as voting:

☒: I Agree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

In my opinion, managing six different standards is a challenging task for a committee. The proposed reorganization will streamline the standards writing process and will allow for better participation by committee members. Technical Committee members have the option to join both the Committee if they wish too.

☐: I Disagree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

YASH MAKW

Signature

JIGNESH MAKW

Name (Please Print)

June 19 2013

Date

Please return your ballots not later than Thursday, June 13, 2013.

RETURN TO:
Yvonne Smith, Project Administrator
NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
E-Mail: ysmith@nfpa.org  FAX: 617-984-7056
Technical Committee on Forest and Rural Fire Protection
Informational Ballot for Committee Reorganization, New Committees, Scopes, and Document Assignments

Please record me as voting:

X: I Agree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

In order to maintain committee continuity, it is expected that members of the current FRU-AAA will have the option of applying to both new committees.

_____ : I Disagree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:


Signature

Name (Please Print)

Date

Please return your ballots not later than Thursday, June 13, 2013.

RETURN TO:
Yvonne Smith, Project Administrator
NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
E-Mail: ysmith@nfpa.org  FAX: 617-984-7056
Technical Committee on Forest and Rural Fire Protection
Informational Ballot for Committee Reorganization, New Committees, Scopes, and Document Assignments

Please record me as voting:

☑ I Agree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:
This is a more logical separation of duties for the technical committees.

☑ I Disagree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:

______________________________
Signature 

______________________________
Name (Please Print) 

______________________________
Date 

Please return your ballots not later than Thursday, June 13, 2013.

RETURN TO:
Yvonne Smith, Project Administrator
NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
E-Mail: ysmith@nfpa.org  FAX: 617-984-7056
Technical Committee on Forest and Rural Fire Protection Informational Ballot for Committee Reorganization, New Committees, Scopes, and Document Assignments

Please record me as voting:

XX: I Agree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:
The proposal makes sense to consolidate the document load for the TC's and to adjust the scopes so as not to conflict with other TC's... I would like to be reassigned to the TC on Wildland and Rural Fire Protection.

: I Disagree with the Proposed Reorganization, New Committees, Scopes, and Document Assignments

Explanation of Vote – Please type or print your comments:


Signature
Rob Rosovich

Name (Please Print)

6/03/2013

Date

Please return your ballots not later than Thursday, June 13, 2013.
RETURN TO:
Yvonne Smith, Project Administrator
NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
E-Mail: ysmith@nfpa.org  FAX: 617-984-7056
On behalf of the National Volunteer Fire Council (NVFC), I would like to express support for the proposal to reorganize the Technical Committee on Forest and Rural Fire Protection to create two new technical committees, on Wildland and Rural Fire Protection and Wildland Fire Management, respectively. Additionally, I request that Ron Graton, the NVFC's current Alternate Representative on the Forest and Rural Fire Protection TC, be made the Principal Organizational Representative of the NVFC on the Technical Committee on Wildland and Rural Fire Protection once it is established.

Philip C. Stittleburg

Chairman
Linda, thanks. As an action item following the PPE summit last April, each TC could decide for itself what it wanted to do in terms of SCAM documents. The WFF TC has decided to do a separate document. Is the original new project initiation form still valid, or does the TC need to do something else for SC approval? I attached that for you.

Thanks,
Dave

---

David G. Trebisacci, CIH, CSP
Public Fire Protection Division
NFPA
1 Batterymarch Park
Quincy, MA 02269
Phone: (617) 984-7420
Fax: (617) 984-7056
dtrebisacci@nfpa.org

**Important Notice:** This correspondence is not a Formal Interpretation issued pursuant to NFPA Regulations. Any opinion expressed is the personal opinion of the author and does not necessarily represent the official position of the NFPA or its Technical Committees. In addition, this correspondence is neither intended, nor should it be relied upon, to provide professional consultation or services.

---

**From:** Fuller, Linda
**Sent:** Thursday, January 09, 2014 5:14 PM
**To:** Trebisacci, Dave
**Subject:** RE: WFF SCAM

That was agenda items 11-8-30. The Council wanted to know if the Committee would consider adding the SCAM material as a chapter to your document. What do you want to do with the other SCAM document on Hazardous Material Protective Clothing and Equipment (11-8-28)?

Linda Fuller
Manager, Standards Operations
National Fire Protection Association
1 Batterymarch Park, Quincy, MA 02169-7471
MEMORANDUM

TO: Secretary, NFPA Standards Council
FROM: Ken Willette, PFP Division Manager
        David Trebisacci, Staff Liaison
DATE: September 12, 2013
SUBJECT: Results of Future of NFPA’s Protective Clothing and Equipment Project Meeting

Purpose and Background

Many challenges have been presented to the Correlating Committee and the Technical Committees of the Fire and Emergency Services Protective Clothing and Equipment project as it has grown, ranging from correlation issues, the introduction of new test methods and their verification, protective clothing and equipment life cycles, the introduction of selection, care and maintenance standards, and many others.

To discuss these topics and the future direction of the project, a one and one-half day meeting was held on April 4-5, 2013 in Nashville, which was hosted by NFPA, to address the protective clothing and equipment (PC&E) used by emergency response personnel. This memo is a summary of the full report, which was issued in May 2013.

NFPA PC&E standards are widely used by many local, state, tribal, federal and provincial public safety agencies including the fire service, EMS, law enforcement, and industry. In recent years, the project technical committees have been developing selection, care and maintenance documents to accompany the many product standards in the project. These documents are also referenced in operational and training documents as the basis for PC&E protection.

The goal of the meeting was to enable NFPA to acquire a stakeholder perspective on the PC&E project and determine ways to improve overall project management.

Meeting objectives included the following:

- Discuss the development of project Supplementary Operating Procedures
- Review product testing, certification and verification requirements
- Discuss the reorganization of PC&E standard revision cycles
- Review workload and resource management
- Examine inter-project coordination
- Discuss the development of selection, care and maintenance documents
- Identify areas of growth and expansion
Seventeen action items have resulted from this meeting. These items represent a compilation of the meeting discussion and summary observations. The following is a summary of these items:

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*Priority  1 - near term  2 - mid-term  3 - long term
Conclusion

It is the intent of the technical committees in the PC&E project to request approval of the above listed action items by the Standards Council as may be required over time. Items categorized “near term” will be submitted to the Council for approval within the next 12 months. Items categorized “mid-term” will be submitted to the Council for its review and approval within the next 12-24 months.

Planning for this meeting was guided by the support of a Planning Committee that was composed of Rich Duffy (IAFF), Chris Farrell (NFPA Staff), Casey Grant (Fire Protection Research Foundation), Bill Haskell (NIOSH NPPTL), Karen Lehtonen (Lion Apparel, Inc.), Dr. Anthony Putorti (NIST), Steven Sawyer (NFPA Staff), Jeff Stull (International Personnel Protection, Inc.), Matthew Sears (NFPA Public Fire Protection Division), David Trebisacci (NFPA Staff) and Ken Willette (Manager, NFPA Public Fire Protection Division). In addition to their input with planning aspects of the meeting, they also provided an active role in its implementation as presenters and facilitators. Their guidance and direction was a valuable contribution to the success of the meeting and is greatly appreciated.
Future of NFPA’s Protective Clothing and Equipment Project

Nashville, TN
April 4-5, 2013

Meeting hosted by the
National Fire Protection Association

Public Fire Protection Division

May 28, 2013
Many challenges have been presented to the Correlating Committee and the Technical Committees of the Fire and Emergency Services Protective Clothing and Equipment project as it has grown, ranging from correlation issues, the introduction of new test methods and their verification, protective clothing and equipment life cycles, the introduction of selection, care and maintenance standards, and many others.

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3 - long term
## Acknowledgements

Planning for this meeting was guided by the support of a Planning Committee that was composed of Rich Duffy (IAFF), Chris Farrell (NFPA Staff), Casey Grant (Fire Protection Research Foundation), Bill Haskell (NIOSH NPPTL), Karen Lehtonen (Lion Apparel, Inc.), Dr. Anthony Putorti (NIST), Steven Sawyer (NFPA Staff), Jeff Stull (International Personnel Protection, Inc.), Matthew Sears (NFPA Public Fire Protection Division), David Trebisacci (NFPA Staff) and Ken Willette (Manager, NFPA Public Fire Protection Division). In addition to their input with planning aspects of the meeting, they also provided an active role in its implementation as presenters and facilitators. Their guidance and direction was a valuable contribution to the success of the meeting and is greatly appreciated.
This report summarizes a one and one-half day meeting held on April 4-5, 2013 in Nashville, Tennessee to address the protective clothing and equipment (PC&E) used by emergency response personnel. The workshop was hosted by NFPA.

NFPA PC&E standards are widely used by many local, state, tribal, federal and provincial public safety agencies including the fire service, EMS, law enforcement, and industry. In recent years, the project technical committees have been developing selection, care and maintenance documents to accompany the many product standards in the project. These documents are also referenced in operational and training documents as the basis for PC&E protection.

Table 1: Standards in the NFPA Protective Clothing and Equipment Project

<table>
<thead>
<tr>
<th>Document Number</th>
<th>Document Title</th>
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<tbody>
<tr>
<td>TBD</td>
<td>Electronic Safety Equipment for Emergency Services</td>
</tr>
<tr>
<td>TBD</td>
<td>SCBA for Non-Structural Fire Fighting</td>
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<tr>
<td>NFPA 1801</td>
<td>Thermal Imagers for the Fire Service</td>
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<tr>
<td>NFPA 1802</td>
<td>Two-Way, Portable (Hand-held) Land Mobile Radios for Use by Emergency Services Personnel</td>
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<tr>
<td>NFPA 1851</td>
<td>Selection, Care and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting</td>
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<tr>
<td>NFPA 1852</td>
<td>Selection, Care and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)</td>
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<tr>
<td>NFPA 1855</td>
<td>Selection, Care and Maintenance of Protective Ensembles for Technical Rescue Incidents</td>
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<tr>
<td>NFPA 1951</td>
<td>Protective Ensembles for Technical Rescue Incidents</td>
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<tr>
<td>NFPA 1952</td>
<td>Surface Water Operations Protective Clothing and Equipment</td>
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<tr>
<td>NFPA 1953</td>
<td>Protective Ensembles for Contaminated Water Diving</td>
</tr>
<tr>
<td>NFPA 1971</td>
<td>Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting</td>
</tr>
<tr>
<td>NFPA 1975</td>
<td>Station/Work Uniforms for Emergency Services</td>
</tr>
<tr>
<td>NFPA 1977</td>
<td>Protective Clothing and Equipment for Wildland Fire Fighting</td>
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<tr>
<td>NFPA 1981</td>
<td>Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services</td>
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<td>NFPA 1982</td>
<td>Personal Alert Safety System (PASS)</td>
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<td>NFPA 1983</td>
<td>Life Safety Rope and Equipment for Emergency Services</td>
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<td>NFPA 1984</td>
<td>Respirator for Wildland Fire Fighting Operations</td>
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<td>NFPA 1989</td>
<td>Breathing Air Quality for Emergency Services Respiratory Protection</td>
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<tr>
<td>NFPA 1991</td>
<td>Vapor-Protective Ensembles for Hazardous Materials Emergencies</td>
</tr>
<tr>
<td>NFPA 1994</td>
<td>Protective Ensembles for First Responders to CBRN Terrorism Incidents</td>
</tr>
<tr>
<td>NFPA 1999</td>
<td>Protective Clothing for Emergency Medical Operations</td>
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</table>
The majority of the documents in the PC&E project are product documents, which are uncommon in the NFPA library of standards. These documents present their own unique issues including product design, testing, certification, labeling and verification, and compliance periods. The selection, care, and maintenance (SCAM) documents also have some unique issues that include product inspection requirements and life cycle/retirement.

The goal of this meeting was to enable NFPA to acquire a stakeholder perspective on the PC&E project and determine ways to improve overall project management.

Meeting objectives included the following:

- Discuss the development of project Supplementary Operating Procedures
- Review product testing, certification and verification requirements
- Discuss the reorganization of PC&E standard revision cycles
- Review workload and resource management
- Examine inter-project coordination
- Discuss the development of selection, care and maintenance documents
- Identify areas of growth and expansion
Future of NFPA’s Protective Clothing and Equipment Project

April 4, 2013

Day 1  Welcome and introductions  (Casey Grant) 8:00 a.m.
1. Review of meeting goals, objectives, deliverables  (Ken Willette and staff) 8:15 a.m.
2. CC TG on Supplemental Operating Procedures (Tony Putorti, Bill Haskell) 8:30 a.m.
3. NFPA’s PC&E Documents – revision cycles (Bill Haskell, Dave Trebisacci) 9:30 a.m.
4. Break 10:15 a.m.
5. Selection, Care and Maintenance Documents (Karen Lehtonen) 10:30 a.m.
6. Discussion 11:00 a.m.
7. Lunch 12:00 p.m.
8. Discussion (continued) 2:00 p.m.
9. Recess for Day 5:00 p.m.

April 5, 2013

Day 2  Welcome 8:00 a.m.
1. Summary of Day 1 Discussions 8:15 a.m.
2. Areas of Growth and Expansion (Rich Duffy, Jeff Stull) 8:30 a.m.
3. Discussion 9:30 a.m.
4. Break 10:15 a.m.
5. Discussion and Summary 10:30 a.m.
6. Adjournment 12:00 p.m.
### MEETING ATTENDEES

<table>
<thead>
<tr>
<th>First Name</th>
<th>Last Name</th>
<th>Interest/Representation</th>
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<tbody>
<tr>
<td>Robert</td>
<td>Athanas</td>
<td>FDNY, SAFE-IR Inc.</td>
</tr>
<tr>
<td>Christina</td>
<td>Baxter</td>
<td>U.S. Department of Defense CTTSO/TSWG</td>
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<tr>
<td>Eric</td>
<td>Beck</td>
<td>Compressed Gas Association</td>
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<td>Joseph</td>
<td>Arrington</td>
<td>San Antonio Fire Department</td>
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<td>Roger</td>
<td>Barker</td>
<td>North Carolina State University</td>
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<tr>
<td>Steven</td>
<td>Corrado</td>
<td>Underwriters Laboratory, Inc.</td>
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<tr>
<td>Dean</td>
<td>Cox</td>
<td>Fairfax County Fire and Rescue Department</td>
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<tr>
<td>Richard</td>
<td>Duffy</td>
<td>International Association of Fire Fighters</td>
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<tr>
<td>Cristine</td>
<td>Fargo</td>
<td>International Safety Equipment Association</td>
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<td>Christopher</td>
<td>Farrell</td>
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<td>Pat</td>
<td>Freeman</td>
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<td>Robert</td>
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<tr>
<td>Patricia</td>
<td>Gleason</td>
<td>Safety Equipment Institute</td>
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<tr>
<td>Casey</td>
<td>Grant</td>
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<tr>
<td>Kim</td>
<td>Henry</td>
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<td>Pamela</td>
<td>Kavalesky</td>
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<tr>
<td>Stephen</td>
<td>King</td>
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<td>Karen</td>
<td>Lehtonen</td>
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<td>David</td>
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<tr>
<td>Michael</td>
<td>McKenna</td>
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<tr>
<td>Amanda</td>
<td>Newsom</td>
<td>Underwriters Laboratories, Inc.</td>
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<tr>
<td>Kirk</td>
<td>Owen</td>
<td>Tencate Protective Fabrics</td>
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<tr>
<td>Anthony</td>
<td>Petrilli</td>
<td>U.S. Department of Agriculture</td>
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<tr>
<td>Anthony</td>
<td>Putorti</td>
<td>National Institute of Occupational Safety and Health</td>
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<tr>
<td>Jack</td>
<td>Reall</td>
<td>Columbus Firefighters Union</td>
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<td>Dan</td>
<td>Rossos</td>
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<td>Marni</td>
<td>Schmid</td>
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<td>Grace</td>
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<td>Jeffrey</td>
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<tr>
<td>Rick</td>
<td>Swan</td>
<td>IAFF Local 2881/CDF Fire Fighters</td>
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<td>Donald</td>
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<td>North Carolina State University</td>
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<tr>
<td>Tim</td>
<td>Tomlinson</td>
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<tr>
<td>Robert</td>
<td>Tutterow</td>
<td>FIERO (representing NFPA Fire Service Section)</td>
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<td>David</td>
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<tr>
<td>Harry</td>
<td>Winer</td>
<td>HIP Consulting LLC</td>
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<tr>
<td>Richard</td>
<td>Young</td>
<td>DuPont Protection Technologies</td>
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SUMMARY OF PRESENTATIONS

1. Correlating Committee Task Group on Supplemental Operating Procedures

Dr. Anthony Putorti (NIST) and Bill Haskell (NIOSH NPPTL) provided a presentation on behalf of a Correlating Committee Task Group that has been developing Supplemental Operating Procedures for the CC. See Annex A for a copy of the presentation.

Two issues identified within the PC&E project are test method/criteria validation and a lack of transparency (real or perceived) in the development of the test methods and criteria. To this end, proposed Supplemental Operating Procedures (See Annex C) were developed to outline the requirements for the validation of new or revised test methods and criteria as well as the responsibilities of both the Technical Committees and the Correlating Committee.

The following items summarize the proposed procedures:

1. Evidence of need and the rationale for consideration of a new performance criteria and test method into an NFPA product standard. The challenge lies in determining what validation means. It must be both defined and described to resolve what is acceptable.

2. Analysis of impact of new performance criteria and test methods on currently certified and fielded products providing acceptable performance to the current edition of the product standard. The Correlating Committee will have to decide what the threshold is for existing methods and criteria, with the understanding that not all tests can be validated at once. The amount of time and effort it will take to use this process to validate existing tests and criteria is likely to be daunting. That work will have to be done on a schedule, perhaps rolled out over several years.

3. Analysis and relevance to in-service use of products.

4. Guidelines and procedures the Technical Committees should follow in introducing new test methods and performance criteria and presenting those methods and criteria to the Correlating Committee. Maintaining the necessary elements of a test while still providing flexibility will be a challenge that each Technical Committees will encounter.

5. Projection/estimate of required resources and funding necessary and identification of the sources that can provide funding and resources.

6. Communication, sharing, and documentation of information and data by a Task Group with the Technical Committee and then to the Correlating Committee.

7. Plans and requirements for validation of the repeatability and reproducibility of the test method and performance criteria (interlaboratory testing, establishment of precision and bias, etc.)
a. How many labs will be able to participate in testing before criteria is added to a standard? Cost could be a factor if a test is ultimately not added to a standard. In that case, resources have been expended needlessly. However, how might testing criteria be introduced in the standard, balancing that with safety? One suggestion is for new test methods to be reportable numbers instead of “pass/fail,” allowing data to drive decisions. The downside of this is how to achieve validation before a test is introduced, thus the decision has been already made. Lastly, use two independent labs to perform testing so there may be a comparison.

b. Additional areas that may need to be resolved include adding more time to the revision process (for additional meetings, understanding the Supplementary Operating Procedures), funding, and gauging the applicability of a test method or performance criteria.

A phased-in implementation of any Supplemental Operating Procedures seems like a logical way to proceed. Also, a hypothetical product could be subjected to the new procedures, which would have the additional benefit of corresponding to the project’s reorganization goals. Although there is a distinct benefit to the Committee process with this approach, overall the goal should be the heightened protection of emergency responders.

2. NFPA’s PC&E Documents and Revision Cycles

Bill Haskell and David Trebisacci (NFPA Staff) provided a presentation that included a review of the scope of the Correlating Committee, its responsibilities and authority. An explanation of the rules governing the development and approval of Supplementary Operating Procedures was also provided. Task group responsibilities were also reviewed, and an update on the project documents and revision cycles was presented. See Annex A for a copy of the presentation.

A proposed reorganization of the project documents was discussed. The presentation also featured a discussion on standardizing compliance dates across all the documents in the project, the retention of Project Definitions, the importance of attending meetings and returning ballots, and project interaction with other NFPA Technical Committees.
3. Selection, Care and Maintenance Documents

Karen Lehtonen (Lion Apparel, Inc.) provided a presentation on the status of selection, care and maintenance (SCAM) documents in the project. See Annex A for a copy of the presentation.

The selection, care and maintenance (SCAM) documents in the PC&E project (NFPA 1851, 1852 and 1855) are focused on four main areas,

- Utilization by end users
- Retirement criteria
- Cycle integration
- Development of additional SCAM documents

Utilization by end users covers both education and understanding. One goal should be to educate end users in the fire service about the PC&E project and how to use and apply the SCAM documents. Work with NIOSH to get product issues disseminated to end users as well as provide better overall education about PC&E and how to participate in the process. Making the standards easier to understand is critical from the end user perspective.

There are several paths forward with respect to the development of SCAM documents,

- Keep SCAMs as separate documents since the users of those standards are not the same as the audience for related product documents (i.e., end users instead of manufacturers)
- Include SCAM requirements within the related product documents
- Put all the SCAM documents together in one document and provide additional explanations in “non-code” language

Retirement criteria and lifecycle consideration will continue to present opportunities to combine experience and research. Empirical field data and the experience of the committee will allow members to make informed, technical decisions about when the useful life of a product has ended. All materials and substances wear out over time, so standardizing a reasonable end of use time is critical.

Integrating SCAM documents into consistent cycles should dovetail with any reorganization of the project documents. An integration plan that is flexible enough to correspond with the needs of the project overall should be formulated.
Technical Committees that are currently considering the development of SCAM documents include the following:

- TC on Hazardous Materials PC&E
- TC on Special Operations PC&E
  - Life Safety Rope and Equipment (NFPA 1983)
  - Emergency Services Work Clothing Elements (NFPA 1975)
- TC on EMS Protective Clothing and Equipment (NFPA 1999)
- TC on Wildland Protective Clothing and Equipment (NFPA 1977)

4. Areas of Growth and Expansion

Rich Duffy (IAFF) and Jeff Stull (International Personnel Protection, Inc.) provided a presentation on areas of growth and expansion within the project. See Annex A for a copy of the presentation.

There are four areas to focus on,

- Credibility and reliability of the standards
- Participation from end users
- Funding issues
- Future product types and user groups

Standards must be credible and reliable if they are to be followed and respected. Many standards have reached a level of “maturity” where fewer changes need to be implemented unless significant technology changes are introduced. Requirements and changes must be meaningful to affect product designs and material choices.

More participation is required from end users to continue to move the project forward. End user participation can be improved on certain Technical Committees if emergency responders are educated about the project and how they can participate. Education works both ways – end users learn about the project and Technical Committee members learn about difficulties and perspectives from end users. One way to immediately address the need is to include more detailed technical information in the substantiations for First and Second Revisions.

Significant funding issues need to be considered going forward. One issue is related to end user participation on Technical Committees. Many members who are categorized as users (U) are members of the fire service and often must pay their own way to meetings. This negatively impacts their participation. Technical Committees have to explore ways to increase the use of technology (i.e., Live Meeting). A second issue revolves around the intersection of science and its impact on end users. More research is necessary to plan for the future of the project, but those with a scientific background should partner with stakeholders who understand the impact the project has on end users to develop solid funding proposals.
Both new product types and user groups will have an impact on the PC&E project. Two new product types already represented in the project are electronics-based equipment and specialized ensembles (and ensemble options). They represent areas the Technical Committees are currently defining and where there will be expansion moving forward. Also, new and current user groups are bringing their perspective and expertise to the project. Members of law enforcement, EMS and special operations entities should be represented as well as some of the skilled trades, especially those who participated in mitigating some recent disasters and emergency response. Adding those skills into the project strengthens its credibility.

The PC&E project moves forward by focusing on those four areas. Preparing and planning for their impact assures that the project expands and grows in unison with its needs. Accomplishing these goals may be combining the documents into one or more to make them easier to follow, understand and use.
The discussions that took place during and after each presentation can be grouped into several categories

- education
- testing
- selection, care and maintenance
- document processing
- general

1. Education

The role of NFPA in global standards was discussed, and if standards are meeting the needs of the end user. Users should be educated on the test methods in the standards and their input should be encouraged. There should be realistic expectations as to a product’s performance, and manufacturers should continue to be aware of changing customer needs and requirements.

The “street level” emergency responder is not reading NFPA publications, rather, they are reading publications such as Fire House and Fire Engineering, and increasingly using the internet and social media for information. These and other media should be used as part of an NFPA outreach or marketing plan to educate the fire service on NFPA standards and the standards development process.

Emergency responders may not fully understand the rapidly changing environments in which they operate. Educational efforts or inclusion in the document can inform responders about the environments they are encountering each day, and the limitations of their protective clothing and equipment.

Standards impact emergency responders, especially in terms of PC&E cost and maintenance. Information should be provided to them to assist in understanding what is in NFPA standards, why changes are made to the standards, to generate interest and participation, and the importance of NFPA compliant PC&E.

Educational efforts should also help to dispel the negative image of NFPA held by some emergency responders, and seek to involve new responders in the process. Explanations as to why standards are in place and their benefit to these responders should be provided, and NFPA should recognize their unique requirements.
Emergency response personnel are many times not aware of the availability of selection, care and maintenance documents. Educational efforts should include informing responders that these types of documents exist as companion standards to several product documents.

Many users of NFPA standards (including those individuals categorized as “Users” on Technical Committees) have never seen the manufacturing process or demonstrations of the many tests that are required of PC&E products before they can be certified. This can sometimes make deliberations difficult when a Technical Committee is considering revising a current test or adding a new test to a standard. Consideration should be given to providing new and current Technical Committee members with an orientation program that covers several topics, including product testing procedures.

These types of educational and outreach efforts should include the use of webinars, handbooks, user guides, presentations that are part of the NFPA Conference and Exhibition, and collaboration and partnerships. Regional meetings could also be held to get user input.

The Fire Analysis department at NFPA will provide a copy of the latest Needs Assessment for the Fire Service, which will be sent to the project technical committees for their input.

2. Testing

The discussion involving testing and validation presented a number of comments and questions. The number of labs that should take part in any testing prior to that test being considered for addition to a standard was discussed. This approach may be cost prohibitive if the test eventually is not included in the standard. New test methods must be reportable values instead of pass/fail. More available data should drive any decisions about tests being added or modified in any given standard. A balance must also be achieved between how to get testing criteria introduced in a standard and the increased safety that the addition or revision of the test provides.

Test procedures must be validated, which will assist in decision-making by the Technical Committee. Testing should be done before the First Draft meeting so that it can enter the process for public review and comment. A definition or description of what validation means should be developed.

The development of Supplementary Operating Procedures for Test Method Validation was discussed. This effort is based on the establishment of policies or procedures to front load the process when testing is being changed or proposed. Some individuals believed that these procedures should be guidelines, while others believed they should be mandatory.
Questions related to test validation were discussed. A task group reviewing these issues will be presenting their findings to the Correlating Committee as part of the proposed Supplementary Operating Procedures.

The Supplementary Operating Procedures will also be provided to the individual Technical Committees so that the procedures can be followed when bringing new test methods and performance criteria to the Correlating Committee for review. A projection or estimate of the required resources and funding necessary and identification of the sources that can provide funding and resources should be determined. Supplementary Operating Procedures should not limit or diminish Public Input.

Plans and requirements for the validation of the repeatability and reproducibility of test methods and performance criteria (inter-laboratory testing, establishment of precision and bias, etc.) should also be developed.

Communication, sharing, and documentation of information and data by a Task Group of any Technical Committee should be open and transparent prior to submitting input to the Technical Committee and then to the Correlating Committee.

Some attendees supported the structuring of a document development timeframe that permitted validation, which included the possibility of additional meetings earlier in the process. If a request for a new test arrives during the Public Input stage, this could slow the validation process and the new test introduction could be slowed. Funding should be available for round-robin testing, it is this balance that provides credibility to the process.

Any new Supplementary Operating Procedures should include requirements for the certification laboratories to conduct proposed revised or new testing much earlier in the document revision process. SOPs would apply to both new and the revision of existing tests. SOPs would also enable Technical Committees to better review new and improved technology and permit them to delete old tests and technology from existing standards.

Test method introduction or revision requires input from fire fighters in the field, and communication will continue to be essential between the testing laboratories and the Technical Committees. Users should be educated on test methods, the reason for their existence and the benefits provided.
3. Selection, Care and Maintenance

The selection, care and maintenance (SCAM) documents in the PC&E project are as follows:

- NFPA 1851, *Standard on Selection, Care and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*
- NFPA 1852, *Standard on Selection, Care and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)*
- NFPA 1855, *Standard on Selection, Care and Maintenance of Protective Ensembles for Technical Rescue Incidents*

SCAM document development focuses on four main areas, utilization by end users, retirement criteria, cycle integration and expansion to more documents.

SCAM documents began to be added to the project library as the need arose for these types of standards to accompany the product documents. SCAM standards typically have different audiences from the users of the product standards. These groups include fire and emergency services departments and inspection, cleaning, decontamination and repair service providers. Manufacturers and certification and testing laboratories utilize the product specification documents primarily.

Proper utilization and application of SCAM documents by end users involves both education and understanding. Technical Committees should work with NIOSH to get product issues disseminated to end users. The TCs and NFPA should provide better overall education about PC&E and how to participate in the process. Making these standards easier to understand is critical from the end user’s perspective.

Three main options for the development of SCAM documents have been proposed. First, keep the SCAM standards as separate document since the users of those standards are not the same audience. Second, include all SCAM information and text within the related product documents. Third, put all the SCAM standards together in one document and provide more detailed explanations in non-mandatory language.

SCAM documents also feature product retirement requirements. A task group of the Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment reviewed the life cycle issue at length in preparation for the 2007 edition of NFPA 1851.

Meeting attendees believed that users of NFPA 1851 have become accustomed to the established retirement requirements, and were not in favor of changing these requirements without the
data to support a change. However, the current retirement requirements remain a significant issue. There is a need to balance risk versus cost. Changes to the requirements would now involve significant data, research and funding.

Retirement criteria and lifecycle consideration will continue to present opportunities to combine experience and research. Using empirical field data in conjunction with the experience of the Committee will allow members to make informed, technical decisions about the useful life of a component. All materials and substances wear out over time, so standardizing a reasonable end is critical. The NFPA 1851 Technical Committee is working with the Fire Protection Research Foundation on a project on the landscape of PPE care and maintenance to begin to gather data on the selection, use and storage of protective clothing and equipment.

While consideration of a possible reorganization of the entire project, SCAM documents should be integrated into consistent cycles. The immediate need is a plan for integration that is flexible enough to correspond with the needs of the project overall.

In terms of outreach, an increased effort should be made to make end users aware that SCAM documents exist. A survey should be conducted of SCAM users to determine what topics should be covered in the document and to determine the user’s practices. In addition, SCAM documents should be written in clear and concise language and show how, for example, ensemble elements should be inspected, cleaned and repaired. In some states, NFPA 1851 is law, so the text should be simple, clear and unambiguous. Expanded directions for disinfection and decontamination should also be provided.

The observation was made that SCAM documents should include information on training and use. Efforts to pursue this path will involve discussions with other Technical Committees, scope changes, committee membership composition and the approval of the NFPA Standards Council should the decision be made to incorporate these topics.

SCAM document revision cycles should be positioned closer to the related product document revision dates, and if possible, all SCAM documents should be in the same cycle.

Several summary points were provided for SCAM documents

- Educate fire departments about SCAM documents
- Work with NIOSH to publicize product issues
- Make SCAM documents easier to understand
- Focus on end users, including the use of end user familiar terminology
• Technical Committees should look at empirical field data and make an educated, technical and experienced decision regarding product life cycles, there is a logical end to a product’s useful life
• Integrate the revision cycles of SCAM documents with product documents for consistency
• Expansion of the SCAM documents
• Other Technical Committees have expressed a need for SCAM documents for the following documents:
  o Life Safety Rope and Equipment (NFPA 1983)
  o EMS Protective Clothing (NFPA 1999)
  o Station/Work Uniforms (NFPA 1975)
  o Wildland Protective Clothing and Equipment (NFPA 1977)

4. Document Processing

In terms of the NFPA document revision process and project management, several topics were discussed including the new document revision process, document revision cycles, meetings and participation, ballots, the importance of substantiations in Technical Committee input and membership categories.

Increased participation in the NFPA process can be obtained by way of increased inputs and comments, especially by active fire service professionals. End users in the fire service may not be aware of the NFPA process, and hence do not participate. For increased document processing efficiency, Technical Committees in the project should consider meeting in one place in the same time frame.

Invitations should be provided to local emergency response organizations when a meeting is scheduled in a particular city.

The relevance of the requirements contained in the standards and their affect on products should also be reviewed.

Fire departments in particular may receive little, if any, training on the NFPA process. Even though virtually everyone in the fire service is affected by NFPA PC&E standards, most personnel passively accept them, and should an issue arise, it is probably not communicated to NFPA.

Technical Committees in the project are typically at their maximum size, with little or no room for additional members in the User category. Hold lists for the standards that fire service professionals
use in “hands-on” applications (i.e., hose, ladders, powered rescue tools) have many Users listed even if the Technical Committee is not at maximum size.

Travel expenses can be significant for individual members to pay their own way to attend TC meetings. The NFPA Enforcer Program provides financial assistance to members classified as Enforcers, but non-enforcers who receive no compensation from a sponsoring organization under budgetary restrictions, find committee membership difficult. Online meetings and teleconferences can help with this issue. TC member classification definitions in the project should be revised, as many current categories are not well-defined and job titles often are not indicative of the work members actually perform.

TC members should be reminded of the requirements for continued TC membership. The importance of meeting attendance and returning ballots should be emphasized.

SCAM documents should follow product documents by one year in the revision cycle.

All PC&E documents currently in Fall revision cycles should be moved to Annual revision cycles. Nine additional months will pass before a standard could be available if a document in a Fall revision cycle receives a NITMAM. Moving all PC&E documents to an annual revision cycle will also facilitate the workload for individuals who may be members of more than one TC.

The Correlating Committee’s role in writing text for correlation and consistency was discussed, as were task groups’ roles, responsibilities, policies and procedures. A review of these requirements should be provided when the CC is considering TC reports. An individual document information (Doc Info) page should also be created for the Correlating Committee.

The effective dates of documents should be reviewed to make sure dates are realistic and achievable.

The new document revision process will provide a clearer picture of how the document will appear throughout the process cycle, thereby reducing the number of editorial corrections, Formal Interpretations and Tentative Interim Amendments (TIAs) required. Each TC will be trained on the use of the new online system.

The Correlating Committee should appoint a task group to review document revision cycles and project reorganization. Topics such as training and use should also be considered for inclusion in project documents. Specific suggestions are as follows:

- Move all project documents to an Annual revision cycle
- Keep NFPA 1851 and NFPA 1999 in the same cycle
• Move NFPA 1999 from the TC on Emergency Services PC&E to the TC on Special Operations PC&E
• Combine NFPA 1991, NFPA 1992 and NFPA 1994 into one Hazmat PC&E document
• SCAM should follow the related product documents by one year
• All respiratory protection standards including the new SCBA for Non-Structural FF should be in the same cycle
• NFPA 1982 should be in the same cycle as the respiratory protection standards
• NFPA 1989 and NFPA 1852 should be in the same cycle or one year following NFPA 1981

5. General

As the Protective Clothing and Equipment Project moves forward, the Correlating Committee and Technical Committees will be focusing on topics including new technology, end user groups, and other project issues.

New Technology.

New technology will be featured prominently in the project standards during future revision cycles. For standards to meet the needs of the end user, the timely introduction of new technology will be critical to their efficacy and usability. Research into the fire environment, fire behavior and the risks involved when responding to emergency incidents must reach the Technical Committees for review. As new technology is introduced, old or outdated design, performance criteria and test methods must be revised or replaced. Conversely, Technical Committees will also have to be aware of the limits of technology.

Electronic equipment will have to be harmonized and integrated into the complete protective ensemble, and consideration will have to be given to personnel assisting devices like cooling vests, radio communications, drone aircraft and robots which will have to operate in hazardous environments. Weak links like alarms to warn of system failures and stored energy hazards must also be considered.

Many users may not understand the environment they are entering during a response. Education is foremost in addressing this, as well as methods for measuring the atmosphere. This in turn may require Technical Committees to include provisions for the proper PC&E for overhaul and fire investigations.
New technology will also affect the way Technical Committees conduct meetings. Platforms like Adobe Connect and other web-based meeting services will enable the greatest participation of members.

**End User Groups.**

End users include more than the fire fighting community. Law enforcement, emergency medical services, emergency management services, trades and many other agencies are likely to be affected by the development of new standards. Many of these entities do not have standards that address personal protective clothing and equipment specific to the hazards their personnel could encounter. In the long-term, fundamental project realignment based on user groups instead of products could be considered.

Standards should be developed and programs should be designed to explain NFPA standards and the document development process and why those organizations should be concerned about standards. During training exercises, these programs can be used to explain the protective clothing and equipment that affects their personnel. This general overview presentation could also show the student how to get involved with NFPA standards development, apply for TC membership, provide input and comments, and describe how Technical Committees and Task Groups work.

With the assistance of periodic updates from NFPA (including Alerts that are generated from the Doc Info pages), current and future end users can keep up to date with which documents are in cycle and open for input or comments. Interested individuals who may have a strong interest in protective clothing and equipment issues should be recruited for Technical Committees.

Ask end users to participate in surveys related to the project standards. After an analysis of the survey results, work with internal stakeholders to determine what information is already known to the Technical Committees and how best to utilize any new information that may be provided as a result of surveys.

Efforts at NFPA are currently underway in the area of cross-functional opportunities. New products like Annotated Standards and marketing campaigns are reaching end users and boosting interest in the NFPA process. The Doc Info pages and the new revision process will make it easier for those who are interested in following the process.
Other project Issues.

Standards have been developed or are currently being developed that are not being adopted, and the importance of independent third-party product verification and compliance with some standards is being downplayed. NFPA should market the project using education and outreach to raise fire service understanding and the importance of NFPA compliance.

Better reporting of equipment incidents or PC&E failure and an improved product recall procedure should be instituted so that not only is manufacturer notified, but emergency response agencies are also informed.

Communication and information sharing between the PC&E project, the NFPA Fire Service Training Committee, and the Fire Service Occupational Safety and Health Committee and other TCs should be increased.

PC&E Technical Committees should review the contents of the Needs Assessment to the U.S. Fire Service and if possible provide input to the next edition. The Technical Committees will be provided with a copy of the Third Report, published by NFPA in 2011. Technical Committees should listen to the voice of the end user.

Use surveys to determine end user needs, provide feedback mechanism to existing TC members, state and provincial training facilities, certified instructors and other national organizations. Use the survey results to help the Technical Committees prioritize the development of each project standard to focus work on greatest impact areas first, then work towards the integration of the information in the standard. Developmental progress can be tracked through agreed-upon metrics developed in conjunction with organizational and strategic goals. Identify areas where standard requirements present unnecessary or unintended barriers.

The project should continue to actively provide input to and request the assistance of the Fire Protection Research Foundation. Projects recommended by the CC or TCs should be field relevant and produce data that can then be used by the committees for improving the project documents.

The overall size of the project and the number of documents should be reviewed. For example, there could be a single document for all the respiratory protection standards. The TC on Special Operations PC&E could reorganize with a basic document and expand out via other documents to specialized protection products.

NFPA should protect its brand and emphasize the importance of consensus-based standards via outreach and education, involve new fire fighters and emergency responders as participants, who may not have a positive view of NFPA based on hearsay or the lack of response to critical views of NFPA that
may appear in industry publications. Standards and requirements would gain greater traction with fire fighter endorsements based on increased awareness. The NFPA process and the expertise that exists on Technical Committees are second to none, NFPA should be the organization that others look to for sound advice and guidance.

Do not revise documents strictly for the sake of change. Documents should be permitted to be reissued (reconfirmed) if no changes are technically necessary.

Technical committees should consider an “all hazards” approach when revising project standards. Listing agencies should be more user-friendly so that information can be easily located. The process appears to focus more on the committees, not the end users. Time and funding are issues, and member participation needs to carefully tracked. Funding is critical to the project. Use more formats to reach the fire service. NFPA is safety oriented, not involved with market standardization. Standards must be credible, technically sound and reliable in order to be followed.

As the Protective Clothing and Equipment project continues to evolve, committees should keep in mind NFPA’s place in global standards. Vital to the success of the project are targeted marketing efforts and the pooling of resources (i.e., IAFF, IAFC, NVFC). A bottom-up approach should be taken, the fire service and other emergency response organizations should not be made to conform to requirements, but rather committees should be prepared to consider the needs and requirements of those organizations.
Correlating Committee Task Group on Supplementary Operating Procedures

ANNEX A: PRESENTATIONS

Test Method Validation Task Group

Anthony Putorti - NIST
Bill Haskell – NIOSH/NPPTL

Background

- NFPA Protective Clothing and Equipment Project
- Recent editions of NFPA standards
- Issues identified
  - Tentative Interim Agreements (TIAs)
  - “Fast-Track” revisions
  - Test method / criteria validation
  - Lack of transparency (real or perceived) in development of test methods and criteria
  - Loss of institutional knowledge over time on committees

Task Group Formation

- NFPA Correlating Committees
  - History of Supplemental Operating Procedures
  - Building code, life safety, electrical code
  - Adopted by CC, Approved by Standards Council
- Task Method Validation Task Group formed by Chairman Haskell
  - June 2012 Correlating Committee meeting
  - Develop Supplemental Operating Procedures for new test methods and criteria
  - Provide guidance to Technical Committees – within responsibilities of Correlating Committee
  - Provide consistent process for all technical committees in the project

Task Group

- Tony Putorti – Chair – NIST
- Jeff Stull – Secretary – Int'l Personnel Protection
- Dave Trebisacci – NFPA Staff Liaison
- Jason Allen – Intertek
- Steve Corrado – UL
- Pat Gleason – SEI
- Rich Young – DuPont
- Bill Haskell – NIOSH/NPPTL

Philosophy Statement

The Test Method Validation Task Group (TM) was established at the June 2012 Correlating Committee meeting to address increasing capacity, test requirements, and test methods now being based upon standards. Interoperable and interlaboratory validation of test methods and criteria as set out in NFPA standards and standards revisions effort. The TM has been charged with developing guidelines and procedures that NFPA Technical Committees can use to develop new test methods and performance criteria for inclusion in standards.

The preliminary concept incorporates a philosophy of the NFPA Technical Committee working on new or revised test methods as defined in a “Test Draft” meeting. The new methods and procedures will provide a road map to assist technical committee in developing new test methods and criteria as part of all new standards and standards revisions effort. Procedures and guidelines for the new test methods and performance criteria will address such development as any of the technical committees to the Correlating Committee. The preliminary concept incorporates a philosophy of the NFPA Technical Committee working on new or revised test methods as defined in a “Test Draft” meeting. The new methods and procedures will provide a road map to assist technical committee in developing new test methods and criteria as part of all new standards and standards revisions effort. Procedures and guidelines for the new test methods and performance criteria will address such development as any of the technical committees to the Correlating Committee.

Process Outline

1. Evidence of need and rationale for consideration of a new test method into an NFPA product standard
2. Analysis of impact of new test methods and performance criteria to the Correlating Committee
3. Projecting costs of resources and finding necessary and justification of the sources that can provide funding and resources
4. Communication, sharing, and documentation of information and data by a Task Group with the Technical Committee and then to the Correlating Committee
5. Plans and requirements for validation of the test method and performance criteria (interlaboratory testing, establishment of precision & bias, etc.)
Correlating Committee Task Group on Supplementary Operating Procedures (continued)

**Difficult Issues**

- Threshold for existing test methods and criteria
- Procedures – Maintain necessary elements, provide flexibility
- Staged application
  - Degree of validation before test / criteria inclusion
  - Interlaboratory study? How many labs?
- Gauging applicability of test method / criteria to performance problem or issue

**Draft Supplemental Operating Procedures**

- “Supplemental Operating Procedures for the Project on Fire and Emergency Services Protective Clothing and Equipment Related to Test Method/Criteria Validation”
- Development of flow chart for TC guidance

**Input from Correlating Committee**

- Your input is welcome!
- Your input is needed!
NFPA’s PC&E Documents – Revision Cycles

Future of the Protective Clothing and Equipment Project
April 4-5, 2013
Nashville, TN
Internet Access Code: cc521

PC&E Project Update
Bill Haskell, CC Chair
Dave Trebisacci, NFPA Staff
April 4-5, 2013
Nashville, TN

FAE-AAC Correlating Committee Scope
Responsibility for documents on the design, performance, testing, and certification of protective clothing and equipment for fire and emergency services organizations and personnel.

Responsibility for documents on the selection, care and maintenance of such protective clothing and equipment.

Authority of CCs (Rules, 3.4.2)
A Correlating Committee
- directs the activities of the Technical Committees
- resolves conflicts to achieve correlation
- corrects errors and omissions
- ensures that Committee activities have been conducted in accordance with these Regulations and any approved Supplemental Operating Procedures
- can choose between alternatives presented by the Technical Committees and write text, but only as necessary for correlation, consistency, and the correction of errors and omissions.

CC Responsibilities (Rules, 3.4.3)
(a) Resolve conflicts within or between NFPA Standards
(b) Recommend the resolution of conflicts between and overlap in Technical Committee Scopes
(c) Recommend the establishment of new or discharge of existing Technical Committees and propose new Scopes or changes to existing Scopes of TCS
(d) Recommend changes in membership to obtain or improve representation on a Technical Committee

CC Responsibilities (Rules, 3.4.3)
(e) Correlate the scheduling of the Reports from the Technical Committees
(f) Notify a Technical Committee of its failure to comply with NFPA Regulations or the Manual of Style
(g) Determine whether or not the Technical Committee has given due consideration to all evidence presented to it in connection with the preparation of its Report, including all comments relating to negative votes
(h) Establish Supplemental Operating Procedures, if desired
(i) Perform other duties as the Standards Council assigns
NFPA’s PC&E Documents – Revision Cycles (continued)

Supplemental Operating Procedures (3.3.8)

A Correlating Committee may adopt Supplemental Operating Procedures

- consistent with NFPA Bylaws and Regulations
- these procedures shall be transmitted to the Standards Council Secretary, who shall submit them to the Standards Council for approval.

Task Groups*

- address a specific topic or problem
- are appointed and discharged by the TC or CC Chair
- persons serving on Task Groups need not be members of the TC or CC
- need not be balanced by interest
- shall be discharged at the conclusion of the task
- there shall not be standing Task Groups.

*From A Guide For Officers Of NFPA Technical Committees and Correlating Committees

Task Groups*

- shall forward recommendations along with a report of underlying issues to the Technical Committee or Correlating Committee for action
- reports shall not be submitted in the name of the Task Group as input, comments, TIA’s, or Fls.
- TC/CC Chairs should avoid potential conflicts of interest in the appointment of all Task Group Chairs

*From A Guide For Officers Of NFPA Technical Committees and Correlating Committees

Project Structure and Voting Members

Correlating Committee (FAE-AAC) 27

- FAE-EMS 13
- FAE-SCE 24
- FAE-SPF 35
- FAE-ELS 29
- FAE-RPE 31
- FAE-HAZ 32
- FAE-ELS 28
- FAE-NSF 15

Task Groups

- TC/CC Chairs should identify participating Task Group members when presenting Task Group reports to the full Committee for review and action
- TC/CC Chairs should ensure that the work of Task Groups is thoroughly reviewed and considered by the full Committee.
- Task Group minutes should list task group members and Committee assignments and record the reasons for the actions taken, particularly if the actions are the result of research or tests
- Staff liaisons attend task group meetings, when possible

*From A Guide For Officers Of NFPA Technical Committees and Correlating Committees
NFPA’s PC&E Documents – Revision Cycles (continued)

Revision Cycles Important Dates

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<th>PC Closing</th>
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Future of PC&E Project

Proposal to move NFPA 1999 (EMS) to Special Ops TC and be renamed

Technical Committee on Emergency Medical Services and Special Operations Protective Clothing and Equipment

EMS TC (13 voting) Opinion
SCE TC (24 voting) Opinion
Four members in common to both TCs
Discussion
Recommendation

Future of PC&E Project

Standardization of compliance dates across the project
Discussion
Recommendation

Future of PC&E Project

- Retain Project Definitions or use NFPA Glossary of Terms
- Importance of attending meetings and returning ballots
- Project interaction with other NFPA TCs
- Conference Call – May (SD NFPA 1975)
- In-person meeting – July (FD NFPA 1952 and 1953)

Future of PC&E Project

Thank you!

Bill Haskell, CC Chair
Dave Trebisacci, NFPA Staff

April 4-5, 2013
Nashville, TN
Selection, Care and Maintenance Documents

Existing Documents
- NFPA 1872 Standard on Selection, Care and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA), 2013 Edition

Key Issues in Existing Documents
- End User Adoption/Utilization
- Life Cycle of Equipment and Ensemble Elements (ex: retirement considerations)
- Reporting of PPE Health and Safety concerns
- Special Incident Handling
- Cycle Integration/timing with product documents for consistency

Short-Term Desire for SCAM
- TC’s currently expressing interest in SCAM Development:
  - SCAM Document for Life Safety Rope and Equipment (NFPA 1983)

Long-Term Desire for SCAM
- TC’s with potential interest in SCAM Development:
  - SCAM Document for EMS Protective Clothing
  - SCAM Document for Station/Work Uniforms
  - SCAM Document for Wildlands Protective Clothing and Equipment

Next Steps
- Initiative Approval
- Process/Guideline to Follow
- Discussion
- Path Forward/Action Items
Areas of Growth and Expansion

The Future of NFPA's Protective Clothing and Equipment Project

Rich Duffy, IAFF (retired)
Jeff Stull, Int'l Personnel Protection

Specific Issues Related to Growth

- Membership (particularly end users)
- Proliferation and acceptance of standards
- Support of standards development efforts
- Changing marketplace
- Funds availability for products purchases
- Potential opportunities
- Possible reorganization of project

Participation on Committees

- Are committees really balanced?
- Do end users truly represent broad fire service interests?
- How can end user participation be improved on certain committees?
- Are there mechanisms that can be used to promote input from non-committee end users and other interests?

Acceptability of Standards

- Project currently covers:
  - 12 total product standards
  - 6 SCAM or other types of standards
- Compliance with current standards radically varies with standard and user group
  - NFPA 1971/1981/1982 certification is high
  - Some standards have no products or product categories that are certified
  - Modest use of SCAM standards

Reasonableness of Standards

- Standards must be credible and reliable to be followed and respected.
- Many standards have reached a level of "maturity" where fewer changes should be implemented unless significant technology changes are manifested.
- Requirements and changes must be meaningful for affecting product designs and material choices.

Marketplace/Committee Dynamics

- Manufacturers choose to comply with standards based on end user perceived risk (liability) and rate of return
- Material suppliers have dominate role in standards development based on industry component recognition practices
- Most committee members are not aware of intricate details involved in creation of test methods and performance criteria
Areas of Growth and Expansion (continued)

Public Sector Funding
- Majority of first responder organizations strained on resources to support safety equipment purchases
  - Grant-based funding is diminishing
  - NFPA Needs Assessment reports show majority of fire departments with turnouts/SCBA > 10 yrs old
- Criteria in standard must be commensurate with demonstrated need and benefits
  - Example: DRD implementation on turnouts

Possible New Areas
- Types of standards
  - Use (interrelationship with NFPA 1500)
  - Training (interrelationship with other committees)
- Product types
  - Additional electronics-based equipment
  - Specialized ensembles; ensemble options
- New user groups
  - Law enforcement, medical first receivers, skilled trades

Possible New Organization
- Focus on end user-based committees
- Recognize other end user populations
- Create base PPE fundamentals TC
- Maintain respiratory and electronics equipment committees
Future of NFPA’s Protective Clothing and Equipment Project

Date: April 4-5, 2013
Location: Embassy Suites Nashville at Vanderbilt
1811 Broadway,
Nashville, TN

1. **Hotel Accommodations:** Attendees can call the Embassy Suites at **800-445-8667 or 615-320-8899** to make their room reservations. The group rate is $145.00 + tax, per night. **You must ask for 2013 NFPA Future of the PC&E Room Block or refer to the Group Code “NFP” in order to receive the negotiated rate.**

   If you prefer to book on-line, please use this direct link:

   [Embassy Suites Nashville at Vanderbilt](#)

   **Important:** Room reservation cut-off date is March 13, 2013

   *Note: A credit card may be required to guarantee your stay, but two nights’ lodging will be applied to the NFPA Master Bill upon check-out and you will not be charged.*

2. **Flight Arrangements:** NFPA will also provide funding for your airfare. To book your flight, please call Lauren Connelly at Colpitts World Travel, 617-984-7313 or 800-795-9500, or by email [lconnelly@colpittswt.com](mailto:lconnelly@colpittswt.com).
ANNEX C: DRAFT SUPPLEMENTARY OPERATING PROCEDURES

Proposed Supplemental Operating Procedures for the
Project on Fire and Emergency Services
Protective Clothing and Equipment
Related to Test Method/Criteria Validation

1.0 Preamble

The Project on Fire and Emergency Services Protective Clothing and Equipment is responsible for several product standards that are dependent on multiple criteria and test methods to establish levels of acceptable minimum product design and performance specifications. These standards are developed or revised by a number of different Technical Committees (TCs), which are collectively organized under a Correlating Committee (CC). While TCs are responsible for the technical content of each standard, the CC is responsible for ensuring correlation among the various standards, including subjects that relate to the consistency of criteria and test methodologies as applied in the various standards.

These supplemental operating procedures were prepared to address specific requirements for the validation of new or revised test methods and criteria as they are applied to various standards that are part of the project. Validation of test methods and criteria is considered an important process to ensure that design/performance requirements are consistent, relevant, and meet the intended purpose. This is particularly true for setting criteria that minimum product performance levels that permit products to be certified to the respective standard. It is further essential that test methods equally meet the intended purpose, are reproducible, and discriminate product performance consistent with observed field performance.

The requirements for validation of test methods and criteria provided in these standard operating procedures are intended to establish a process by which the TCs ensure that test method and criteria validation take place and to provide oversight for their implementation by the CC. Specific appendix sections tied to requirements offer guidance for how the TC and CC work together to provide a high level of quality for introducing new test methods and criteria in addition to making significant revisions to existing test methods and criteria.

2.0 Requirements for Validation of New or Revised Test Methods and Criteria

2.1 Each new or revised test method and criteria shall be validated through the following:

2.1.1* Supporting evidence shall be provided that substantiates the need or rationale for establishing new test methods or criteria or revised existing test methods of criteria that are provided in terms of field relevance, safety concerns, recognition of new product technology, to account for advances in testing technology, or for other clearly stated objectives.

2.1.2* An assessment shall be made for the impact of the new test methods or criteria or revised existed test methods or criteria for products that already certified or field that are considered to have acceptable performance.
2.1.3* The intra-laboratory repeatability and inter-laboratory reproducibility shall be established for new or revised test methods. Where possible, test methods shall include procedures for their calibration. At a minimum, participating certification organizations and their laboratories shall affirm their ability to reliably conduct proposed testing and apply established criteria.

2.1.4* The relevance of test methods and any associated criteria shall be determined through a determination for how proposed or revised test methods discriminate product performance consistent with field performance.

2.1.5* Test data and any other supporting documentation shall be made available to the members of the respective TC and the CC, or any individuals that request this information.

3.0 Responsibilities of the Technical Committee (TC)

3.1* Each TC under the project shall require that individuals, organizations, or the committee originating proposals for the introduction of new test methods or criteria or significant changes to existing test methods or criteria prepare a prospectus that addresses the following elements related to the validation of the new requirements:

3.1.1* Specific evidence for the need or rationale for the proposed new or revised requirements shall be provided.

3.1.2* The impact of the new or revised requirements on current certified or fielded products providing acceptable performance to the existing edition of the relevant standard shall be identified.

3.1.3* A projection or estimate shall be provided for the level of resources needed to support the introduction of the new or revised requirement that includes major capital equipment and research required for the validation of the requirements according to 3.1.4 and 3.1.5.

3.1.3.1 Specific sponsors involved in providing resources shall be identified.

3.1.4* For new or revised test methods, a plan shall be described how the proposed/modified test method will be validated for its intra-laboratory repeatability and inter-laboratory reproducibility.

3.1.5* For new or revised criteria, a plan shall be described how the proposed/modified criteria will be validated through field testing or other correlations to determine its relevance and suitability.

3.2* The TC shall review the prospectus and provide feedback to the originator on specific areas that need to be addressed or recommendations for how specific elements of the prospectus may be addressed.

3.2.1 If the prospectus is provided as a result of public input, the TC shall communicate to the originator the need to address the elements identified in 3.1.

3.2.2 If the prospectus is provided as the result of public input, the TC shall include in its substantiation of the action taken on the public input specific observations for the state of the proposed/modified test method or criteria against the requirements for validation.
3.3* The TC shall forward the prospectus to the CC for its review.

3.4* Through the standards development process, the TC shall monitor progress on the validation of new or revised test methods and criteria.

3.5* At the time of preparing the second draft, the TC shall review the status of new and revised test methods and criteria and shall determine if the specific validation requirements in 2.0 have been adequately met for the proposed/modified test method or criteria.

3.6* The TC shall have the ability to waive individual validation requirements when due diligence has been followed in attempting to meet the requirements in 2.0.

4.0 Responsibilities of the Correlating Committee (CC)

4.1* The CC shall establish a standing Task Group (TG) for providing oversight for the implementation of test method/criteria validation.

4.2* The CC shall direct the TG to review prospectuses forwarded by individual TCs with regard to how each individual prospectus meets the requirements of 3.1 and how individual test methods and criteria may impact the development activities of other committees.

4.2.1 The TG shall report to the CC its recommendations for any feedback to be provided to the originator of the prospectus that includes any criticisms related to validation or recommendations for how to proceed.

4.2.2 If the prospectus originates as the result of public input on a specific standard, the TG shall make recommendations for providing specific notes from the CC to TC directing that specific actions to be taken with respect to the subject prospectus if warranted.

4.3* At the time of second draft for the specific standard, the CC shall assign the TG to review any new test methods and criteria or significant revisions to existing test methods and criteria for the level of validation that has taken place relative to the requirements in 2.0.

4.3.1 The TG shall make recommendations to the CC for the handling of any specific comments related to new test methods and criteria or significant revisions to existing test methods and criteria based on its review.

4.3.2 The CC shall determine an appropriate action for new test methods or criteria and revised existing test methods and criteria.

4.3.3 The CC shall direct the TC to maintain and make available any test results or documentation on new or modified test methods and criteria to the CC, other TCs, or any individuals or organizations upon request.
Annex

A.2.1.1 Examples of supporting evidence can include the documentation of specific safety issues that have been identified by end user or other groups, which may include statistics on the number of accidents or highlight specific cases where the issues have arisen. Other forms of supporting evidence can include aspects of existing requirements that unduly prevent the proper testing or considering of new product technologies because the existing test methods or criteria are found to be design-restrictive, or information that shows that new test methods have become available that provide more reliable or relevant forms of evaluation for the specific product property or attribute under consideration. The provision of scientific papers, test data, or statistics provides a more robust justification for supporting evidence.

A.2.1.2 The nature of this requirement is to have the TC assess what the anticipated impact of the new or modified requirements are relative to specific products. It is not the intent to identify specific products that might be excluded by a new or modified requirement, but rather for the submitter to provide an analysis for the types of products that might be affects with an indication for why the affected products do not provide adequate performance.

A.2.1.3 An essential part of the validation process is to include an assessment of the repeatability (intra-laboratory precision) and reproducibility (inter-laboratory precision) of any new test method or significant modification of an existing test method. This information is important for establishing the reliability of the test method and should as a minimum include those laboratories that provide certification services for the relevant product standard. This information may also be useful in setting specific criteria to account for expected test method variability. It is further important that the principal certification organizations and their laboratories affirm formerly to the TC that the tests can be conducted reliably as proposed at least by the time of the second draft.

A.2.1.4 Attempts should be made to determine the degree to which new or significantly revised test methods discriminate product performance or relate the field performance of products. One recommended approach is to identify product types that are considered to be unsuitable based on end user field experience and evaluate those products alongside other products to determine if the test method suitably discriminates performance consistent with observed field performance. Another approach is to demonstrate the impact and relevance of test results for products through carefully designed experiments carried out in the field. Lastly, one additional approach is to relate proposed criteria to specific safety levels that can be documented through scientific or other reasonably based field investigative work.

A.2.1.5 Access of the information on which new or revised test methods and criteria are based should be available to all parties seeking this information, including TC members, CC members, and individuals outside the committee process. Supporting documentation that includes, but is not limited to, proposed new or modified methodology/criteria with justification statements, supporting evidence, test data, references to published papers or statistics, inter-laboratory test results, and other information should be maintained by the TC as part of meeting minutes or made available elsewhere on the NFPA TC website page.

A.3.1 The intent of this requirement is not require a specific format for particular information to be presented but rather to address the type of content that should be provided as part of a prospectus.
A.3.1.1 See A.2.1.1.

A.3.1.2 See A.2.1.2.

A.3.1.3 A reasonable estimate should be made if significant resources will be needed to accomplished the proposed introduction of a new or modified test method, particularly as it related to the acquisition of new test equipment or modifications to existing equipment. An assessment should be made if such equipment would be commercially available or would have to be constructed by individual laboratories. If government or other extramural funding is available to support the method development with regard to equipment, these sources should be identified.

A.3.1.4 The plan should identify the specific laboratories to be involved in any laboratory testing for validation purposes and who will be responsible for coordinating this testing and presenting the results to the TC.

A.3.1.5 See A.2.1.4.

A.3.2 At the first draft stage, the TC may provide feedback in the form of its substantiation statement to the submitter. If the proposed new or modified test method/criteria occurs before the first draft stage, the TC may informally respond to the submitter with any recommendations that it considers improves on the level of documentation as may be submitted as input during the first draft stage.

A.3.3 The communication of any prospectus should be from the TC chair to the CC chair. The TC chair may establish an individual task group or have a standing task group for its review of prospective test method/criteria proposals or revisions.

A.3.4 It is recommended that the TC send out reminders or seek an update for any specific committee activities where new or significantly modified test methods and criteria are being proposed.

A.3.5 The TC should base its determinations on a review of the criteria in Section 2.0. The TC may assign this function to a task group which can make recommendations to the TC for their ultimate consideration.

A.3.6 The intent of this paragraph is permit the TC to consider special circumstances in determine the level and detail to which new or modified test methods/criteria are subjected to validation requirements. It is understood that the new validation requirements are not intended to stymie the development or revision of new standards but instead are to establish uniform and comprehensive approaches to ensuring that methods and criteria achieve the intended objectives. It is further recognized that in some cases, it may be not practical to address all elements of proper validation process, particularly if there is a pressing need for the inclusion of a new or modified test methods and criteria.

A.4.1 The role of this task group is to ensure that the validation process is followed by the individual TCs and that correlation issues are captured. A number of test method and criteria are used in multiple standards and the CC is responsible for providing oversight that consistency in how test methods and criteria affect multiple standards is addressed.
A.4.2 The review by the TG is intended to assess the completeness of any prospectus and to identify any correlation issues that affect multiple standards.

A.4.3 The purpose of any comments from the CC to the TC via the TG are to be considered advisory in nature but may reflect specific issues will be identified by the CC in its review of first and second drafts for the specific standard.

A.4.3.3 See A.2.1.5.
Revision Cycles Important Dates

<table>
<thead>
<tr>
<th>Cycle</th>
<th>PI Closing</th>
<th>FD Meeting</th>
<th>PC Closing</th>
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<tr>
<td>A17</td>
<td>7/6/2015</td>
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<td>A18</td>
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</table>
The Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment and the Committees on Hazardous Materials Protective Clothing, and Wildland Fire Fighting Protective Clothing and Equipment submitted requests to the Standards Council to develop new documents on the selection, care, and maintenance of protective ensembles for hazardous materials and wildland fire fighting protective clothing and equipment.

During the agenda review for the August meeting, the chair of the Council asked to administratively withdraw these requests. He questioned whether it was necessary for the Protective Clothing and Equipment Committees to produce separate selection, care, and maintenance documents. He wondered if it would be beneficial for the users of the documents to add the SCAM material as a chapter in the documents.

Could you please discuss the possibility of adding the SCAM material as a chapter in your documents with your committees, and report back to the Council with their response?

c: K. Willette

11-8-28
11-8-30
To:       NFPA Standards Council  

From:  Les Boord, Chairman  
        Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment  

Date:  3 May 2011  

Re:  Proposed NFPA Standard on the Selection, Care and Maintenance of Wildland Fire Fighting Clothing and Equipment  

As part of an ongoing directive by the Technical Correlating Committee (TCC) on Fire and Emergency Services Protective Clothing and Equipment to the technical committees in the Fire and Emergency Services Protective Clothing and Equipment Project, the Technical Committee (TC) on Wildland Fire Fighting Protective Clothing and Equipment has requested approval to develop a new standard on the selection, care and maintenance of wildland firefighting clothing and equipment.  

The TCC has reviewed this request and recommends that the Standards Council grant approval to the TC to proceed with the development of this standard.  

cc:  Rick Swan, FAE-WFF Chair  
      David Trebisacci, Staff Liaison
a. Explain the Scope of the new project/document:

To conform with the scopes of previous selection, care and maintenance (SCAM) documents in the Fire and Emergency Services Protective Clothing and Equipment project previously approved by the Standards Council, the following scope is provided:

1.1 Scope.

1.1.1 This standard shall specify the minimum selection, care, and maintenance requirements wildland firefighting incidents that include garments, helmets, gloves, footwear, and interface components that are compliant with NFPA1977, *Protective Clothing and Equipment for Wildland Fire Fighting Standard*.

Additional scope statements will be added to the new document to confirm with other existing SCAM documents.

b. Provide an explanation and any evidence of the need for the new project/document:

NFPA 1977, *Protective Clothing and Equipment for Wildland Fire Fighting Standard* *(first edition 1993)*, has been in effect for many years. The protective clothing in compliance with this standard is in use by many fire departments and other emergency response entities. Currently there is no standardized end user document to provide guidelines on the selection, care and maintenance of these ensembles and clothing. Recognizing this need, the Technical Correlating Committee on Protective Clothing and Equipment has directed the Technical Committee on Wildland Fire Fighting Protective Clothing and Equipment to develop this supporting documentation.

c. Identify intended users of the new project/document:

The users of this document include NFPA 1977 document users, including but not limited to fire departments and other emergency responders, law enforcement and military.

d. Identify individuals, groups and organizations that should review and provide input on the need for the proposed new project/document; and provide contact information for these groups:

Reviewers of the document should include representatives of entities with organizations engaged in wildland firefighting incident response, including law enforcement and the military, subject matter experts, protective clothing and equipment manufacturers, independent service providers, testing and certification organizations and wildland firefighting response educators.

e. Identify individuals, groups and organizations that will be or could be affected, either directly or indirectly, by the proposed new project/document, and what benefit they will receive by having this new document available:

The new document will provide the guidance to assist entities and individuals in making the most appropriate decision when selecting wildland firefighting protective ensembles and clothing and developing policies for care and maintenance. Besides the economic benefit of making a wise purchasing decision, the most important benefit is the increased safety of the incident responder by the use of ensembles and clothing that have been properly cared for and maintained.

f. Identify other related documents and projects on the subject both within NFPA and external to NFPA:

This new selection, care and maintenance document relates directly to NFPA 1977. Other key documents include all the standards (including other SCAMs) in the Fire and Emergency Protective Clothing and Equipment project.

g. Identify the technical expertise and interest necessary to develop the project/document, and if the committee membership currently contains this expertise and interest:

The development of this document will require expertise in the use of wildland firefighting clothing and its related care and maintenance. The Technical Committee on Wildland Fire Fighting Protective Clothing and Equipment currently has users qualified in wildland firefighting incident response. The committee members also include manufacturers of wildland firefighting incident response ensembles and clothing, independent service providers, and testing and certification organizations.
h. Provide an estimate on the amount of time needed to develop the new project/document:

The technical committee estimates that the document can be developed in three years with most of the work being performed via the internet and conference call.

i. Comment on the availability of data and other information that exists or would be needed to substantiate the technical requirements and other provisions of the proposed new project/document:

The technical requirements of the new document can be substantiated by referring to other SCAM documents within the Fire and Emergency Services Protective Clothing and Equipment project, industry requirements, best practices and procedures, and product manufacturer’s user instructions.

Please send your request to:

| NFPA Codes and Standards Administration |
| 1 Batterymarch Park |
| Quincy, MA 02169 |
| Stds_admin@nfpa.org |
| Rev. 10/09 |

| Signature: Rick Swan (electronic signature) |
| Name: Rick Swan |
| (please print) |
| Affiliation: FAE-WFF TC Chair |
Item 14-3-22
Linda,

At the September 2013 committee meeting, the technical committee on Liquefied Natural Gas voted to close the open work project to develop a standard for fire protection on offshore LNG facilities (SC Minutes item 11-3-18). Interest in such facilities has diminished in the past several years as the US moves more toward exporting LNG. In addition, the committee members indicated that the existing committee does not have the necessary expertise to develop a standard on offshore LNG facilities, and inquiries to other organizations did not result in any new volunteers coming forward.

Please let me know if you need any further information.

Best Regards,

Denise

Denise Beach
Senior Engineer
National Fire Protection Association
Ph. 617/984-7501
Fax. 617/984-7110
www.nfpa.org
TO: Technical Committee on Liquefied Natural Gas
FROM: Linda Fuller
DATE: March 25, 2011
SUBJECT: Proposed Document Scope for Proposed New Project on Offshore LNG Facilities

I am transmitting to you herewith the following action of the Standards Council (February 28 – March 1, 2011):

At the October 2010 meeting, the Council considered the request of the Technical Committee (TC) on Liquefied Natural Gas, that NFPA consider the establishment of a new document on offshore LNG facilities. After review of all the material before it, the Council voted to publish a notice to solicit comments on the need for the project, information on resources on the subject matter, those interested in participating if established, and other organizations actively involved with the subject. (See Minute Item 10-10-13) Two comments were received in support of the proposed document.

After review of the entire record before it, the Council has voted to approve the request of the TC on Liquefied Natural Gas to develop a document on offshore LNG facilities. The Council directs NFPA Staff to solicit fire service expertise. Once the TC has developed and balloted a draft document (see Regs. 4.3.1.1), the TC can then make a request to the Council to enter an appropriate revision cycle. The Council approved the document scope as follows:

**Document Scope:** This standard would apply to fixed and floating offshore facilities that liquefy natural gas or store, vaporize, transfer, and handle liquefied natural gas (LNG). The Standard will include training requirements for offshore personnel involved with offshore LNG as well as general requirements for design, maintenance, and operation of an offshore LNG facility. This standard will not apply to offshore buoys designed to transfer natural gas from a vessel designed for LNG vaporization.

**Minute Item 10-10-13** The Council reviewed the request of the Technical Committee on Liquefied Natural Gas, that NFPA consider the establishment of a new document on offshore LNG facilities. The Council voted to publish a notice of receipt of the request soliciting opinions on the need for the project, information on resources on the subject matter, those interested in participating, if established, and other organizations actively involved with the subject.

**Proposed Document Scope:** The Standard will include training requirements for offshore personnel involved with offshore LNG as well as general requirements for design, maintenance, and operation of an offshore LNG facility. This standard will apply to fixed and floating offshore facilities that liquefy natural gas or store, vaporize, transfer, and handle liquefied natural gas (LNG). This standard will not apply to offshore buoys designed to transfer natural gas from a vessel designed for LNG vaporization.

c: G. Colonna, D. Beach, J. Goyette, C. Cronin
TC Marine Fire Fighting Vessels
Interested parties
28 October 2010

Secretary Standards Council,

The Liquefied Natural Gas (LNG) market is expanding around the world and the development of an applicable standard to all fixed and floating offshore facilities that liquefy natural gas or store, vaporize, transfer, and handle liquefied natural gas is needed. The existing NFPA 59A standard, which is onshore oriented, will be used as the base code for the development of the offshore standard which is essential to the safe operation of vessels, safety of people and the security of environment and property.

I am interested in serving in the committee to develop this standard. As a classification society, the American Bureau of Shipping (ABS) is committed on promoting security of life, property and environment. ABS has participated on NFPA 59A for more than 25 years in the interest of safety as a marine classification society. We feel that this is an opportunity for ABS to provide a very significant contribution towards offshore LNG applications.

ABS will be able to contribute with information on resources for the design, construction and operational maintenance of marine-related facilities.

If you need additional information, please do not hesitate to contact me.

Sincerely,

[Signature]
Leo Campos
American Bureau of Shipping
Offshore Engineering Department
281-877-6754
Dear Sir or Madam,

This email is sent to notify NFPA that the U.S. Coast Guard is interested in development of a NFPA standard for offshore LNG operations. Over the past several years, we have seen an increase in the interest of designing and constructing LNG facilities offshore. A standard developed specifically for the offshore storage, production, and handling of LNG would be beneficial for establishing essential requirements and standards for the design, installation, and safe operation. We look favorably toward development of such a standard and do intend on participating in its development and in serving on committee.

Very Respectfully,

Ken Smith
Asst. Division Chief / General Engineer
Office of Vessel and Facility Operating Standards U.S. Coast Guard Headquarters (CG-5222)

PH: 202-372-1413
FX: 202-372-1926

Mailing Address:

COMMANDANT (CG-5222)
ATTN: KEN SMITH, ROOM 1210-E
U.S. COAST GUARD
2100 2ND ST, SW, STOP 7126
WASHINGTON, DC 20593-7126
TO: Technical Committee on Liquefied Natural Gas
FROM: Linda Fuller
DATE: October 25, 2010
SUBJECT: Request for a new document on Offshore LNG Facilities

I am transmitting to you herewith the following action of the Standards Council (October 19-20, 2010):

The Council reviewed the request of the Technical Committee on Liquefied Natural Gas, that NFPA consider the establishment of a new document on offshore LNG facilities. The Council voted to publish a notice of receipt of the request soliciting opinions on the need for the project, information on resources on the subject matter, those interested in participating, if established, and other organizations actively involved with the subject.

Proposed Document Scope: The Standard will include training requirements for offshore personnel involved with offshore LNG as well as general requirements for design, maintenance, and operation of an offshore LNG facility. This standard will apply to fixed and floating offshore facilities that liquefy natural gas or store, vaporize, transfer, and handle liquefied natural gas (LNG). This standard will not apply to offshore buoys designed to transfer natural gas from a vessel designed for LNG vaporization.

cc: G. Colonna, T. Lemoff, D. Beach, J. Moreau-Correia, C. Cronin

10-10-13
Possible list of interested parties for the proposed new project on Offshore LNG Facilities
Council Action (letters) sent on October 27, 2010

Kenneth Smith
US Coast Guard
Commandant (CG-5223)
2100 Second Street, SW
Washington, DC 20593-0001

Stanley T. Kastanas
US Department of Transportation
Pipeline & Hazardous Materials Safety Administration
1200 New Jersey Avenue, SE
Washington, DC 20590

Christina Sames, VP Operation and Engineering
American Gas Association
400 North Capitol Street, NW
Washington, DC 20001

Bill Cooper, President
Center for Liquefied Natural Gas
1220 L Street, NW, 9th Floor
Washington, DC 20005-4070

David C.D. Clark, President
Society of International Gas Tanker and Terminal Operators
DC Maritime Technologies Inc.
407-1200 Lonsdale Ave.
North Vancouver, B.C. V7M 3H6
Canada

Leo Campos
American Bureau of Shipping
16855 Northchase Drive
Houston, TX 77060
Jeffrey D. Wiese  
U.S. Department of Transportation  
Pipeline and Hazardous Materials Safety Administration  
East Building, 2nd Floor  
1200 New Jersey Ave., SE  
Washington, DC 20590

Donald Santa, President  
Interstate Natural Gas Association of America  
20 F Street, NW Suite 450  
Washington, DC 20001  
202-216-5900  
dsanta@ingaa.org

Roger J. Roue  
Society of International Gas Tankers  
And Terminal Operators  
17 St. Helen’s Place  
London EC3A 6DG  
United Kingdom

LNG Importing Companies
**New Project Initiation Form**

*(To be completed by proponent of new project/document)*

*Additional pages may be attached if necessary.*

<table>
<thead>
<tr>
<th>a. Explain the Scope of the new project/document: This standard would apply to fixed and floating offshore facilities that liquefy natural gas or store, vaporize, transfer, and handle liquefied natural gas (LNG). The standard would include training requirements for offshore personnel involved with offshore LNG as well as general requirements for design, maintenance, and operation of an offshore LNG facility. The standard would not apply to offshore buoys designed to transfer natural gas from a vessel designed for LNG vaporization.</th>
</tr>
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<tbody>
<tr>
<td>b. Provide an explanation and any evidence of the need for the new project/document: Other than voluntary requirements from classification societies, there is currently no standard that addresses offshore LNG facilities. The standard for onshore facilities (NFPA 59A) is only partially applicable to offshore facilities (see response to item f). Growing public concern for onshore LNG facilities has prompted the LNG industry to explore and develop offshore LNG projects.</td>
</tr>
<tr>
<td>c. Identify intended users of the new project/document: Offshore LNG facility designers, owners, operators, classification societies, and AHJs. The standard will establish essential requirements and standards for the design, installation, and safe operation of offshore LNG facilities. It will also provide guidance to all persons concerned with the construction and operation of equipment for the production, storage, and handling of offshore LNG.</td>
</tr>
<tr>
<td>d. Identify individuals, groups and organizations that should review and provide input on the need for the proposed new project/document; and provide contact information for these groups: NFPA 59A technical committee members and interested parties thereof. (See contact data associated with NFPA 59A)</td>
</tr>
<tr>
<td>e. Identify individuals, groups and organizations that will be or could be affected, either directly or indirectly, by the proposed new project/document, and what benefit they will receive by having this new document available: NFPA 59A technical committee members and interested parties thereof including LNG facility designers, owners, operators, classification societies, and AHJs. A new document would establish baseline standards for safe design, construction, maintenance, and operation of offshore LNG facilities.</td>
</tr>
<tr>
<td>f. Identify other related documents and projects on the subject both within NFPA and external to NFPA: A working group on the technical committee for NFPA 59A has conducted a review of NFPA 59A and identified sections which may apply directly, need modification, or do not apply to offshore applications. The developed documents will help expedite development of a new standard for offshore LNG. Other publications and documents which may be related include ABS Rules and Guides and the IMO Gas Code.</td>
</tr>
<tr>
<td>g. Identify the technical expertise and interest necessary to develop the project/document, and if the committee membership currently contains this expertise and interest: The technical committee for NFPA 59A currently contains the expertise and interest necessary to develop the project.</td>
</tr>
<tr>
<td>h. Provide an estimate on the amount of time needed to develop the new project/document: 24 months</td>
</tr>
<tr>
<td>i. Comment on the availability of data and other information that exists or would be needed to substantiate the technical requirements and other provisions of the proposed new project/document: The expertise within the NFPA 59A members covers both LNG and maritime issues. Additionally, several offshore facilities have been designed, built and in operation in different countries. A review of the criteria adopted for those facilities may provide a basis for the development of the new standard.</td>
</tr>
</tbody>
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**Please send your request to:**
NFPA
Codes and Standards Administration
1 Batterymarch Park
Quincy, MA 02169

**Signature:** [Signature]

**Name:** [Name] (please print)

**Affiliation:** NFPA 59A TC member (please print)

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**Rev. 10/09**

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**February 25, 2014**

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**Supplemental Agenda March 3-4, 2014**
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<tr>
<th>Name</th>
<th>Need?</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Gil Poe</td>
<td>N</td>
<td>The picture of LNG is changing in America. We are leaning to converting some of the import terminals into export terminals. I would doubt we would look into an offshore facility in the US at this time. That said, on the international front several floating liquefaction plants / export terminals are in design. NAPA 59A does a fairly good job at covering the aspects of an onshore import terminal. I think it lacks a little when considering all the additional aspects of a liquefaction plant (import pipelines, skid catchers, etc.); storage/export, gas drying, gas cleaning, VCSS, etc.) The challenge with writing an &quot;offshore&quot; document is the scope. Floating vs jacket vs GBS. Terminal vs manufacturing facility and the added complexity of production, dry tree, and subsea. In my opinion, at this time, I would think that we should stick to our core and not pursue an offshore document. As I mentioned before, I have been on the API 14 C committee for 2 years now and we are coming to a draft later this year. If we do pursue an offshore document and we do have a scope, I should be able to help.</td>
</tr>
<tr>
<td>Jim Lewis</td>
<td>N</td>
<td>On the offshore LNG facilities, ISO is working on developing a standard. Hopefully, it will be adequate. I will be attending the ISO meeting in mid-April and will try to summarize what I learn. It is probably premature for 59A to launch a new code or chapter. The T.C. probably needs to lean on the marine aspects for bunkering plans for LNG fueling with the efforts of the Port of Houston and the USCG. As you have noted, there has been no activity associated with the offshore standard. I believe this is in part driven by a decline in interest amongst owners and operators for pursuing offshore projects and a shift in other use of LNG. A few years ago there appeared to be developing interest with an emphasis on importation of LNG. The primary focus we now see is in the use of LNG as a marine fuel. Stricter air emission standards on marine engines are the driving factor and a number of companies are looking to construct small scale LNG bunkering facilities in order to supply fuel to marine vessels. My time and work efforts have shifted towards developing policy and regulations associated with that. Due to the impact of sequestration, my involvement and ability to travel for NFPA 59A committee meetings is very uncertain at this time. I'm not sure what the options are, but given the lack of interest I would be inclined to say the proposal should be taken off the table.</td>
</tr>
<tr>
<td>Ken Smith</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Charles Haskat</td>
<td>N</td>
<td>I don't see a need for NFPA 59A to tackle this issue at this time. If there is a strong move to introduce offshore LNG facilities, we can reconsider. I think the lack of the subcommittee/task group moving forward is representative of this too.</td>
</tr>
<tr>
<td>Leon Bowdoin</td>
<td>N</td>
<td>My answer is No at this time. There are several regulations currently in development that will deal with LNG as a fuel and LNG bunkering two areas that seem to be of much greater interest than offshore LNG projects at this time. It would be prudent to first see what the new regulations from ISO and the USCG will be before trying to establish a new standard for offshore LNG facilities.</td>
</tr>
<tr>
<td>Constantyn Gieskes</td>
<td>N</td>
<td>I think the particular challenges of building offshore LNG lead to plenty of issues that the current NFPA 59A doesn't address (like cryogenic spills onto carbon steel structures, in-hull storage, etc.) If there are an increasing number of these projects there would be value in developing industry-wide practice. But limited owners and EPC contractors have completed a detailed FEED or engineering for Offshore LNG and could participate and add value at this stage. The current NFPA 59A is a very good document for onshore LNG and it would need to be added to significantly or a new document prepared. So we have to respond &quot;no&quot;, we're not in a position to support yet. Maybe one day.</td>
</tr>
<tr>
<td>Jeffrey Savchuk</td>
<td>N</td>
<td>With respect to the need for the NFPA 59A TC to develop a new standard for offshore LNG facilities, while not having any specific experience with offshore proposed/planned facilities, I would say that due to the shift the LNG industry in the US has experienced from importing to exporting that focusing on an offshore facility standard may not be in the best interest of the TC members time. Has the original proponent for the offshore standard been consulted to see if the same need still exists? That said, I would suggest that the current scope of the 59A LNG Standard to evaluated to ensure we adequately address the requirements for the scale of the liquefaction processes which are being planned and installed at potential exporting facilities.</td>
</tr>
<tr>
<td>Kevin Ritz</td>
<td>N</td>
<td>I don't really see that an Offshore standard would get very much use, and I think it would be a great amount of work to develop a standard that would be useful to users.</td>
</tr>
<tr>
<td>Frank Kablak</td>
<td>N</td>
<td>The marine environment is already covered by a multitude of agencies, each with specific authorizations and regulations, including fire protection. Selection of the appropriate agency depends upon location and type of offshore facility and can get quite confusing without adding more design parameters. Also, with the increase in natural gas production in the U.S.A. I don't believe the demand is there for such a standard at this time.</td>
</tr>
<tr>
<td>Dale Edibobuk</td>
<td>N</td>
<td>Activity seems to have subsided and I think we have higher priorities right now. We might find the need at some future date to revisit, or not.</td>
</tr>
<tr>
<td>Charlie Helling</td>
<td>N</td>
<td>Yes, I believe that NFPA should create a standard (or amend 59A) for offshore/floating LNG projects. We're currently involved with a couple and NFPA leadership could certainly help with the Authorities having jurisdiction.</td>
</tr>
<tr>
<td>Jeff Beale</td>
<td>Y</td>
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</tbody>
</table>
Jay Jablonski

I am involved in a few LNG projects that are not land-based (either permanently or semi-permanently moored or a few miles offshore) and the near complete lack of regulations is a big problem for developers (and regulators). I would support developing a new standard and would be willing to participate. Also – but this is just my opinion – based on my experience with the previous effort, as compared with another new standard which was successfully developed (NFPA 2). I think that the lack of a clear timeline and regular updates to keep people on track made it difficult to fit within everybody's busy work stream.

Filippo Gavelli

Joe Zanoni

Terry Turpin

Jack Blanchard

February 25, 2014

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Although the LNG drivers in the US have changed significantly in the last few years, away from offshore facilities, there is still interest worldwide to build such facilities. It is generally best for the industry to develop standards to maintain a minimum level of safety and to provide a common base for the industry to grow. Since this is a new part of the industry, there needs to be significant flexibility so innovation is not shut down. As innovation progresses, it is possible that applications near the US will again become viable. I think a standard should be developed, but it should be less prescriptive and more performance based with an emphasis on high level safety issues. The standard can then grow with the industry rather than try to control a runaway train.

Reason: there is a growing need to use LNG globally, and offshore LNG, though slow in coming, will eventually be more utilized, as evidenced in several projects outside the US (Australia, Indonesia, Israel, etc.). There are currently no specific LNG codes around the world addressing offshore LNG facilities. There are several standards and recommended practices put out principally by the classification societies such as ABS, DNV, BV, etc. that try to address these, but they are skewed toward tank containment aspects. DNV-OS-F101 “Safety Principles and Arrangement” April 2011 does have some good safety principles. But no code nor standard has been developed to address the entire offshore LNG terminal similar to NFPA 59A or EN 1473. So certainly there is a need for that. ISO is investigating this. But I think NFPA should too because ISO mainly draws input from the producers, contractors and operators, but lack input from regulators and safety experts as diverse as NFPA. The only concern I have is that, for offshore LNG facilities, one needs to broaden the framework of standard, i.e., instead of using prescriptive approach, risk based approach needs to be used because of the offshore environment (e.g., tight plot space and weight, met-ocean conditions, emergency response & escape, etc.).

Ben Ho

Given the ongoing press announcements of new offshore LNG facilities being built and planned, it seems to me that a standard is needed. Writing such a standard would require a commitment from several committee members with the appropriate expertise and the time to meet and draft a new document. I would like to help, but I don’t have the knowledge or the time.

Glenn Mahnken

I believe that there is in fact a need for a standard on offshore LNG facilities; however, before the Committee decides to develop such a Standard, it might be worth considering the following: 1. For the subject of offshore LNG facilities to be adequately covered, it will require a significant expansion of the Committee’s scope. 2. More importantly, most of this expanded scope will require technical expertise that is normally outside the LNG field itself. 3. Is there an existing NFPA Standard that covers offshore oil platforms? If there is, it might be a more suitable “platform” from which to launch a document on offshore LNG facilities. If there isn’t, it weakens the case for such a document since presumably there are fewer offshore LNG facilities than there are oil platforms. I assume that some or all these factors were considered by the task group, although I do not know how they were resolved. In conclusion, I believe there is a need for a Standard on offshore LNG facilities, but I am not sure if it should be undertaken by the S9A Committee.

Nick Legatos

Nino Nicotra

I do not have much experience with offshore but I can certainly contribute from a safety point of view if other disciplines are interested in pursuing this type of project.

This area, in my opinion, is one of vital interest to the LNG industry, but one that I do not know if we, the S9A committee, would have the capability and skills to develop an appropriate standard that the industry would use. Looking at the BP / Gulf of Mexico incident, we have to be extremely thorough in writing the performance words and some prescriptive words to have our document useful to the industry. From what I have seen, there will be an expansion of the offshore facilities that will convert LNG into NG to feed into our pipelines. The placement of liquefaction facilities on the ship or GIS, with the storage on the water / gravity based structures and then send the LNG out to the world from there is a little more risky, since the water is a corrosive environment. In summary, I think it would be good for NFPA to partner with industries that are involved in designing these facilities for this document. This could be an interesting document to work on.

The activity for offshore LNG facilities seems to be quiet at this time; however the interest for the development of LNG facilities in the future remains attractive to the industry as an alternative solution for gas recovery from stranded wells. The liquefaction and its associated equipment and the offloading of cryogenic fluids represent some of the main challenges for the industry when operating in the offshore environment. I would think that an offshore document may not be necessary at this time; however it may be reconsidered for future action to take based on how the industry moves and the need for such document. I will be able to assist if we decided to pursue with the new document.

Dick Hoffman

Leo Campos

February 25, 2014

Supplemental Agenda March 3-4, 2014

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MEMORANDUM

TO: NFPA Correlating Committee on Professional Qualifications
FROM: Jenny Depew, Administrator, Technical Projects
DATE: January 29, 2014
SUBJECT: NFPA 1072 Fall 2016 Revision Cycle Withdrawal

During its January 3, 2014 conference call, the Technical Committee on Hazardous Materials Response Personnel (TC) discussed the merits of withdrawing the current draft of NFPA 1072, Standard on Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Professional Qualifications. After this discussion, the TC voted to remove the current draft from the Fall 2016 revision cycle, in order to allow the TC to complete its ongoing work and to allow public review of the most up to date draft of NFPA 1072. An informational ballot confirming its meeting vote to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle has been completed and the results are attached.

The Correlating Committee on Professional Qualifications held a conference call on January 22, 2014 to discuss the merits of the withdrawing the current draft of NFPA 1072. After this discussion, the CC voted to remove the current draft from the Fall 2016 revision cycle, in order to allow the TC to complete its ongoing work and to allow the public review of the most up to date draft on NFPA 1072. As a result, the CC is now being asked, via an informational ballot, to confirm its meeting vote to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle. Please be aware that this is being done with the intent that the TC will submit a revised draft to the Standards Council for approval, at the August 2014 meeting, for inclusion in the Fall 2016 revision cycle once again.

In accordance with Section 4.2.4 of the Regulations Governing the Development of NFPA Standards, attached is a Letter Ballot to determine whether or not the TC wishes to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle.

Please return the ballot as soon as possible but no later than Wednesday, February 5, 2014. As noted on the ballot form, please return the ballot to Jenny Depew via email: jdepew@nfpa.org or via fax to 617-984-7056. You may also mail your ballot to the attention of Jenny Depew at NFPA, 1 Batterymarch Park, Quincy, MA 02169.

The return of ballots is required by the Regulations Governing the Development of NFPA Standards.
MEMORANDUM

To: NFPA Correlating Committee on Professional Qualifications

From: Jenny Depew, Administrator, Technical Projects

Date: February 6, 2014

Subject: NFPA 1072 Informational CC Ballot FINAL Results (Withdrawal from F16 Cycle)

The Final Results of the NFPA 1072 Informational Letter Ballot are as follows:

12 Members Eligible to Vote
0 Not Returned

12 Affirmative (w/comment: W. Peterson, J. Jaracz)
0 Negative
0 Abstain

Attached are the reasons for Negative votes, along with any Abstentions and Affirmatives with Comment. Ballots received from alternate members are not included unless the ballot from the principal member was not received.

A simple majority is necessary to pass ballot. The calculation is as follows:

[34 eligible ÷ 2 = 17 +1 = 18]

As always please feel free to contact me if you have any questions.
Correlating Committee on Professional Qualifications
(PQU-AAC)
INFORMATIONAL Ballot
NFPA 1072

This Informational Ballot has been provided in order to confirm the intent of the CC to withdraw the current draft of NFPA 1072 Standard on Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Professional Qualifications from the Fall 2016 revision cycle. Please select one of the following as a recommendation to the Standards Council (check one):

☐ Yes, I wish to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle.

OR

☐ No*, I do not wish to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle.

☐ Abstain*

*Reason(s) must accompany these votes.

When possible, reasons are requested via email in a Word Document.

Allow the Technical Committee the necessary time needed to create a draft document that provides current and up-to-date information for the user.

Signature

Name (Please Print) Jim Jaracz

Date 2-5-14

Please return the ballot as soon as possible but no later than Wednesday, February 5, 2014, to jdepew@nfpa.org or via fax to 617-984-7056. You may also mail your ballot to the attention of Jenny Depew at NFPA, 1 Batterymarch Park, Quincy, MA 02169.
Correlating Committee on Professional Qualifications  
(PQU-AAC)  
INFORMATIONAL Ballot  
NFPA 1072  

This Informational Ballot has been provided in order to confirm the intent of the CC to withdraw the current draft of NFPA 1072 Standard on Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Professional Qualifications from the Fall 2016 revision cycle. Please select one of the following as a recommendation to the Standards Council (check one):

- [ ] Yes, I wish to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle.  
- [ ] OR  
- [ ] No*, I do not wish to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle.  
- [ ] Abstain*

*Reason(s) must accompany these votes.  
When possible, reasons are requested via email in a Word Document.

The draft currently available on the standards development website is out of date. The TC has developed a more current version.

Signature  

date 2-1-14

Name (Please Print) WILLIAM PETERSON

Please return the ballot as soon as possible but no later than Wednesday, February 5, 2014, to idepew@nfpa.org or via fax to 617-984-7056. You may also mail your ballot to the attention of Jenny Depew at NFPA, 1 Batterymarch Park, Quincy, MA 02169.
MEMORANDUM

To: NFPA Technical Committee on Hazardous Materials Response Personnel
From: Jenny Depew, Administrator, Technical Projects
Date: January 23, 2014
Subject: NFPA 1072 Informational Ballot FINAL Results (Withdrawal from F16 Cycle)

The Final Results of the NFPA 1072 Informational Letter Ballot are as follows:

34 Members Eligible to Vote
3 Not Returned (T. Clawson, B. Lindley, J. Lovett)
29 Affirmative (w/comment: R. Potts)
1 Negative (T. Miller)
1 Abstention (T. Rehak)

Attached are the reasons for Negative votes, along with any Abstentions and Affirmatives with Comment. Ballots received from alternate members are not included unless the ballot from the principal member was not received.

A simple majority is necessary to pass ballot. The calculation is as follows:

[34 eligible ÷ 2 = 17 +1 = 18]

As always please feel free to contact me if you have any questions.
Technical Committee on Hazardous Materials Response Personnel
(HCZ-AAA)

INFORMATIONAL Ballot

NFPA 1072

This Informational Ballot has been provided in order to confirm the intent of the TC to withdraw the current draft of NFPA 1072 Standard on Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Professional Qualifications from the Fall 2016 revision cycle. Please select one of the following as a recommendation to the Standards Council (check one):

☐ Yes, I wish to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle.

OR

☐ No*, I do not wish to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle.

☐ Abstain*

*Reason(s) must accompany these votes.

When possible, reasons are requested via email in a Word Document.

I have been working on the document and feel that, with continued active participation and a concerted effort, we can produce a viable document.

__________________________
Signature

__________________________
Name (Please Print) Thomas D. Miller

Date 01/15/2013

Please return the ballot as soon as possible but no later than Wednesday, January 15, 2014, to jdepew@nfpa.org or via fax to 617-984-7056. You may also mail your ballot to the attention of Jenny Depew at NFPA, 1 Batterymarch Park, Quincy, MA 02169.
Technical Committee on Hazardous Materials Response Personnel
(HCZ-AAA)
INFORMATIONAL Ballot

NFPA 1072

This Informational Ballot has been provided in order to confirm the intent of the TC to withdraw the current draft of NFPA 1072 Standard on Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Professional Qualifications from the Fall 2016 revision cycle. Please select one of the following as a recommendation to the Standards Council (check one):

[ ] Yes, I wish to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle.

OR

[ ] No*, I do not wish to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle.

[ ] Abstain*

*Reason(s) must accompany these votes.

When possible, reasons are requested via email in a Word Document.

The current draft of the NFPA 1072 is not current considering the substantial proposed changes by the technical committee. A new draft document including the recent proposed changes would better serve the NFPA membership and stakeholders as they review the proposed standard update prior to the Fall 2016 revision cycle.

Signature

Robert L. Potts

Name (Please Print)

Date 01-08-2014

Please return the ballot as soon as possible but no later than Wednesday, January 15, 2014, to jdepew@nfpa.org or via fax to 617-984-7056. You may also mail your ballot to the attention of Jenny Depew at NFPA, 1 Batterymarch Park, Quincy, MA 02169.
Technical Committee on Hazardous Materials Response Personnel

(HCZ-AAA)

INFORMATIONAL Ballot

NFPA 1072

This Informational Ballot has been provided in order to confirm the intent of the TC to withdraw the current draft of NFPA 1072 Standard on Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Professional Qualifications from the Fall 2016 revision cycle. Please select one of the following as a recommendation to the Standards Council (check one):

☐ Yes, I wish to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle.

OR

☐ No*, I do not wish to withdraw the current draft of NFPA 1072 from the Fall 2016 revision cycle.

☐ Abstain*

*Reason(s) must accompany these votes.

When possible, reasons are requested via email in a Word Document.

I am not a member of the NFPA 1072 task group and do not feel I am in a position to determine whether or not the current draft should be withdrawn or not.

Signature

Name (Please Print) Timothy R. Rehak

Date 23 January 2014

Please return the ballot as soon as possible but no later than Wednesday, January 22, 2014, to jdepew@nfpa.org or via fax to 617-984-7056. You may also mail your ballot to the attention of Jenny Depew at NFPA, 1 Batterymarch Park, Quincy, MA 02169.
TO: Correlating Committee on Professional Qualifications
    Technical Committee on Hazardous Materials Response Personnel

FROM: Linda Fuller

DATE: November 6, 2012

SUBJECT: Document Revision Cycle - NFPA 1072

I am transmitting to you herewith the following action of the Standards Council
(October 29-30, 2012):

The Council approved the request of the Correlating Committee (CC) on Professional
Qualifications and the Technical Committee (TC) on Hazardous Materials Response
Personnel to enter a new document NFPA 1072, Standard for Hazardous
Materials/Weapons of Mass Destruction Emergency Response Personnel Professional
Qualifications, into the Fall 2016 revision cycle. The Council approved the
establishment of this proposed document at the August 2011 Council Meeting.


12-10-17
September 28, 2012

To:
Mr. James Pauley, Chair
NFPA Standards Council

From:
Chair William Peterson
NFPA Correlating Committee on Fire Fighter Professional Qualifications (PQU-AAC)
Chair Greg Noll
NFPA Technical Committee on Hazardous Materials Response Personnel (HCZ-AAA)

Re:

Mr. Pauley:

The Technical Committee on Hazardous Materials Response Personnel has been preparing a preliminary draft of the document. Recently, the TC was balloted to release the document to the Correlating Committee. The ballot results are available.

Additionally, the Correlating Committee on Professional Qualifications was balloted to release the document to the Standards Council. The ballot results are available.

Your approval to release the draft will give opportunity for public input.

Thank you in advance for the Standards Council’s consideration.

Respectfully,

Tom McGowan
Staff Liaison
MEMORANDUM

TO: NFPA Technical Committee on Hazardous Materials Response Personnel
FROM: Stacey Van Zandt
DATE: September 10, 2012
SUBJECT: NFPA 1072 Draft Release TC Final Ballot Results

The Final Results of the NFPA 1072 (Standard for Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Professional Qualifications) Draft Release Letter Ballot are as follows:

- 32 Members Eligible to Vote
- 3 Not Returned (Baxter, D’Onofrio, and Sprifke)
- 29 Affirmative on All (T. Miller and R. Raksnis – affirmative with comment)
- 0 Negative
- 0 Abstentions

An affirmative vote of at least a simple majority of the total membership eligible to vote is required. This is the calculation for simple majority:

\[ 32 \text{ eligible} / 2 = 16 + 1 = 17\]

Reasons for negative votes, etc. from alternate members are not included unless the ballot from the principal member was not received.
Technical Committee on Hazardous Materials Response Personnel


Approve the preliminary draft of NFPA 1072.

X AFFIRMATIVE  _____ NEGATIVE*  _____ ABSTAINING*

EXPLANATION OF VOTE - Please type or print your comments:
*An explanation must accompany a negative or abstaining vote.

I strongly believe that the draft document has met the scope and intent of the TEC's charge to our Task Group.

Signature

THOMAS D. MILLER
Name (Please Print) PRINCIPAL, NFPA REP.

Date

Please return your ballots not later than Friday, September 7, 2012.

RETURN TO:
Stacey Van Zandt, Project Administrator
NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
svanzandt@nfpa.org or FAX: (617-984-7056)
Technical Committee on Hazardous Materials Response Personnel


Approve the preliminary draft of NFPA 1072.

X AFFIRMATIVE  _____ NEGATIVE*  _____ ABSTAINING*

EXPLANATION OF VOTE - Please type or print your comments:
*An explanation must accompany a negative or abstaining vote.

Administrative Notes:

Section 3.3.6 (page 9): Please remove “The Chemical Transportation Emergency Response Center” from definition of CHEMTREC. All other parts of definition should remain. Our name is no longer an acronym. We should simply be referred to as CHEMTREC.

Section C.1.2.1(page 66): Remove “(formerly Chemical Manufacturers Association)” as this name has long since been removed. Also new address (effective 2010) for American Chemistry Council is 700 Second St., NE, Washington, DC 20002

Signature

Rick Raksnis
Name (Please Print)

September 7, 2012
Date

Please return your ballots not later than Friday, September 7, 2012.

RETURN TO:
Stacey Van Zandt, Project Administrator
NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
svanzandt@nfpa.org or FAX: (617-984-7056)
MEMORANDUM

TO: NFPA Correlating Committee on Professional Qualifications
FROM: Stacey Van Zandt
DATE: October 1, 2012
SUBJECT: NFPA 1072 Draft Release CC Final Ballot Results

The Final CC Results of the NFPA 1072 (Standard for Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Professional Qualifications) Draft Release Letter Ballot are as follows:

8 Members Eligible to Vote
0 Not returned
8 Affirmative on All
0 Negative
0 Abstentions

An affirmative vote of at least a simple majority of the total membership eligible to vote is required. This is the calculation for simple majority:

\[
\frac{8 \text{ eligible}}{2} = 4 + 1 = (5)
\]

Reasons for negative votes, etc. from alternate members are not included unless the ballot from the principal member was not received.
Standard for
Professional Qualifications
20XX Edition

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This edition of NFPA 1072, Standard for Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Professional Qualifications, was prepared by the Technical Committee on Hazardous Materials Response Personnel and acted on by NFPA at its (month) Association Technical Meeting held (date). It was issued by the Standards Council on (date), with an effective date of (date), and supersedes all previous editions.

This edition of NFPA 1072 was approved as an American National Standard on (date).

Origin and Development of NFPA 1072

To be completed after Second Draft

Technical Committee on Hazardous Materials Response Personnel

Gregory G. Noll,
Hildebrand & Noll Associates, Inc., PA [SE]

Glen Rudner, Secretary
CRA-USA Inc., VA [SE]
(Alt. to R. B. Emery)

Christina M. Baxter, U.S. Department of Defense, VA [E]
Donald Beckering, Minnesota State Colleges and Universities, MN [U]
Rep. International Society of Fire Service Instructors
Tom Clawson, Technical Resources Group, Inc., ID [SE]
William R. Coffey, WRC Safety and Risk Consultants, PA [SE]
Rep. American Society of Safety Engineers
K. Wade Collins, Virginia Department of Emergency Management, VA [C]
Cris D’Onofrio, U.S. Environmental Protection Agency, NJ [E]
Richard C. Edinger, Chesterfield County Fire & Emergency Medical Services, VA [E]
Rep. International Association of Fire Chiefs
Manuel H. Ehrlich, Jr., ESP Consulting, LLC, NJ [SE]
Christian W. Hays, Orange County Sheriff’s Department, CA [E]
Rep. National Tactical Officers Association
Steven Hergenreter, Fort Dodge Fire Fighters, IAFF Local 633, IA [L]

Draft NFPA 1072 - 2 -

February 25, 2014

Supplemental Agenda March 3-4, 2014

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Rep. International Association of Fire Fighters

Robert J. Ingram, Fire Department City of New York, NY [E]
Kevin W. Johnson, U.S. Federal Bureau of Investigation, VA [E]
Wayne McNett, Hemlock Semiconductor Corporation, MI [U]

Rep. NFPA Industrial Fire Protection Section

Leslie A. Miller, Fire Protection Publications, OK [M]

Rep. International Fire Service Training Association

Thomas D. Miller, Sissonville Volunteer Fire Department, WV [C]

Rep. NFPA Industrial Fire Protection Section

Leslie A. Miller, Fire Protection Publications, OK [M]

Rep. International Fire Service Training Association

Thomas D. Miller, Sissonville Volunteer Fire Department, WV [C]

Rep. National Volunteer Fire Council

Matthew Minson, Critical Management Programs, TX [SE]

John F. Porter, Louisiana State Police, LA [C]

Richard J. Raksnis, CHEMTREC, VA [SE]

Timothy R. Rehak, National Institute for Occupational Safety & Health, PA [E]

Robert W. Royall, Jr., Harris County Fire Marshal’s Office, TX [E]

Rob Schnepf, Alameda County Fire Department, CA [C]

Danny G. Simpson, CN Railway, IL [U]

Daniel Gary Snell, Houston Fire Department, TX [E]

Gary L. Sprifke, Jr., U.S. Capitol Police, VA [E]

Robert Stenner, Pacific Northwest National Laboratory, WA [RT]

Fred C. Terryn, U.S. Department of the Air Force, FL [U]

Christopher Tracy, Fairfield Fire Department, CT [C]

Rep. Fairfield County Hazardous Incident Response Team

Kenneth W. Uzeloc, Calgary Fire Department, Canada [E]

Rep. Canadian Association of Fire Chiefs

Dennis L. Wilson, Dallas Police Department/Bomb Squad, TX [C]

Rep. National Bomb Squad Commanders Advisory Board

Charles J. Wright, Omaha, NE [SE]

Alternates

Charles Cordova, Seattle Fire Department, WA [E]
(Alt. to R. C. Edinger)

Nicholas Del Re, Fire Department City of New York, NY [E]
(Alt. to R. J. Ingram)

(Alt. to G. G. Noll)

Thomas C. Jordan, Virginia Department of Emergency Management, VA [C]
(Alt. to K. W. Collins)

Bruce S. Kelly, Fairfield County Hazardous Incident Response Team, OR [C]
(Alt. to C. Tracy)

Mike Montgomery, Harris County Fire Marshal’s Office, TX [E]
(Alt. to R. W. Royall, Jr.)

**David L. Moore**, U.S. Environmental Protection Agency, NV [E]
(Alt. to C. D’Onofrio)

**Tony J. Mussorfiti**, Massapequa, NY [RT]
(Alt. to R. Stenner)

**Lee Nelson**, CN Railway, Canada [U]
(Alt. to D. G. Simpson)

**Steven G. Patrick**, U.S. Federal Bureau of Investigation, VA [E]
(Alt. to K. W. Johnson)

**James E. Podolske, Jr.**, U.S. Department of the Air Force, FL [U]
(Alt. to F. C. Terryn)

**Kevin D. Quinn**, Union Fire District, RI [C]
(Alt. to T. D. Miller)

**Barry R. Weissman**, Weissman Consultants, NJ [SE]
(Alt. to W. R. Coffey)

**Nonvoting**

**Joseph J. Leonard**, U.S. Coast Guard, TX [E]


**Erik S. Glassman**, Oak Ridge Associated Universities, VA [E]

Thomas McGowan, **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 the requirements for professional qualifications, professional competence, training, procedures, and equipment for emergency responders to hazardous materials/weapons of mass destruction incidents.
Chapter 1 Administration

1.1 Scope. This standard identifies the minimum job performance requirements (JPRs) for hazardous materials/weapons of mass destruction emergency response personnel.

1.2* Purpose. The purpose of this standard is to specify the minimum job performance requirements for service as hazardous materials/weapons of mass destruction emergency response personnel.

1.2.1 This standard shall define five levels for hazardous materials/weapon of mass destruction emergency response personnel including awareness, operations, mission-specific operations, technician and incident commander.

1.2.2 The intent of the standard shall be to ensure that personnel serving at the awareness, operations, mission-specific, technician and incident commander level for hazardous materials/WMD are qualified.

1.2.3* This standard shall not address organization/management responsibility.

1.2.4 It is not the intent of this standard to restrict any jurisdiction from exceeding or combining these minimum requirements. [1026, 2009]
1.2.5* Job performance requirements for each level are the tasks an individual must be able to perform in order to carry out the job duties. They are not intended to measure a level of knowledge. Together, the duties and job performance requirements define the parameters of the tasks of hazardous materials/WMD emergency response personnel for a specific level.

1.2.6* Hazardous materials/WMD emergency response personnel at all levels shall remain current with all requirements and applicable standards as determined by the authority having jurisdiction (AHJ).

1.3 Application. The application of this standard is to specify how and to what the requirements within the document shall apply to hazardous materials/WMD emergency response personnel.

1.3.1 The JPRs shall be accomplished in accordance with the requirements of the authority having jurisdiction (AHJ) and NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program* and NFPA 472, *Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents* or NFPA 473, *Competencies for EMS Personnel Responding to Hazardous Materials/Weapons of Mass Destruction Incidents*.

1.3.2* It shall not be required that the JPRs be mastered in the order in which they appear. The AHJ shall establish instructional priority and the training program content to prepare individuals to meet the JPRs of this standard.

1.3.3* Performance of each requirement of this standard shall be evaluated by individuals approved by the AHJ.

1.3.4 The job performance requirements for each level shall be completed in accordance with recognized practices and procedures or as defined by law or by the authority having jurisdiction.

1.3.5 A person assigned the duties at the Awareness level for hazardous materials/WMD incidents shall meet all of the requirements defined in Chapter 4 prior to being qualified.

1.3.6 A person assigned the duties at the Operations level for hazardous materials/WMD incidents shall meet all of the requirements defined in Chapter 5 prior to being qualified.

1.3.7 A person assigned the duties of specific Mission-Specific Operations level for hazardous materials/WMD incidents shall meet the specific requirements defined in Chapter 6 prior to being qualified.

1.3.8 A person assigned the duties at the Technician level for hazardous materials/WMD incidents shall meet all of the requirements defined in Chapter 7 prior to being qualified.

1.3.9 A person assigned the duties for Incident Commander for hazardous materials/WMD incidents shall meet all of the requirements defined in Chapter 8 prior to being qualified.

1.3.10 The AHJ shall provide personal protective clothing and the equipment necessary to conduct assignments at hazardous materials/WMD incidents.

1.3.11 Prior to training to meet the requirements of Chapter 4, 5, 6, 7, and 8 the candidate shall meet the following requirements:

1) Educational requirements established by AHJ
2) Age requirements established by the AHJ
3) Medical requirements as developed and validated by AHJ and in compliance with applicable legal requirements
4) Job related physical performance requirements as developed and validated by the AHJ

1.3.12 Wherever in this standard the terms, rules, regulations, policies, procedures, supplies, apparatus, or equipment are referred to, it is implied that they are those of the AHJ.

1.4 Units. In this standard, values for measurement are followed by an equivalent in SI units, but only the first stated value shall be regarded as the requirement. Equivalent values in SI units shall not be considered as the requirement, as these values can be approximate. (See Table 1.4.)

****INSERT TABLE HERE****

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 1026, . . . .

2.3 Other Publications.
2.3.1 U.S. Government Publications.
Title 18, U.S. Code, Section 2332a, “Use of Weapons of Mass Destruction.”

2.3.2 Other Publications.

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* Approved. Acceptable to the authority having jurisdiction.
3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.
3.2.3* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.
3.2.4 Shall. Indicates a mandatory requirement.
3.2.5 Should. Indicates a recommendation or that which is advised but not required.
3.2.6 Standard. 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* Allied Professional. That person who possesses the knowledge, skills, and technical competence to provide assistance in the selection, implementation, and evaluation of mission-specific tasks at a hazardous materials weapons of mass destruction (WMD) incident. [472, 2013]
3.3.2 Analyze. The process of identifying a hazardous materials/weapons of mass destruction (WMD) problem and determining likely behavior and harm within the training and capabilities of the emergency responder. [472, 2013]
3.3.3 Area of Specialization.
3.3.3.1 Individual Area of Specialization. The qualifications or functions of a specific job(s) associated with chemicals and/or containers used within an organization. [472, 2013]
3.3.3.2 Organization's Area of Specialization. Any chemicals or containers used by the specialist employee's employer. [472, 2013]
3.3.4 Awareness Level Personnel. (29 CFR 1910.120: First Responder at the Awareness Level) Personnel who, in the course of their normal duties, could encounter an emergency involving hazardous materials/weapons of mass destruction (WMD) and who are expected to recognize the presence of the hazardous materials/weapons of mass destruction (WMD), protect themselves,
call for trained personnel, and secure the scene. *(See Annex X).* [472, 2013]

3.3.5 CANUTEC. The Canadian Transport Emergency Center, operated by Transport Canada, which provides emergency response information and assistance on a 24-hour basis for responders to hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

3.3.6 CHEMTREC. The Chemical Transportation Emergency Response Center, a public service of the American Chemistry Council, which provides emergency response information and assistance on a 24-hour basis for responders to hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

3.3.7 Competence. Possessing knowledge, skills, and judgment needed to perform indicated objectives. [472, 2013]

3.3.8* Confined Space. An area large enough and so configured that a member can bodily enter and perform assigned work but which has limited or restricted means for entry and exit and is not designed for continuous human occupancy. [472, 2013]

3.3.9 Confinement. Those procedures taken to keep a material, once released, in a defined or local area. [472, 2013]

3.3.10 Container. A receptacle used for storing or transporting material of any kind. [472, 2013]

3.3.11 Containment. The actions taken to keep a material in its container (e.g., stop a release of the material or reduce the amount being released). [472, 2013]

3.3.12 Contaminant. A hazardous material, or the hazardous component of a weapon of mass destruction (WMD), that physically remains on or in people, animals, the environment, or equipment, thereby creating a continuing risk of direct injury or a risk of exposure. [472, 2013]

3.3.13 Contamination. The process of transferring a hazardous material, or the hazardous component of a weapon of mass destruction (WMD), from its source to people, animals, the environment, or equipment, that can act as a carrier. [472, 2013]

3.3.13.1 Cross Contamination. The process by which a contaminant is carried out of the hot zone and contaminates people, animals, the environment, or equipment. [472, 2013]

3.3.14 Control. The procedures, techniques, and methods used in the mitigation of hazardous material/weapons of mass destruction (WMD) incidents, including containment, extinguishment, and confinement. [472, 2013]

3.3.15* Control Zones. The areas at hazardous materials/weapons of mass destruction incidents within an established/a controlled perimeter that are designated based upon safety and the degree of hazard. [472, 2013]

3.3.15.1 Cold Zone. The control zone of hazardous materials/weapons of mass destruction incidents that contains the incident command post and such other support functions as are deemed necessary to control the incident. [472, 2013]

3.3.15.2 Decontamination Corridor. The area usually located within the warm zone where decontamination is performed. [472, 2013]

3.3.15.3 Hot Zone. The control zone immediately surrounding hazardous materials/weapons of mass destruction (WMD) incidents, which extends far enough to prevent adverse effects of hazards to personnel outside the zone. [472, 2013]

3.3.15.4* Warm Zone. The control zone at hazardous materials/weapons of mass destruction (WMD) incidents where personnel and equipment decontamination and hot zone support takes
3.3.16 Coordination. The process used to get people, who could represent different agencies, to work together integrally and harmoniously in a common action or effort. [472, 2013]

3.3.17* Decontamination. The physical and/or chemical process of reducing and preventing the spread of contaminants from people, animals, the environment, or equipment involved at hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

3.3.17.1* Emergency Decontamination. The physical process of immediately reducing contamination of individuals in potentially life-threatening situations with or without the formal establishment of a decontamination corridor. [472, 2013]

3.3.17.2* Gross Decontamination. The phase of the decontamination process during which the amount of surface contaminants is significantly reduced. [472, 2013]

3.3.17.3* Mass Decontamination. The physical process of reducing or removing surface contaminants from large numbers of victims in potentially life-threatening situations in the fastest time possible. [472, 2013]

3.3.17.4* Technical Decontamination. The planned and systematic process of reducing contamination to a level that is as low as reasonably achievable. [472, 2013]

3.3.18 Degradation. (1) A chemical action involving the molecular breakdown of a protective clothing material or equipment due to contact with a chemical. (2) The molecular breakdown of the spilled or released material to render it less hazardous during control operations. [472, 2013]

3.3.19* Demonstrate. To show by actual performance. [472, 2013]

3.3.20 Describe. To explain verbally or in writing using standard terms recognized by the hazardous materials/weapons of mass destruction (WMD) response community. [472, 2013]

3.3.21 Dispersal Device. Any weapon or combination of mechanical, electrical or pressurized components that is designed, intended or used to cause death or serious bodily injury through the release, dissemination or impact of toxic or poisonous chemicals or their precursors, biological agent, toxin or vector or radioactive material. [472, 2013]


3.3.23 Endangered Area. The actual or potential area of exposure associated with the release of a hazardous material/weapon of mass destruction (WMD). [472, 2013]

3.3.24 Evaluate. The process of assessing or judging the effectiveness of a response operation or course of action within the training and capabilities of the emergency responder. [472, 2013]

3.3.25 Example. An illustration of a problem serving to show the application of a rule, principle, or method (e.g., past incidents, simulated incidents, parameters, pictures, and diagrams). [472, 2013]

3.3.26* Exposure. The process by which people, animals, the environment, and equipment are subjected to or come in contact with a hazardous material/weapon of mass destruction (WMD). [472, 2013]

3.3.XX Extinguishment.

3.3.27* Fissile Material. Material whose atoms are capable of nuclear fission (capable of being split). [472, 2013]

3.3.28 Hazard/Hazardous. Capable of posing an unreasonable risk to health, safety, or the
3.3.29* **Hazardous Material.** A substance (either matter — solid, liquid, or gas — or energy) that when released is capable of creating harm to people, the environment, and property, including weapons of mass destruction (WMD) as defined in 18 U.S. Code, Section 2332a, as well as any other criminal use of hazardous materials, such as illicit labs, environmental crimes, or industrial sabotage. [472, 2013]

3.3.30* **Hazardous Materials Branch/Group.** The function within an overall incident management system that deals with the mitigation and control of the hazardous materials/weapons of mass destruction (WMD) portion of an incident. [472, 2013]

3.3.31* **Hazardous Materials Officer.** (NIMS: Hazardous Materials Branch Director/Group Supervisor.) The person who is responsible for directing and coordinating all operations involving hazardous materials/weapons of mass destruction (WMD) as assigned by the incident commander. [472, 2013]

3.3.32* **Hazardous Materials Response Team (HMRT).** An organized group of trained response personnel operating under an emergency response plan and applicable standard operating procedures who perform hazardous material technician level skills at hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

3.3.33* **Hazardous Materials Safety Officer.** (NIMS: Assistant Safety Officer — Hazardous Material.) The person who works within an incident management system (IMS) (specifically, the hazardous materials branch/group) to ensure that recognized hazardous materials/WMD safe practices are followed at hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

3.3.34* **Hazardous Materials Technician.** Person who responds to hazardous materials/weapons of mass destruction (WMD) incidents using a risk-based response process by which they analyze a problem involving hazardous materials/weapons of mass destruction (WMD), select applicable decontamination procedures, and control a release using specialized protective clothing and control equipment. [472, 2013]

3.3.34.1* **Hazardous Materials Technician with a Cargo Tank Specialty.** Person who provides technical support pertaining to cargo tanks, provides oversight for product removal and movement of damaged cargo tanks, and acts as a liaison between the hazardous materials technician and other outside resources. [472, 2013]

3.3.34.2 **Hazardous Materials Technician with a Marine Tank and Non-tank Vessel Specialty.** Person who provides technical support pertaining to marine tank and non-tank vessels, provides oversight for product removal and movement of damaged marine tank and non-tank vessels, and acts as a liaison between the hazardous materials technician and other outside resources. [472, 2013]

3.3.34.3** Hazardous Materials Technician with an Intermodal Tank Specialty.** Person who provides technical support pertaining to intermodal tanks, provides oversight for product removal and movement of damaged intermodal tanks, and acts as a liaison between the hazardous materials technician and other outside resources. [472, 2013]

3.3.34.4** Hazardous Materials Technician with a Tank Car Specialty.** Person who provides technical support pertaining to tank cars, provides oversight for product removal and movement of damaged tank cars, and acts as a liaison between the hazardous materials technician and other outside resources. [472, 2013]
3.3.34.5 Hazardous Materials Technician with a Flammable Liquids Bulk Storage Specialty. Person who, in incidents involving bulk flammable liquid storage tanks and related facilities, provides support to the hazardous materials technician and other personnel, provides strategic and tactical recommendations to the on-scene incident commander, provides oversight for fire control and product removal operations, and acts as a liaison between technicians, response personnel, and outside resources. [472, 2013]

3.3.34.6 Hazardous Materials Technician with a Flammable Gases Bulk Storage Specialty. Person who, in incidents involving flammable gas bulk storage tanks, provides support to the hazardous materials technician and other personnel, provides strategic and tactical recommendations to the on-scene incident commander, provides oversight for fire control and product removal operations, and acts as a liaison between technicians, fire-fighting personnel, and other resources. [472, 2013]

3.3.34.7 Hazardous Materials Technician with a Radioactive Materials Specialty. Person who provides support to the hazardous materials technician and other personnel, uses radiation detection instruments, manages the control of radiation exposure, conducts hazards assessment, and acts as a liaison between hazardous materials technicians at incidents involving radioactive materials. [472, 2013]

3.3.35 Identify. To select or indicate verbally or in writing using standard terms to establish the fact of an item being the same as the one described. [472, 2013]

3.3.36 Incident. An emergency involving the release or potential release of hazardous materials/weapons of mass destruction (WMD). [472, 2013]

3.3.37* Incident Commander (IC). The individual responsible for all incident activities, including the development of strategies and tactics and the ordering and the release of resources. [472, 2013]

3.3.38 Incident Command System. A management system designed to enable effective and efficient on-scene incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure. [472, 2013]

3.3.39* Incident Management System (IMS). A plan that defines the roles and responsibilities to be assumed by personnel and the operating procedures to be used in the management and direction of emergency operations to include the incident command system, multi-agency coordination system, training, and management of resources. [472, 2013]

3.3.40 Match. To provide with a counterpart. [472, 2013]

3.3.41* Material Safety Data Sheet (MSDS). A form, provided by manufacturers and compounders (blenders) of chemicals, containing information about chemical composition, physical and chemical properties, health and safety hazards, emergency response, and waste disposal of the material. [472, 2013]

3.3.42 Monitoring Equipment. Instruments and devices used to identify and quantify contaminants. [472, 2013]

3.3.43 Objective. A goal that is achieved through the attainment of a skill, knowledge, or both, that can be observed or measured. [472, 2013]

3.3.44* Packaging. Any container that holds a material (hazardous or nonhazardous). [472, 2013]
3.3.44.1* Bulk Packaging. Any packaging, including transport vehicles, having a liquid capacity of more than 119 gal (450 L), a solids capacity of more than 882 lb (400 kg), or a compressed gas water capacity of more than 1001 lb (454 kg). [472, 2013]

3.3.44.2 Nonbulk Packaging. Any packaging having a liquid capacity of 119 gal (450 L) or less, a solids capacity of 882 lb (400 kg) or less, or a compressed gas water capacity of 1001 lb (454 kg) or less. [472, 2013]

3.3.44.3* Radioactive Materials Packaging. Any packaging for radioactive materials including excepted packaging, industrial packaging, Type A, Type B, and Type C packaging. [472, 2013]

3.3.45 Penetration. The movement of a material through a suit's closures, such as zippers, buttonholes, seams, flaps, or other design features of chemical-protective clothing, and through punctures, cuts, and tears. [472, 2013]

3.3.46 Permeation. A chemical action involving the movement of chemicals, on a molecular level, through intact material. [472, 2013]

3.3.47* Personal Protective Equipment. The equipment provided to shield or isolate a person from the chemical, physical, and thermal hazards that can be encountered at hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

3.3.48 Plan. [472, 2013]

3.3.48.1* Emergency Response Plan. A plan developed by the authority having jurisdiction, with the cooperation of all participating agencies and organizations, that details specific actions to be performed by all personnel who are expected to respond during an emergency. [472, 2013]

3.3.48.2* Incident Action Plan. An oral or written plan approved by the incident commander containing general objectives reflecting the overall strategy for managing an incident. [472, 2013]

3.3.48.3 Site Safety and Control Plan. A site safety and control plan should be completed and approved by the hazardous materials officer, the hazardous materials safety officer, and the incident commander for inclusion in the incident action plan. The plan must be briefed to personnel operating within the hot zone by the hazardous materials safety officer or the hazardous materials officer prior to entry mission initiation. The initial site safety and control plan for the first operational period can be written or oral. The plan should be documented as soon as resources allow. [472, 2013]

3.3.49* Planned Response. The incident action plan, with the site safety and control plan, consistent with the emergency response plan and/or standard operating procedures for a specific hazardous material/weapon of mass destruction (WMD) incident. [472, 2013]

3.3.XX* Policies and Procedures.

3.3.50 Predict. The process of estimating or forecasting the future behavior of a hazardous materials/weapons of mass destruction (WMD) container and/or its contents within the training and capabilities of the emergency responder. [472, 2013]

3.3.51* Protective Clothing. Equipment designed to protect the wearer from heat and/or from hazardous materials, or from the hazardous component of a weapon of mass destruction contacting the skin or eyes. [472, 2013]

(1) Structural fire-fighting protective clothing

(2) High temperature–protective clothing
(3) Chemical-protective clothing

3.3.51.1* Chemical-Protective Clothing. Items made from chemical-resistive materials, such as clothing, hood, boots, and gloves, that are designed and configured to protect the wearer's torso, head, arms, legs, hands, and feet from hazardous materials. [472, 2013]

3.3.51.1.1* Liquid Splash–Protective Clothing. The garment portion of a chemical-protective clothing ensemble that is designed and configured to protect the wearer against chemical liquid splashes but not against chemical vapors or gases. [472, 2013]

3.3.51.1.2* Vapor–Protective Clothing. The garment portion of a chemical-protective clothing ensemble that is designed and configured to protect the wearer against chemical vapors or gases. [472, 2013]

3.3.51.2* High Temperature–Protective Clothing. Protective clothing designed to protect the wearer for short-term high temperature exposures. [472, 2013]

3.3.51.3* Structural Fire-Fighting Protective Clothing. The fire resistant protective clothing normally worn by fire fighters during structural fire-fighting operations, which includes a helmet, coat, pants, boots, gloves, PASS device, and a fire resistant hood to cover parts of the head and neck not protected by the helmet and respirator facepiece. [472, 2013]

3.3.XX Public Safety Sampling

3.3.52 Qualified. Having knowledge of the installation, construction, or operation of apparatus and the hazards involved. [472, 2013]

3.3.53* Respiratory Protection. Equipment designed to protect the wearer from the inhalation of contaminants. [472, 2013]

3.3.54* Response. That portion of incident management in which personnel are involved in controlling hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

3.3.55 Risk-Based Response Process. Systematic process by which responders analyze a problem involving hazardous materials/weapons of mass destruction (WMD), assess the hazards, evaluate the potential consequences, and determine appropriate response actions based upon facts, science, and the circumstances of the incident. [472, 2013]

3.3.56 Safely. To perform the assigned tasks without injury to self or others, to the environment, or to property. [472, 2013]

3.3.57 Scenario. A sequence or synopsis of actual or imagined events used in the field or classroom to provide information necessary to meet student competencies; can be based upon threat assessment. [472, 2013]

3.3.58 SETIQ. The Emergency Transportation System for the Chemical Industry in Mexico. [472, 2013]

3.3.XX Size-Up. A mental process used to evaluate the influencing factors at an incident prior to committing resources to a course of action. [1670, 2009]

3.3.60 Stabilization. The point in an incident when the adverse behavior of the hazardous material, or the hazardous component of a weapon of mass destruction (WMD), is controlled. [472, 2013]

3.3.61* Termination. That portion of incident management after the cessation of tactical operations in which personnel are involved in documenting safety procedures, site operations, hazards faced, and lessons learned from the incident. [472, 2013]
3.3.62* UN/NA Identification Number. The four-digit number assigned to a hazardous material/weapon of mass destruction (WMD), which is used to identify and cross-reference products in the transportation mode. [472, 2013]

3.3.63* Weapon of Mass Destruction (WMD). (1) Any destructive device, such as any explosive, incendiary, or poison gas bomb, grenade, rocket having a propellant charge of more than four ounces, missile having an explosive or incendiary charge of more than one quarter ounce (7 grams), mine, or device similar to the above; (2) any weapon involving toxic or poisonous chemicals; (3) any weapon involving a disease organism; or (4) any weapon that is designed to release radiation or radioactivity at a level dangerous to human life. [472, 2013]

3.3.63.1* Radiological Weapons of Mass Destruction [472, 2013]

3.3.63.1.1* Radiation Exposure Device (RED) — an RED, used interchangeably with the term “radiological exposure device” or “radiation emitting device”, consists of radioactive material, either as a sealed source or as material within some type of container, or a radiation-generating device, such as an X-ray device, that directly exposes people to ionizing radiation. [472, 2013]

3.3.63.1.2* Radiation Dispersal Device (RDD) — an RDD, also as referred to as a “dirty bomb”, is a device designed to spread radioactive material through a detonation of conventional explosives or other (non-nuclear) means. [472, 2013]

3.3.63.1.3* Improvised Nuclear Device (IND) — an IND is an illicit nuclear weapon that is bought, stolen, or otherwise obtained from a nuclear State (that is, a national government with nuclear weapons), or a weapon fabricated from fissile material that is capable of producing a nuclear explosion. [472, 2013]

3.4 Operations Level Responders Definitions. [472, 2013]

3.4.1 Agent-Specific Competencies. The knowledge, skills, and judgment needed by operations level responders who have completed the operations level competencies and who are designated by the authority having jurisdiction to respond to releases or potential releases of a specific group of WMD agents. [472, 2013]

3.4.2 Core Competencies. The knowledge, skills, and judgment needed by operations level responders who respond to releases or potential releases of hazardous materials/weapons of mass destruction (WMD). [472, 2013]

3.4.3 Mission-Specific Competencies. The knowledge, skills, and judgment needed by operations level responders who have completed the operations level competencies and who are designated by the authority having jurisdiction to perform mission specific tasks, such as decontamination, victim/hostage rescue and recovery, evidence preservation, and sampling.

3.4.4* Operations Level Responders. Persons who respond to hazardous materials/weapons of mass destruction (WMD) incidents for the purpose of implementing or supporting actions to protect nearby persons, the environment, or property from the effects of the release. [472, 2013]

3.4.5 Operations Level Responders Assigned to Perform Air Monitoring and Sampling. Persons, competent at the operations level, who are assigned to implement air monitoring and sampling operations at hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

3.4.6 Operations Level Responders Assigned to Perform Evidence Preservation and Sampling. Persons, competent at the operations level, who are assigned to preserve forensic evidence, take samples, and/or seize evidence at hazardous materials/weapons of mass
destruction (WMD) incidents involving potential violations of criminal statutes or governmental regulations. [472, 2013]

3.4.7 Operations Level Responders Assigned to Disablement/Disruption of Improvised Explosives Devices (IED), Improvised WMD Dispersal Devices, and Operations at Improvised Explosive Laboratories. Persons, competent at the operations level, who are assigned to interrupt the functioning of improvised explosive devices (IED) and improvised WMD dispersal devices and to conduct operations at improvised explosive laboratories. [472, 2013]

3.4.8 Operations Level Responders Assigned to Perform Mass Decontamination During Hazardous Materials/Weapons of Mass Destruction (WMD) Incidents. Persons, competent at the operations level, who are assigned to implement mass decontamination operations at hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

3.4.9 Operations Level Responders Assigned to Perform Product Control. Persons, competent at the operations level, who are assigned to implement product control measures at hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

3.4.10 Operations Level Responders Assigned to Perform Technical Decontamination During Hazardous Materials/Weapons of Mass Destruction (WMD) Incidents. Persons, competent at the operations level, who are assigned to implement technical decontamination operations at hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

3.4.11 Operations Level Responders Assigned to Perform Victim Rescue/Recovery During Hazardous Materials/Weapons of Mass Destruction (WMD) Incidents. Persons, competent at the operations level, who are assigned to rescue and/or recover exposed and contaminated victims at hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

3.4.12 Operations Level Responders Assigned to Respond to Illicit Laboratory Incidents. Persons, competent at the operations level, who, at hazardous materials/weapons of mass destruction (WMD) incidents involving potential violations of criminal statutes specific to the illegal manufacture of methamphetamines, other drugs, or weapons of mass destruction (WMD), are assigned to secure the scene, identify the laboratory/process, and preserve evidence. [472, 2013]

3.4.13 Operations Level Responders Assigned Responsibilities for Biological Response. Persons, competent at the operations level, who, at hazardous materials/weapons of mass destruction (WMD) incidents involving biological materials, are assigned to support the hazardous materials technician and other personnel, provide strategic and tactical recommendations to the on-scene incident commander, serve in a technical specialist capacity to provide technical oversight for operations, and act as a liaison between the hazardous materials technician, response personnel, and other outside resources regarding biological issues. [472, 2013]

3.4.14 Operations Level Responders Assigned Responsibilities for Chemical Response. Persons, competent at the operations level, who, at hazardous materials/weapons of mass destruction (WMD) incidents involving chemical materials, are assigned to support the hazardous materials technician and other personnel, provide strategic and tactical recommendations to the on-scene incident commander, serve in a technical specialist capacity to provide technical oversight for operations, and act as a liaison between the hazardous material technician, response personnel, and other outside resources regarding chemical issues. [472, 2013]
3.4.15 Operations Level Responders Assigned Responsibilities for Radioactive Material Response. Persons, competent at the operations level, who, at hazardous materials/weapons of mass destruction (WMD) incidents involving radioactive materials, are assigned to support the hazardous materials technician and other personnel, provide strategic and tactical recommendations to the on-scene incident commander, serve in a technical specialist capacity to provide technical oversight for operations, and act as a liaison between the hazardous material technician, response personnel, and other outside resources regarding radioactive material issues. [472, 2013]

3.4.16 Operations Level Responders Assigned to Use Personal Protective Equipment During Hazardous Materials/Weapons of Mass Destruction (WMD) Incidents. Persons, competent at the operations level, who are assigned to use of personal protective equipment at hazardous materials/weapons of mass destruction (WMD) incidents. [472, 2013]

Chapter 4 Awareness

Awareness Level Personnel. Persons who, in the course of their normal duties, could encounter an emergency involving hazardous materials/weapons of mass destruction (WMD) and who are expected to recognize the presence of the hazardous materials/WMD, protect themselves, call for trained personnel, and secure the scene.

4.1 General.

For qualification at the Awareness level at a hazardous materials/WMD incident, the candidate shall meet the general knowledge requirements (*), the general skill requirements (*), and the job performance requirements (JPRs) defined in Sections (*) through (*).

- Recognition and Identification (see 4.2).
- Initial protective actions (see 4.3).
- Scene control actions (see 4.4).
- Notification (see 4.5).

4.1.1 General Knowledge Requirements. (Reserved)

4.1.2 General Skills Requirements. (Reserved)

4.2 Recognition and Identification.

Recognize indicators identify the materials and hazards involved in a hazardous materials/WMD incident, given a hazardous materials/ WMD incident, an assignment, and resources including the Emergency Response Guidebook or equivalent guide, safety data sheets, shipper/manufacturer papers, and contacts, so that a hazardous materials/WMD incident,

(A)* Requisite Knowledge. What hazardous materials/WMD are the risks associated with various hazardous materials/ WMD, indicators of the presence of hazardous materials/WMD including occupancy and locations including fixed facilities and transportation, container shapes, placards and labels, markings and colors, shipping documents and safety data sheets, and sensory clues, and information available from resources including the Emergency Response Guidebook.
or equivalent guide, safety data sheets, hazard class information, shipper/manufacturer papers, and contacts.

(B) Requisite Skills. Recognizing clues indicating the presence of hazardous materials and identifying hazardous materials and their potential hazards using resources including the Emergency Response Guidebook or equivalent guide, safety data sheets, shipper/manufacturer papers, and contacts.

4.3 Initial Protective Actions.

Initiate protective actions for people, property and the environment at a hazardous materials/WMD incident, given a hazardous materials/WMD incident, an assignment, and applicable policies, procedures, tools, and equipment provided by the AHJ, so that the incident is isolated and secured, safety procedures are followed, hazards are avoided or minimized, and people, property and the environment are not exposed to further harm.

(A) Requisite Knowledge. Initial protective actions, methods to implement evacuation and shelter-in-place, applicable policies and procedures, tools and equipment provided by the AHJ, and the types of hazard and response information available from the Emergency Response Guidebook or equivalent guide, safety data sheets, shipper/manufacturer papers, and contacts to provide guidance in initiating protective actions.

(B)* Requisite Skills. Collecting hazard and response information for initiating protective actions from the Emergency Response Guidebook or equivalent guide, safety data sheets, shipper/manufacturer papers and contacts, limiting responder and civilian access to the incident, and initiating protective actions.

4.4* Scene Control Actions.

Perform scene control actions at a hazardous materials/WMD incident, given a hazardous materials/WMD incident, an assignment, and applicable policies, procedures, tools, and equipment provided by the AHJ, so that nearby persons, property, and the environment are protected from the effects of the released or potential release of a material, isolation distances are established, the need for personal protective equipment (PPE) is identified, initial protective actions are implemented and monitored, safety procedures are followed, hazards are avoided or minimized, and potential evidence is protected.

(A)* Requisite Knowledge. Scene control actions, isolation distances, safety procedures, applicable policies, procedures, tools, and equipment provided by the AHJ for scene control actions, different types of PPE including respiratory equipment and protective clothing (chemical protective clothing, high-temperature protective clothing, and structural firefighter protective clothing), methods to implement evacuation and shelter-in-place, and methods to protect evidence/potential evidence.

(B)* Requisite Skills. Performing scene control operations, using assigned tools and equipment provided by the AHJ, following safety procedures, and identifying and protecting evidence/potential evidence.

4.5 Notification.
Initiate the emergency notification process at a hazardous materials/WMD incident, given a hazardous materials/WMD incident, an assignment, and applicable policies and procedures for notification, reporting, and communications, and communications equipment provided by the AHJ, so that the notification process is initiated and the necessary information is communicated.

(A) Requisite Knowledge. Incidents that require the need for additional resources, and applicable policies and procedures for notification, reporting, and communications, and types of communications equipment provided by the AHJ.

(B) Requisite Skills. Operating communication equipment provided by the AHJ and communicating in accordance with applicable policies and procedures of the AHJ.

Chapter 5 Operations - Core

Operations Level Personnel – Core. Persons who respond to hazardous materials/WMD incidents for the purpose of protecting nearby persons, the environment, or property from the effects of the release. They should be trained to respond in a defensive fashion to control the release from a safe distance and keep it from spreading. Operations level responders can have additional competencies that are specific to their response mission, expected tasks, and equipment and training as determined by the AHJ.

5.1 General.

For qualification at the Operations – Core level at a hazardous materials/WMD incident, the candidate shall meet the job performance requirements (JPRs) at the Awareness level, the general knowledge requirements (*), the general skill requirements (*), and the job performance requirements (JPRs) defined in Sections (*) through (*).

- Scene size-up (see 5.2).
- Response planning (see 5.3).
- Action plan implementation (see 5.4).
- Emergency decontamination (see 5.5).
- Progress Evaluation and Reporting (see 5.6).

5.1.1 General Knowledge Requirements. (Reserved)

5.1.2 General Skills Requirements. (Reserved)

5.2* Scene Size-Up.

Perform size-up at a hazardous materials/WMD incident, given a hazardous materials/WMD incident, an assignment, shipper/manufacturer papers and contacts, and reference sources, so that the hazardous materials/WMD incident is surveyed, hazard and response information is collected the potential behavior of a material and its container is identified, and any potential harm is identified.

(A)* Requisite Knowledge. Types of containers and their markings, methods for determining container capacities, types of hazard and response information available from the reference sources, behaviors of hazardous materials based on their properties, how hazardous materials cause harm, and the process for estimating outcomes.
**5.3* Response Planning.**

Plan the response for a hazardous materials/WMD incident, given a hazardous materials/WMD incident, an assignment, available resources, and incident size-up information, so that response objectives are identified, action options are identified and implemented, the suitability of available PPE is determined, and emergency decontamination issues are identified.

**(B)* Requisite Skills.** Collecting information regarding surrounding conditions, identifying the containers and materials involved, determining if materials have been released, collecting hazard and response information, describing the behavior of hazardous materials/WMD, describing the potential harm at a hazardous materials/WMD incident, and describing potential outcomes.

**(A)* Requisite Knowledge.** Components of an action plan; response objectives for hazardous material/WMD incidents, action options for hazardous materials/WMD incidents, safety considerations and risk analysis, advantages, limitations, uses, and operational components of respiratory protection, purpose, advantages, and limitations of protective clothing, and emergency decontamination procedures and potential issues.

**(B)* Requisite Skills.** Developing an action plan, identifying appropriate response objectives based on risk assessment, selecting appropriate actions based on available resources, determining if available respiratory protection is suitable for the given hazard(s), determining if available protective clothing is suitable for the given hazard(s), and identifying emergency decontamination issues.

**5.4 Action Plan Implementation.**

Implement the action plan for a hazardous materials/WMD incident, given a hazardous materials/WMD incident, an assignment in an action plan, and applicable policies and procedures, PPE, and tools and equipment provided by the AHJ, so that the actions of the plan are implemented, safety procedures are followed, hazards are avoided or minimized, and the assignment is completed.

**(A)* Requisite Knowledge.** Scene control procedures, techniques for evacuation and sheltering-in-place, methods to communicate with first responders and public, evidence preservation and protection procedures, incident management system (IMS)/incident command system (ICS) organization and procedures, capabilities, limitations, and maintenance of PPE provided by the AHJ, maintenance of available PPE, signs/symptoms of heat/cold stress, safety precautions when working at hazardous materials/WMD incidents, cleaning, disinfecting, and inspecting tools and equipment including PPE, and purpose, advantages and limitations for emergency decontamination.

**(B)* Requisite Skills.** Recognizing, preserving, and protecting evidence, establishing incident management system (IMS)/incident command system (ICS), using PPE, performing scene control, identifying signs of heat/cold stress, performing emergency decontamination, isolating contaminated tools and equipment, and cleaning, disinfecting, and inspecting PPE.

**5.5* Emergency Decontamination.**

Perform emergency decontamination procedures at a hazardous materials/WMD incident, given a hazardous materials/WMD incident that requires emergency decontamination, an assignment in an action plan, and applicable policies and procedures, PPE, and tools and equipment provided...
by the AHJ for emergency decontamination, so that exposures are protected, PPE is used, safety procedures are followed, hazards are avoided or minimized, and the victims and responders are decontaminated.

**(A)** *Requisite Knowledge.* Contamination and decontamination, tools and equipment provided by the AHJ for emergency decontamination, hazard avoidance during decontamination, AHJ policies and procedures, and emergency decontamination procedures.

**(B)** *Requisite Skills.* Protecting exposures during emergency decontamination, avoiding hazards during emergency decontamination, and performing emergency decontamination.

### 5.6 Progress Evaluation and Reporting.

Evaluate and report the progress of the action plan for a hazardous materials/WMD incident, given a hazardous materials/WMD incident, an assignment in an action plan, an initial progress report, and communication equipment provided by the AHJ, so that the actions taken are evaluated to determine whether the response objectives are being accomplished, the action plan is adjusted as needed, and progress of the plan is communicated.

**(A)** *Requisite Knowledge.* Components of an action plan, components of an initial progress report, communication equipment and procedures of the AHJ, and available resources to ascertain improving, static, or deteriorating conditions based on the objectives of the action plan.

**(B)** *Requisite Skills.* Determining whether the response objectives are being accomplished, using communications equipment provided by the AHJ, communicating the status of response objectives, and revising an action plan based on conditions found during the incident status review.

### Chapter 6 Operations – Mission-Specific

**Operations Level Personnel – Mission-Specific.** Operations level responders can have additional competencies that are specific to their response mission, expected tasks, and equipment and training as determined by the AHJ.

#### 6.1 General.

**6.1.1** JPRs listed in this chapter are only required for those operations level responders assigned the responsibility of the specific action covered by the JPR by the AHJ utilizing the resources provided by the AHJ. Section 6.2 is a prerequisite for any other JPRs defined in Sections 6.3 through 6.8.

**6.1.2** For qualification for an assigned Operations – Mission-Specific level task at a hazardous materials/WMD incident, the candidate shall meet the job performance requirements (JPRs) at the Awareness and Operations – Core levels, the general knowledge requirements (*), the general skill requirements (*), the job performance requirement (JPR) defined in Section 6.2, and the job performance requirement (JPR) for the assigned task defined in the appropriate Section - Sections (*) through (*),

- Personal protective equipment. (see 6.2).
- Decontamination.
  - Mass decontamination (see 6.3.1).
6.1.3 The operations level responder who is assigned mission-specific responsibilities at hazardous materials/WMD incidents shall operate under the guidance of a hazardous materials technician, an allied professional, an emergency response plan, or standard operating procedures.

6.1.4 General Knowledge Requirements. (Reserved)

6.1.5 General Skills Requirements. (Reserved)

6.2 Personal Protective Equipment.

Select, don, work-in, and doff PPE at a hazardous materials/WMD incident, given a hazardous materials/WMD incident that requires use of PPE, an assignment in an IAP including the results of the incident size-up and the response objectives and options for the incident, access to a hazardous materials technician or an allied professional, and applicable policies, procedures, and PPE provided by the AHJ, so that suitable PPE is selected under the guidance of a hazardous materials technician, allied professional, or standard operating procedures, PPE is used, inspected, donned, worked in, decontaminated, and doffed, safety procedures are followed, hazards are avoided or minimized, and all reports and documentation required by AHJ pertaining to PPE use are completed.

(A) Requisite Knowledge. The need for working under the guidance of a hazardous materials technician, allied professional, the action plan, or standard operating procedures when selecting and using PPE, capabilities, limitations, and use of the PPE provided by the AHJ, components of an incident action plan, procedures for decontamination, maintenance, inspection, and storage of PPE provided by the AHJ, process for undergoing decontamination while wearing PPE, and AHJ procedures for reporting and documenting the use of PPE.

(B) Requisite Skills. Determining the necessary PPE for the assignment, inspecting, donning, working in, and doffing PPE, undergoing decontamination (emergency or technical) while wearing the PPE, maintaining and storing PPE, and reporting and documenting the use of PPE.

6.3 Decontamination.

6.3.1 Mass Decontamination.

Perform mass decontamination for ambulatory and non-ambulatory victims at a hazardous materials/WMD incident, given a hazardous materials/WMD incident that requires mass decontamination, an assignment in an IAP, and applicable policies and procedures, PPE, and the tools and equipment provided by the AHJ, so that PPE is selected under the guidance of a hazardous materials technician, allied professional, or standard operating procedures and used,
appropriate mass decontamination procedures are selected, implemented, evaluated, and terminated, safety procedures are followed, hazards are avoided or minimized, emergency responders are not contaminated, and, if contaminated, personnel, tools, and equipment are decontaminated.

(A)* Requisite Knowledge. Different levels of PPE and when they are used, advantages and limitations of operations and methods of mass decontamination, applicable policies and procedures provided by the AHJ for selecting the correct mass decontamination procedures, tools and equipment provided by the AHJ for performing mass decontamination, procedures, safety precautions, and equipment for communicating with crowds provided by the AHJ, crowd management techniques, mass decontamination duties within the command structure, and procedures to perform mass decontamination.

(B)* Requisite Skills. Selecting and using the appropriate level of PPE, selecting correct/appropriate mass decontamination procedure, setting up and implementing mass decontamination operations for ambulatory and non-ambulatory victims, determining if victims have been fully decontaminated, and completing reporting and documentation requirements of the AHJ.

6.3.2 Technical Decontamination.

Perform technical decontamination in support of entry operations and for ambulatory and non-ambulatory victims at a hazardous materials/WMD incident, given a hazardous materials/WMD incident that requires technical decontamination, an assignment in an IAP, and applicable policies and procedures, PPE, and the tools and equipment provided by the AHJ, so that PPE is selected under the guidance of a hazardous materials technician, allied professional, or standard operating procedures and used, appropriate technical decontamination procedures are selected, implemented, evaluated, and terminated, safety procedures are followed, hazards are avoided or minimized, emergency responders are not contaminated, and, if contaminated, personnel, tools, and equipment are decontaminated.

(A)* Requisite Knowledge. Different levels of PPE and when they are used, advantages and limitations of operations and methods of technical decontamination, applicable policies and procedures provided by the AHJ for selecting the correct technical decontamination procedures, tools and equipment provided by the AHJ for performing technical decontamination, procedures, equipment provided by the AHJ, and safety precautions for communicating with crowds, crowd management techniques, technical decontamination duties within the command structure, and procedures to perform technical decontamination.

(B)* Requisite Skills: Selecting and using the appropriate level of PPE, selecting correct/appropriate technical decontamination procedure; setting up and implementing technical decontamination operations for ambulatory and non-ambulatory victims, determining if victims have been fully decontaminated, and completing reporting and documentation requirements of the AHJ.

6.4* Evidence Preservation and Public Safety Sampling.

Perform evidence preservation and public safety sampling at a hazardous materials/WMD incident, given a hazardous materials/WMD incident involving potential violations of criminal statutes or governmental regulations, an assignment in a incident action plan, applicable policies
and procedures, PPE, and tools and equipment provided by the AHJ, so that PPE is selected under the guidance of a hazardous materials technician, allied professional, or standard operating procedures and used, evidence preservation and public safety sampling is conducted in accordance with the AHJ protocols and techniques, public safety samples are packaged, safety procedures are followed, hazards are avoided or minimized, emergency responders are not contaminated, and, if contaminated, emergency responders, tools and equipment are decontaminated.

(A) Requisite Knowledge. Different levels of PPE and when they are used, unique aspects of a suspicious letter, suspicious package or device, illicit laboratories, a release/attack with a WMD agent, or potential violations of criminal statues or governmental regulations, agencies having response authority to collect evidence and public safety samples, notification procedures for agencies having investigative authority and explosive ordnance disposal responsibility, chain-of-custody procedures, securing, characterizing, and preserving the scene, documentation procedures for the AHJ, types of evidence, use and limitations of equipment used to conduct field sampling and screening for admission into a laboratory system, use of collection kits, collection and packaging of public safety samples, decontamination of packaging, prevention of secondary contamination, transportation requirements for sample packaging, AHJ policies and procedures for undergoing decontamination while wearing PPE.

(B) Requisite Skills: Determining if an incident is potentially a violation of criminal statues or governmental regulations, identifying the agency having investigative jurisdiction over an incident that is potentially criminal in nature or a violation of government regulations, operating field sampling equipment, securing, characterizing, and preserving the scene, identifying and protecting potential evidence until it can be collected by an agency with investigative authority, following chain of custody procedures, characterizing hazards, performing protocols for field screening samples for admission into the Laboratory Response Network or other forensic laboratory system, protecting evidence from secondary contamination, determining agency having response authority to collect public safety samples, determining agency having investigative law enforcement authority to collect evidence and public safety samples, collecting public safety samples, packaging and labeling samples, decontaminating samples, undergoing decontamination, and preparing samples for transportation to a laboratory.

6.5 Product Control.

6.5.1* Basic Product Control.

Perform basic control techniques at a hazardous materials/WMD incident, given a hazardous materials/WMD incident with release of product, an assignment in an IAP, and applicable policies and procedures, PPE, and tools and equipment, including foam, provided by the AHJ, so that an effective product control option is selected, PPE is selected under the guidance of a hazardous materials technician, allied professional, or standard operating procedures and used, product is controlled, safety procedures are followed, hazards are avoided or minimized, and emergency responders, tools and equipment are decontaminated.

(A)* Requisite Knowledge. Product control options and safety precautions associated with each option, location and use of emergency shutoff devices in MC/DOT-306, MC/DOT-307, and MC-331 cargo tanks containing flammable liquids or gases, location and operation of emergency remote shutoff devices at fixed facilities in AHJ response area, characteristics and applicability
of foams provided by the AHJ, capabilities and limitations of available PPE, applicable policies and procedures for basic product control operations, the tools and equipment provided by the AHJ, and applicable AHJ procedures for undergoing technical decontamination when wearing PPE.

**(B)** Requisite Skills. Selecting and using the PPE provided by the AHJ, using foams and foam equipment or agents on a spill or fire involving hazardous materials/WMD, using emergency remote shutoff devices on cargo tanks containing flammable liquids or gases, undergoing decontamination, and performing product control operations.

### 6.5.2 Flammable Liquid Fire Control

Control a flammable liquid fire at a hazardous materials/WMD incident, given a hazardous materials/WMD incident involving a flammable liquid fire, an assignment in an IAP, applicable policies and procedures, PPE, and tools, extinguishing agents (*including foams*), and equipment provided by the AHJ, so that the proper control method is selected, PPE is selected under the guidance of a hazardous materials technician, allied professional, or standard operating procedures and used, the proper application technique is used, safety procedures are followed, hazards are avoided or minimized, exposures and personnel are protected, the fire is controlled or extinguished, and personnel and equipment are decontaminated.

**(A)** Requisite Knowledge. Product control options for flammable liquid fires and safety precautions associated with each option, location and use of emergency shutoff devices in MC/DOT-306 and MC/DOT-307 cargo tanks containing flammable liquids, location and operation of emergency remote shutoff devices for flammable liquid storage at fixed facilities in the AHJ’s response area, characteristics and applicability of extinguishing agents (*including foams*) provided by the AHJ on flammable liquid fires, considerations for selecting product control options for flammable liquid fires, capabilities and limitations of available PPE, applicable policies and procedures for flammable liquid fires, application techniques for product control methods at a flammable liquid fire, agents, tools, and equipment for flammable liquid fires provided by the AHJ, and local procedures for undergoing technical decontamination when wearing PPE.

**(B)** Requisite Skills. Selecting and using the PPE provided by the AHJ, applying foams or agents properly on a spill or fire involving flammable liquids, operating emergency remote shutoff devices on flammable liquid containers, performing product control methods at a flammable liquid fire using the equipment furnished by the AHJ, and undergoing technical decontamination.

### 6.5.3 Flammable Gas Fire Control

Control of a flammable gas fire at a hazardous materials/WMD incident, given a hazardous materials/WMD incident involving a flammable gas fire, an assignment in an IAP, and applicable policies and procedures, PPE, and tools, extinguishing agents, and equipment provided by the AHJ, so that the proper control method is selected, PPE is selected under the guidance of a hazardous materials technician, allied professional, or standard operating procedures and used, the proper application technique is used, safety procedures are followed, hazards are avoided or minimized, exposures and personnel are protected, the fire is controlled or extinguished, and personnel and equipment are decontaminated.
(A) *Requisite Knowledge.* Product control options for flammable gas fires and safety precautions associated with each option, location and use of emergency shutoff devices in cargo tanks containing flammable gases, location and operation of emergency remote shutoff devices for flammable gas storage at fixed facilities in the AHJ response area, characteristics and applicability of extinguishing agents on flammable gas fires, considerations for selecting product control options for flammable gas fires, capabilities and limitations of PPE provided by the AHJ, applicable policies and procedures for flammable gas fires, application techniques for product control methods at a flammable gas fire, agents, tools, and equipment for flammable gas fires provided by the AHJ, and local procedures for undergoing technical decontamination when wearing PPE.

(B) *Requisite Skills.* Selecting and using the PPE provided by the AHJ, applying extinguishing agents properly on a spill or fire involving flammable gas, operating emergency remote shutoff devices on flammable gas containers, performing product control methods at a flammable gas fire using the agents, PPE, tools, and equipment furnished by the AHJ, and undergoing technical decontamination.

6.6* Air Monitoring and Sampling.*

Perform air monitoring, detection, and sampling activities, given a hazardous materials/WMD incident requiring air monitoring, detection, and/or sampling, an assignment in an incident action plan, and applicable policies and procedures, PPE, and air monitoring, detection, and sampling equipment provided by the AHJ, so that the proper equipment is selected to sample, detect, and monitor the solid, liquid, or gaseous hazardous materials/WMD present, air monitoring, detection, and sampling methods are selected, PPE is selected under the guidance of a hazardous materials technician, allied professional, or standard operating procedures and used, safety procedures are followed, hazards are avoided or minimized, exposures and personnel are protected, results of air monitoring, detection, and sampling are properly read, interpreted, documented, and communicated, personnel performing air monitoring, detection, and sampling, and their equipment, are properly decontaminated, air monitoring, detection, and sampling equipment is maintained and all reports and documentation, required by AHJ, pertaining to air monitoring, detection, and sampling are completed.

(A)* Requisite Knowledge.* Air monitoring, detection, and sampling equipment provided by the AHJ, applicable AHJ policies and procedures for air monitoring, detection, and sampling, process for selection of air monitoring, detection, and sampling equipment for an assigned task, capabilities and limitations of PPE provided by the AHJ, operation of the air monitoring, detection, and sampling equipment provided by the AHJ including capabilities, limitations, local monitoring procedures, and field testing, how to read, interpret, document, and what to communicate, operation of communication equipment provided by the AHJ, methods for decontaminating air monitoring, detection, and sampling equipment per manufacturer recommendations or AHJ policies and procedures, local procedures for undergoing technical decontamination when wearing PPE, and maintenance procedures for air monitoring, detection, and sampling equipment per manufacturer recommendations or AHJ policies and procedures.

(B) *Requisite Skills.* Selecting and using PPE provided by the AHJ, field testing and operating each air monitoring, detection, and sampling device provided by the AHJ, reading, interpreting, and documenting the readings from air monitoring, detection, and sampling equipment,
communicating results of air monitoring, detection, and sampling operations, undergoing decontamination, decontaminating personnel and air monitoring, detection, and sampling equipment, and maintaining air monitoring, detection, and sampling equipment per manufacturer recommendations or AHJ policies and procedures.

6.7 Victim Rescue and Recovery.
Perform rescue or recovery operation, given a hazardous materials/WMD incident involving exposed or contaminated victims, an assignment in an IAP, applicable policies and procedures, PPE, and tools and equipment, including special rescue equipment, provided by the AHJ, so that the feasibility of conducting a rescue or a recovery operation is determined, victims are correctly triaged, rescue or recovery options are selected within the capabilities of available personnel, PPE, and tools, equipment, and special rescue equipment, PPE is selected under the guidance of a hazardous materials technician, allied professional, or standard operating procedures and used, safety procedures are followed, hazards are avoided or minimized, victims are rescued or recovered, and personnel performing rescue and recovery, victims, and equipment used are decontaminated.

(A)* Requisite Knowledge. The difference between victim rescue and victim recovery, victim triage methods, considerations for determining the feasibility of rescue or recovery operations, procedures for implementing rescue in applicable policies and procedures provided by the AHJ including safety issues, procedures, tactical guidelines, specialized rescue equipment required, and incident response considerations to effect a rescue in the following situations - line-of-sight with ambulatory victims, line-of-site with nonambulatory victims, non-line-of-sight with ambulatory victims, non-line-of-sight with nonambulatory victims, and victim rescue operations versus victim recovery operations, rescue team positions and their functions, capabilities and limitations of available PPE, local procedures for undergoing technical decontamination when wearing PPE, and decontamination procedures.

(B) Requisite Skills. Determining the feasibility of conducting a rescue or recovery operation, triaging victims, selecting proper rescue or recovery methods for the assigned task, using available specialized rescue equipment, following AHJ procedures for safe and effective victim rescue or recovery, selecting and using proper PPE for the victim and rescuer, undergoing decontamination, and performing decontamination for personnel, tools, and equipment.

6.8 Response to Illicit Laboratories.
Perform response operations at an illicit laboratory, given a hazardous materials/WMD incident involving an illicit laboratory, an assignment in an incident action plan, applicable policies and procedures, PPE, and tools and equipment provided by the AHJ, so that the scene is secured, control procedures are implemented, type of laboratory is identified, potential hazards are identified, PPE is selected under the guidance of a hazardous materials technician, allied professional, or standard operating procedures and used, safety procedures are followed, hazards are avoided or minimized, evidence is preserved, and personnel/victims are decontaminated.

(A)* Requisite Knowledge. Process for determining if a hazardous materials/WMD incident is an illicit laboratory operation, types of illicit laboratories, operational considerations at illicit laboratories, hazards and products at illicit laboratories, potential booby traps found at illicit laboratories, law enforcement agency with investigative authority and responsibilities at illicit laboratories, securing and preserving evidence, procedures for conducting a joint hazardous
materials/EOD site recon and hazard identification, procedures for determining atmospheric hazards through air monitoring, detection, and sampling; procedures to mitigate immediate hazards, safety procedures and tactics, crime scene coordination with law enforcement agencies, capabilities and limitations of available PPE, factors to be considered in the selection of decontamination, factors to considered in the selection of detection devices, and factors to be considered in the development of a remediation plan.

**(B)* Requisite Skills.** Selecting appropriate PPE, selecting air monitoring, detection, and sampling equipment, implementing decontamination procedures for tactical law enforcement personnel securing an illicit laboratory, implementing technical decontamination, identifying and avoiding unique safety hazards, conducting a joint hazardous materials/EOD operation to identify safety hazards, and implementing scene control procedures.

**Chapter 7 Hazardous Materials Technician.**

**Hazardous materials technician** - person who responds to hazardous materials/weapons of mass destruction (WMD) incidents using a risk-based response process by which they analyze a problem involving hazardous materials/WMD, select applicable decontamination procedures, and control a release using specialized protective clothing and control equipment.

**7.1 General.**

**7.1.1** For qualification at the Hazardous Materials Technician level at a hazardous materials/WMD incident, the candidate shall meet the job performance requirements (JPRs) at the Awareness and Operations – Core levels, the general knowledge requirements (*), the general skill requirements (*), and the job performance requirements (JPRs) defined in Sections (*) through (*).

- **Incident Analysis.**
  - Container Identification. (see 7.2.1)
  - Air monitoring, Detection, and Sampling. (see 7.2.2)
  - Hazard and Response Information Collection and Interpretation. (see 7.2.3)
  - Container Damage Identification. (see 7.2.4)
  - Predicting Behavior. (see 7.2.5)
  - Estimating Outcomes. (see 7.2.6)

- **Response Planning.**
  - Response Objectives and Options. (see 7.3.1)
  - PPE Selection. (see 7.3.2)
  - Decontamination Operations and Methods Selection. (see 7.3.3)
  - IAP Development. (see 7.3.4)

- **IAP Implementation.** (see 7.4)
  - IMS/ICS Duties. (see 7.4.1)
  - PPE Use. (see 7.4.2)
  - Control Functions. (see 7.4.3)
    - Basic Product Control. (see 7.4.3.1)
    - Flammable Liquid Fire Control. (see 7.4.3.2)
    - Flammable Gas Fire Control. (see 7.4.3.3)
7.1.2 General Knowledge Requirements.  (Reserved)

7.1.3 General Skills Requirements.  (Reserved)

7.2 Incident Analysis.  Analyze a hazardous materials/WMD incident to determine the complexity of the problem and the potential outcomes.

7.2.1* Container Identification.

Identify containers at hazardous material/WMD incidents, given a hazardous materials/WMD incident, an assignment in an IAP required markings on the containers, applicable reference sources, and applicable policies and procedures, so that containers are identified by name, and specification number, capacity of the containers is determined, suitable PPE is used, safety procedures are followed, hazards are avoided or minimized, and container information is communicated as necessary.

(A) Requisite Knowledge. Markings and other resources that indicate the name, specification (when applicable), and typical contents by name and hazard class in transportation and fixed facility containers including railroad cars (nonpressure, pressure, cryogenic liquid tank cars and pressure differential covered hopper cars), intermodal tanks/HM portable tanks (nonpressure, pressure, cryogenic liquid tank containers and tube modules), cargo tanks (nonpressure, low pressure, high pressure, cryogenic liquid, corrosive liquid tanks, and compressed gas tube trailers), facility storage tanks (nonpressure, pressure, and cryogenic liquid tanks), nonbulk packaging (bags, carboys, cylinders, and drums), and radioactive materials packaging (exempted, industrial, Type A, Type B), and ton containers, markings and other resources that indicate the approximate capacity by weight or volume in transportation containers (cargo tanks, tank cars, and HM portable tanks) and fixed facility containers (cryogenic liquid, nonpressure, and pressure facility containers), and process for describing radiation dose rates from the information provided on a radioactive material label (type or category of label, contents, activity, transport index, and criticality safety index, as applicable).

(B) Requisite Skills. Identifying containers by name, specification number when applicable, identifying typical contents found in containers by name and hazard class, identifying the capacity of various containers, and describing radiation dose rates from label information on radioactive containers.

7.2.3 Air Monitoring, Detection, and Sampling.
Classify, identify, verify, and quantify the materials involved in a hazardous materials/WMD incident using air monitoring, detection, and sampling, given a hazardous materials/WMD incident with released hazardous materials/WMD (including one unknown), an assignment in an IAP (formal or informal), applicable resources, applicable policies and procedures, a selection of PPE, and air monitoring, detection, and sampling equipment, so that appropriate PPE is selected and used, unknown materials are identified or classified, identity of hazardous materials/WMD involved is verified, concentrations of hazardous materials are determined or verified through the use of monitoring, detection, and sampling, safety procedures are followed, hazards are avoided or minimized, results of air monitoring, detection, and sampling are properly read, interpreted, documented, and communicated as necessary, and personnel performing air monitoring, detection, and sampling and their equipment are decontaminated, and the necessary information is communicated.

(A) Requisite Knowledge. Methods for identifying, or classifying by hazard, an unknown material (solid, liquids, and atmosphere), hazard classes and divisions, methods for verifying the identity of hazardous materials/WMD, monitoring technology used to determine the following hazards - corrosivity, flammability, oxidation potential, oxygen deficiency, pathogenicity, radioactivity, and toxicity, capabilities and limitations associated with the selection and use of monitoring equipment, test strips, and reagents - including biological immunoassay indicators, chemical agent monitors (CAMs), colorimetric indicators (colorimetric detector tubes, indicating papers - pH paper and meters, reagents, test strips), combustible gas indicator, DNA fluoroscopy, electrochemical cells (carbon monoxide meter, oxygen meter), flame ionization detector, gas chromatograph/mass spectrometer (GC/MS), infrared spectroscopy, ion mobility spectroscopy, gamma spectrometer (radioisotope identification device (RIID)), metal oxide sensor, photo ionization detectors, polymerase chain reaction (PCR), radiation detection and measurement instruments, raman spectroscopy, surface acoustical wave (SAW), and wet chemistry.

(B) Requisite Skills. Selecting and using appropriate PPE, selecting and using appropriate monitoring equipment, test strips, and reagents, including carbon monoxide meter, colorimetric tubes, combustible gas indicator, oxygen meter, passive dosimeters, pH indicators and/or pH meters, photo ionization and flame ionization detectors, radiation detection instruments, reagents, test strips, WMD detectors (chemical and biological), and any specialized equipment provided by the AHJ, to identify or classify hazards, performing field maintenance and testing for monitoring equipment, test strips, and reagents provided by the AHJ, and collecting samples (gas, liquid, and solid).

7.2.4* Hazard and Response Information Collection and Interpretation.

Collect and interpret hazard and response information from sources other than the DOT Emergency Response Guidebook or a Safety Data Sheet (SDS), given a hazardous materials/WMD incident, an assignment in an IAP (formal or informal), hazardous materials databases, results of air monitoring, detection, and sampling including survey and monitoring equipment for radioactive materials, reference manuals, technical information centers (i.e., CHEMTREC/CANUTEC/SETIQ and local, state, and federal authorities), and technical information specialists, applicable policies and procedures, and available tools and equipment (computers, printers, etc), so that hazard and response information is collected and interpreted, signs and symptoms of exposure are identified, and information is communicated as necessary.
(A)* Requisite Knowledge. Types of hazard and response information available from specified resources (hazardous materials databases, monitoring equipment, reference manuals, technical information centers, technical information specialists), advantages and limitations of the various resources (hazardous materials databases, monitoring equipment, reference manuals, technical information centers, technical information specialists), significance and application of hazard and response terms including corrosive (acids and bases/alkaline), air reactivity, autorefrigeration, biological agents and biological toxins, blood agents, catalyst, chemical change, chemical interactions, compound, mixture, concentration, critical temperature and pressure, dissociation (acid/base), dose, dose response, expansion ratio, fire point, half-life, halogenated hydrocarbon, ignition (autoignition) temperature, inhibitor, instability, ionic and covalent compounds, irritants (riot control agents), maximum safe storage temperature (MSST), melting point and freezing point, miscibility, nerve agents, organic and inorganic, oxidation potential, physical change, polymerization, radioactivity, reactivity, riot control agents, saturated, unsaturated (straight and branched), and aromatic hydrocarbons, self-accelerating decomposition temperature (SADT), solubility, solution and slurry, strength, sublimation, temperature of product, vesicants (blister agents), viscosity, and volatility, signs and symptoms of exposure to hazardous materials/WMD, and target organ effects of exposure to hazardous materials/WMD.

(B) Requisite Skills. Collecting and interpreting hazard and response information, explaining the significance and application of hazard and response terms, and identifying signs and symptoms of exposure to hazardous materials/WMD including target organ effects of exposure to hazardous materials/WMD.

7.2.5 Identifying Container Condition.

Describe the damage to nonbulk and bulk packagings at an incident involving hazardous materials/WMD (damaged with no product release, undamaged with no product release, damaged with product release, and undamaged with product release), given an incident involving hazardous materials/WMD, an assignment in an IAP (formal or informal), specification markings on containers, printed and technical resources, computer databases, specialists in the field, applicable policies and procedures, and results of air monitoring, detection, and sampling, so that damage is identified (cracks, scores, gouges, dents), level of risk associated with the damage is identified, integrity of a radioactive material container is determined (breached or not), stress on container is identified (thermal, mechanical, chemical), and a description of the damage is communicated as necessary.

(A) Requisite Knowledge. Basic design and construction features, including closures, of bulk containers including cargo tanks – compressed gas tube trailers, corrosive liquid tanks, cryogenic liquid tanks, dry bulk cargo tanks, high-pressure tanks, low-pressure liquid tanks, and nonpressure liquid tanks, fixed facility tanks – cryogenic liquid tanks, nonpressure tanks, and pressure tanks, intermediate bulk containers – tote tanks, intermodal tanks/HM Portable Tanks – nonpressure intermodal tanks [IM-101 portable tank (IMO Type 1 internationally), IM-102 portable tank (IMO Type 2 internationally)], pressure intermodal tanks (DOT Specification 51; IMO Type 5 internationally), cryogenic intermodal tanks (IMO Type 7 internationally), and tube modules, one-ton containers, pipelines, railroad cars – cryogenic liquid tank cars, nonpressure tank cars, pneumatically unloaded hopper cars, and pressure tank cars, basic design and construction features, including closures, of nonbulk containers – bags, carboys, drums, cylinders, basic design features and testing requirements of radioactive material packages –
excepted, industrial, Type A, and Type B, basic design and construction of pipelines, including
how liquid petroleum product pipeline carries different products, and how identifying
information on a pipeline – ownership of the pipeline, procedures for checking for gas migration,
procedure for shutting down the pipeline or controlling the leak, and type of product in the
pipeline, types of damage and level of risk associated with the damage, types of stress, methods
for determining the pressure inside a container, methods for determining the quantity of the
commodity inside a container, and methods for determining whether the integrity of a radioactive
material container has been breached.

(B)* Requisite Skills. Identifying the container damage including quantity of the commodity
and pressure inside the container, identifying level of risk associated with the damage,
identifying stress on container, determining integrity of radioactive material containers, and
communicating the type and significance of damage as necessary.

7.2.6 Predicting Behavior.

Predict the behavior of the hazardous materials/WMD involved in a hazardous materials/WMD
incident, given an incident involving multiple hazardous materials/WMD, an assignment in an
IAP (formal or informal), results of hazard and response information collection, results of
monitoring and sampling, condition of the container both damage and stress, results of the
incident size-up including weather conditions (current and projected), terrain, time of day, etc.,
printed and technical resources, computer databases, specialists in the field, and applicable
policies and procedures, so that type stress applied is identified (thermal, mechanical, chemical),
type potential breach is identified (disintegration, runaway cracking, closures opening up,
punctures, and splits or tears), type potential release are identified (detonation, violent rupture,
rapid relief, and spill or leak), type potential dispersion pattern is identified (hemisphere, cloud,
plume, cone, stream, pool, and irregular), length of potential contact time is identified (short
term, medium term, long term), potential hazards that could cause harm are identified (thermal,
mechanical, poisonous, corrosive, asphyxiating, radiation, and etiological), and a description of
the likely behavior is communicated as necessary.

(A) Requisite Knowledge. Process for predicting behavior [considerations: stress, breach,
release, dispersion pattern, contact time, hazards creating harm, synergistic effects of mixing
materials], types of stress applied (thermal, mechanical, chemical), types potential breach
(disintegration, runaway cracking, closures opening up, punctures, and splits or tears), types
potential release (detonation, violent rupture, rapid relief, and spill or leak), types potential
dispersion patterns (hemisphere, cloud, plume, cone, stream, pool, and irregular), length of
potential contact time (short term, medium term, long term), potential hazards that could cause
harm (thermal, mechanical, poisonous, corrosive, asphyxiating, radiation, and etiological)
resources that indicate the synergistic effects of mixing various hazardous materials, impact of
fire and safety features on the behavior of products at a bulk liquid facility, impact of fire and
safety features on the behavior of products at a bulk gas facility, heat transfer processes that
occur as a result of a cryogenic liquid spill, and methods for communicating the results of
predicting behavior.

(B) Requisite Skills. Predicting likely behavior of materials and their containers when multiple
materials are involved (including identifying stress, identifying potential breach, identifying
potential release, identifying potential engulf, identifying potential contact, and identifying
potential harm) and identifying synergistic effects of mixing various hazardous materials.
7.2.7 Estimating Outcomes.

Estimate the likely outcomes at a hazardous materials/WMD incident, given an incident involving hazardous materials/WMD, an assignment in an IAP (formal or informal), results of the incident size-up including weather conditions (current and projected), terrain, time of day, etc. (buildings, people, bodies of water, etc.), results of hazard and response information collection, results of air monitoring and sampling, condition of container, predicted behavior, printed and technical resources, computer databases, specialists in the field, and applicable policies and procedures, so that the size and shape of the endangered area are determined, number and types of exposures within the endangered area are identified, concentrations of materials within the endangered area are measured or predicted, physical, health, and safety hazards within the endangered area are identified, areas of potential harm in the endangered area are identified, potential outcomes within the areas of potential harm in endangered area are identified, and potential outcomes are communicated as necessary.

(A) Requisite Knowledge. Resources for dispersion pattern prediction and modeling, including computers, monitoring equipment, or specialists in the field, methods for determining the dimensions of the endangered area, methods for identifying the number and types of exposures within the endangered area, methods for determining concentrations of materials within the endangered area, methods for identifying physical, health, and safety hazards within the endangered area, health hazard terms and exposure values and their significance in the analysis process including counts per minute (cpm) and kilocounts per minute (kcpm), immediately dangerous to life and health (IDLH) value, incubation period, infectious dose, lethal concentrations (LC50), lethal dose (LD50), parts per billion (ppb), parts per million (ppm), permissible exposure limit (PEL), radiation absorbed dose (rad), roentgen equivalent man (rem), millirem (mrem), microrem (μrem), threshold limit value ceiling (TLV-C), threshold limit value short-term exposure limit (TLV-STEL), threshold limit value time-weighted average (TLV-TWA), methods for identifying areas of potential harm within the endangered area, methods for identifying potential outcomes in the areas of potential harm within the endangered area, and procedures for communicating potential outcomes.

(B) Requisite Skills. Determining the dimensions of the endangered area, estimating the number of exposures within the endangered area, measuring or predicting concentrations of materials within the endangered area, estimating the physical, health, and safety hazards within the endangered area, identifying the areas of potential harm in the endangered area, estimating the potential outcomes within the areas of potential in endangered area, and communicating the potential outcomes.

7.3 Response Planning. Plan a response within the capabilities of available personnel, PPE, and control (tools and) equipment.

7.3.1* Response Objectives and Options.

Develop response objectives and response options, given a hazardous materials/WMD incident, an assignment in an IAP (formal or informal), results of the incident size-up including incident-related information, life safety risks, environmental risks, and property risks, available resources, and applicable policies and procedures, so that response objectives are identified for the incident and response options are identified for each response objective.
(A) Requisite Knowledge. Steps for developing response objectives and steps for identifying response options for each response objective.

(B) Requisite Skills. Developing response objectives for a hazardous materials incident and identifying response options for each response objective.

7.3.2* PPE Selection.
Select the PPE required for a given response option including both respiratory protection and liquid splash-protective clothing, vapor-protective clothing, high temperature protective clothing, and structural fire fighting protective clothing, given a hazardous materials/WMD incident, results of the incident size-up, response objectives and options for the given incident, available resources, and applicable policies and procedures, so that required PPE is identified for each response option.

(A) Requisite Knowledge. Four levels of PPE *[Annex: Specified by the Environmental Protection Agency (EPA) and National Institute for Occupational Safety and Health (NIOSH)], types of PPE available for various hazards *[Annex: Thermal, radiological, asphyxiating, chemical (liquids and vapors), etiological (biological), and mechanical (explosives)], factors to be considered in selecting respiratory protection, factors to be considered in selecting chemical-protective clothing, significance of degradation, penetration, and permeation on the selection of chemical-protective clothing, different designs of vapor-protective clothing and splash-protective clothing and their advantages and disadvantages, types of heat exchange units used for cooling personal in PPE and their advantages and disadvantages, information provided on chemical compatibility charts, and affects of physiological and psychological stresses on users of PPE.

(B) Requisite Skills. Selecting PPE ensemble (both respiratory protection and chemical-protective clothing) for a specified response option and determining protective clothing construction material using chemical compatibility charts.

7.3.3* Decontamination Operations and Methods.
Select the decontamination operations and methods required for a given response option, given a hazardous materials/WMD incident, results of the incident analysis, response objectives and options for the given incident, available resources, and applicable policies and procedures, so that decontamination operations and methods are identified to minimize the hazards for each response option and the equipment required to implement the decontamination method is identified.

(A) Requisite Knowledge. Decontamination operations, decontamination methods, advantages and disadvantages of various decontamination operations and methods including absorption, adsorption, chemical degradation, dilution, disinfecting, evaporation, isolation and disposal, neutralization, solidification, sterilization, vacuuming, and washing, reference sources for determining decontamination operations and methods, methods for accessing these resources, and equipment required to implement a specified decontamination operations and methods.

(B) Requisite Skills. Selecting decontamination operations and methods and identifying the equipment required to implement decontamination operations and methods.

7.3.4 IAP Development.
Develop an IAP, given a hazardous materials/WMD incident, an assignment, incident size-up information, response objectives and options for the given incident, available resources, and applicable policies and procedures, so that an IAP is developed, specified response objectives and response options are addressed, plan is consistent with the emergency response plan and applicable policies and procedures, plan is within the capability of available personnel, PPE, and control equipment, plan includes procedures, equipment, and safety precautions for preserving and collecting legal evidence, and equipment required for implementation is identified.

(A) Requisite Knowledge. Components of an IAP, including site safety and control, safety briefing, pre-entry activities, purpose of, procedures for, required equipment for, and applicable safety precautions (considerations?) for various methods (techniques) for HM/WMD control including absorption, adsorption, blanketing, covering, damming, diking, dilution, dispersion, diversion, fire suppression, neutralization, overpacking, patching, plugging, pressure isolation and reduction (flaring; venting, vent and burn, isolation of valves, pumps, or energy sources), retention, solidification, transfer, and vapor control (dispersion, suppression), atmospheric and physical safety hazards associated with HM/WMD in confined spaces, considerations for assessing a leak or spill inside a confined space, and procedures, equipment, and safety precautions for preserving and collecting legal evidence.

(B) Requisite Skills. Preparing an IAP, identifying site safety and control components, identifying points for a safety briefing, identifying pre-entry activities, identifying atmospheric and physical safety hazards when incident involves a confined space, and preserving and collecting legal evidence.

7.4 IAP Implementation. Implement the planned response consistent with the IAP.

7.4.1* Performing Assigned IMS/ICS Duties.

7.4.2* PPE Use.

Don, work-in, and doff PPE at a hazardous materials/WMD incident, given a hazardous materials/WMD incident that requires use of PPE, results of the incident size-up, response objectives and options for the given incident, an assignment in an incident action plan, available resources including PPE ensembles, and applicable policies and procedures, so that suitable PPE is selected, inspected, donned, worked in, decontaminated, and doffed, safety procedures are followed, hazards are avoided or minimized, equipment is maintained and stored properly, and the use of PPE is documented and reported.

(A) Requisite Knowledge. Capabilities, limitations, selection, and use of PPE, components of an incident action plan, safety procedures for personnel working in chemical-protective clothing (CPC) including keeping the individual cool and protected from heat exposure, the prevention of dehydration, medical monitoring, stringent accounting for time spent on air and in the suit, and additional safety concerns of working in the hot zone including visibility, mobility, and communications, emergency procedures for personnel working in chemical-protective clothing including loss of suit integrity, loss of verbal communications, the buddy system, and use of backup personnel wearing the same level of personal protective equipment (PPE), procedures for decontamination, maintenance, inspection, and storage of PPE, process for undergoing decontamination while wearing PPE, maintenance, testing, inspection, and storage for PPE
provided by the AHJ according to manufacturer’s specifications, and AHJ procedures for reporting and documenting the use.

(B) Requisite Skills. Inspecting, donning, working in, undergoing decontamination (emergency or technical), and doffing liquid splash-protective and vapor protective chemical protective, clothing ensembles (including respiratory protection) and any other specialized personal protective equipment provided by the AHJ), recording the use of CPC, and repairing and testing of chemical protective clothing (CPC) according to the manufacturer’s specifications.

7.4.3* Performing Control Functions

7.4.3.1* Basic Product Control.

Perform basic control techniques at a hazardous materials/WMD incident including absorption, adsorption, damming, diking, dilution, diversion, retention, remote valve shut-off, vapor dispersion, and vapor suppression, given a hazardous materials/WMD incident with release of product, an assignment in an IAP (formal or informal), and applicable policies and procedures, PPE, and tools and equipment, including foam, provided by the AHJ, so that an effective product control option is selected, suitable PPE is used, product is controlled, safety procedures are followed, hazards are avoided or minimized, and emergency responders, tools and equipment are decontaminated.

(A)* Requisite Knowledge. Product control options (absorption, adsorption, damming, diking, dilution, diversion, retention, remote valve shut-off, vapor dispersion, and vapor suppression), safety precautions associated with each option, location and use of emergency shutoff devices in cargo tanks containing flammable liquids or gases, location and operation of emergency remote shutoff devices at fixed facilities within the AHJ response area, characteristics and applicability of foams provided by the AHJ, capabilities and limitations of available PPE, applicable policies and procedures for basic product control operations, the tools and equipment provided by the AHJ, and AHJ procedures for undergoing technical decontamination when wearing PPE.

(B)* Requisite Skills. Selecting and using the PPE provided by the AHJ, selecting and using foams and foam equipment or agents on a spill or fire involving hazardous materials/WMD, using emergency remote shutoff devices on cargo tanks containing flammable liquids or gases, undergoing decontamination, and performing product control operations.

7.4.3.2* Flammable Liquid Fire Control.

Control a flammable liquid fire at a hazardous materials/WMD incident, given a hazardous materials/WMD incident involving a flammable liquid fire, an assignment in an IAP (formal or informal), applicable policies and procedures, PPE, and tools, extinguishing agents (including foams), and equipment provided by the AHJ, so that the proper control method is selected, suitable PPE is used, the proper application technique is used, safety procedures are followed, hazards are avoided or minimized, exposures and personnel are protected, the fire is controlled or extinguished, and personnel and equipment are decontaminated.

(A)* Requisite Knowledge. Product control options for flammable liquid fires, safety precautions associated with each option, location and use of emergency shutoff devices in cargo tanks containing flammable liquids, location and operation of emergency remote shutoff devices for flammable liquid storage at fixed facilities in the AHJ’s response area, characteristics and
applicability of extinguishing agents (including foams) provided by the AHJ on flammable liquid fires, considerations for selecting product control options for flammable liquid fires, capabilities and limitations of available PPE, applicable policies and procedures for flammable liquid fires, application techniques for product control options at a flammable liquid fire, agents, tools, and equipment for flammable liquid fires provided by the AHJ, and local procedures for undergoing technical decontamination when wearing PPE.

**B)** *Requisite Skills.* Selecting and using the PPE provided by the AHJ, performing product control methods at a flammable liquid fire using the equipment furnished by the AHJ, applying foams or agents properly on a spill or fire involving flammable liquids, operating emergency remote shutoff devices on flammable liquid containers, and undergoing technical decontamination.

### 7.4.3.3* Flammable Gas Fire Control.

Control a flammable gas fire at a hazardous materials/WMD incident, given a hazardous materials/WMD incident involving a flammable gas fire, an assignment in an IAP (formal or informal), applicable policies and procedures, PPE, and tools, extinguishing agents, and equipment provided by the AHJ, so that the proper control method is selected, suitable PPE is used, the proper application technique is used, safety procedures are followed, hazards are avoided or minimized, exposures and personnel are protected, the fire is controlled or extinguished, and personnel and equipment are decontaminated.

**A)** *Requisite Knowledge.* Product control options for flammable gas fires, safety precautions associated with each option, location and use of emergency shutoff devices in cargo tanks containing flammable gases, location and operation of emergency remote shutoff devices for flammable gas storage at fixed facilities in the AHJ’s response area, characteristics and applicability of extinguishing agents provided by the AHJ on flammable gas fires, considerations for selecting product control options for flammable gas fires, capabilities and limitations of available PPE, applicable policies and procedures for flammable gas fires, application techniques for product control options at a flammable gas fire, agents, tools, and equipment for flammable gas fires provided by the AHJ, and local procedures for undergoing technical decontamination when wearing PPE.

**B) Requisite Skills.** Selecting and using the PPE provided by the AHJ, performing product control methods at a flammable gas fire using the agents, PPE, tools and equipment furnished by the AHJ, applying extinguishing agents properly on a spill or fire involving flammable gas, operating emergency remote shutoff devices on flammable gas containers, and undergoing technical decontamination.

### 7.4.3.4 Pressure Container Leaks.

Contain a leak from a pressure container, given a hazardous materials/WMD incident, a leaking pressure container with a leak from a fusible plug, fusible plug threads, side wall of cylinder, valve blowout, valve gland, valve inlet thread, valve seat, or valve stem assembly blowout, and applicable policies and procedures, PPE, tools and equipment provided by the AHJ, so that the appropriate control method is used, the leak is controlled, suitable PPE is used, safety procedures are followed, hazards are avoided or minimized, emergency responders, tools and equipment are decontaminated, and tools and equipment are inspected and maintained.
(A) **Requisite Knowledge.** Ways in which pressure vessels may develop leaks via fusible plug, fusible plug threads, side wall of cylinder, valve blowout, valve gland, valve inlet threads, valve seat, or valve stem assembly blowout, methods to control pressure vessel leaks, applicable policies and procedures for pressure vessel leak control operations, the tools and equipment provided to control pressure vessel leaks, capabilities and limitations of available PPE, hazards associated with pressure vessel leaks, and local procedures for undergoing technical decontamination when wearing PPE, and equipment and maintenance procedures.

(B) **Requisite Skills.** Selecting and using suitable PPE, controlling the leak, following safety procedures, avoiding or minimizing hazards, decontaminating emergency responders, tools and equipment, and inspecting and maintaining tools and equipment.

### 7.4.3.2* Pressure Container Fitting Leaks.

Contain leaks from the fittings on a pressure container, given a hazardous materials/WMD incident, an assignment in an IAP (formal or informal), fittings on a pressure container, and applicable policies and procedures, PPE, tools and equipment provided by the AHJ, so that suitable PPE is used, open valves are closed, missing plugs are replaced, loose plugs are tightened, the leaks are controlled, safety procedures are followed, hazards are avoided or minimized, emergency responders, tools and equipment are decontaminated, and tools and equipment are inspected and maintained.

(A) **Requisite Knowledge.** Fittings on a pressure container, ways in which pressure containers may develop leaks from the fittings, methods to control leaks from fittings, applicable policies and procedures for controlling pressure container fitting leaks, the tools and equipment provided to control fitting leaks, capabilities and limitations of available PPE, hazards associated with pressure container leaks, procedures for undergoing technical decontamination when wearing PPE, and equipment and maintenance procedures.

(B) **Requisite Skills.** Closing open valves, replacing missing plugs, tightening loose plugs, controlling leaks, selecting and using suitable PPE, following safety procedures, minimizing hazards, decontaminating emergency responders, tools and equipment, and inspecting and maintaining tools and equipment.

### 7.4.3.3 55-Gallon Drum Leaks.

Contain a leak from a 55 gallon (208 L) drum, given a hazardous materials/WMD incident, a bung leak, chime leak, forklift puncture, or nail puncture on a 55 gallon (208 L) drum, and applicable policies and procedures, PPE, tools and equipment provided by the AHJ, so that the appropriate control method is used, the leak are controlled, suitable PPE is used, safety procedures are followed, hazards are avoided or minimized, emergency responders, tools and equipment are decontaminated, and tools and equipment are inspected and maintained.

(A) **Requisite Knowledge.** Ways in which drums leak including bung leak, chime leak, forklift puncture, or nail puncture, methods to control leaks from drums, applicable policies and procedures for controlling drum leaks, tools and equipment provided used to control leaking drums, capabilities and limitations of available PPE, hazards associated with drum leaks, local procedures for undergoing technical decontamination when wearing PPE, and equipment and maintenance procedures.
(B) Requisite Skills. Using the appropriate control method, controlling the leak, selecting and using suitable PPE, following safety procedures, decontaminating emergency responders, tools and equipment, and inspecting and maintaining tools and equipment.

7.4.3.4* Overpacking Drums.

Place a 55-gallon (208 L) drum into an overpack drum, given a hazardous materials/WMD incident, an assignment in an IAP (formal or informal), a leaking 55-gallon (208 L) drum, an overpack drum, and applicable policies and procedures, PPE, tools, and equipment provided by the AHJ, so that the drum is placed into the overpack drum using an suitable overpack method - rolling slide-in, slide-in, slip-over, or other, suitable PPE is used, safety procedures are followed, hazards are avoided or minimized, emergency responders, tools, and equipment are decontaminated, and tools and equipment are inspected and maintained.

(A) Requisite Knowledge. Ways in which drums leak, hazards associated with drum leaks, methods to overpack leaking drums including rolling slide-in, slide-in, and slip-over, or other, capabilities and limitations of available PPE, applicable policies and procedures for using overpacks, the tools and equipment used to overpack leaking drums, local procedures for undergoing technical decontamination when wearing PPE, and equipment and maintenance procedures.

(B) Requisite Skills. Placing a drum into the overpack drum using an appropriate overpack method, selecting and using suitable PPE, following safety procedures, minimizing and avoiding hazards, decontaminating emergency responders, tools and equipment, and inspecting and maintaining tools and equipment.

7.4.3.5 Dome Clamp Application.

Install a dome cover clamp, given a hazardous materials/WMD incident, an assignment in an IAP (formal or informal), a nonpressure cargo tank with a dome leak from the dome, a dome clamp, and applicable policies and procedures, PPE, tools and equipment provided by the AHJ, so that the clamp is correctly installed on the dome, suitable PPE is used, safety procedures are followed, hazards are avoided or minimized, emergency responders, tools, and equipment are decontaminated, and tools and equipment are inspected and maintained.

(A) Requisite Knowledge. Types of dome cover leaks, hazards associated with dome leaks, use of dome cover clamps, capabilities and limitations of available PPE, applicable policies and procedures for using dome cover clamps, tools, and equipment provided by the AHJ, local procedures for undergoing technical decontamination when wearing PPE, and equipment and maintenance procedures.

(B) Requisite Skills. Installing the dome cover clamp, selecting and using suitable PPE, following safety procedures, minimizing and avoiding hazards, decontaminating emergency responders, tools and equipment, and inspecting and maintaining tools and equipment.

7.4.4 Decontamination

7.4.4.1 Mass Decontamination.

Perform mass decontamination for ambulatory and non-ambulatory victims at a hazardous materials/WMD incident, given a hazardous materials/WMD incident requiring mass decontamination.
decontamination, an assignment in an IAP (formal or informal), and applicable policies and procedures, PPE, tools, and equipment provided by the AHJ, so that appropriate mass decontamination procedures are selected, set up, implemented, evaluated, and terminated, suitable PPE is used, safety procedures are followed, hazards are avoided or minimized, emergency responders are not contaminated, and personnel, tools, and equipment are decontaminated.

(A) Requisite Knowledge. Capabilities and limitations of available PPE, advantages and limitations of operations and methods of mass decontamination, applicable policies and procedures, tools and equipment provided by the AHJ, procedures for mass decontamination, safety precautions, procedures for communicating with crowds provided by the AHJ, and crowd management techniques,

(B) Requisite Skills. Selecting and using suitable PPE, selecting suitable mass decontamination procedure, setting up and implementing mass decontamination operations for ambulatory and non-ambulatory victims, determining if victims have been fully decontaminated, and completing reporting and documentation requirements of the AHJ.

7.4.4.2* Technical Decontamination.
Perform technical decontamination in support of entry operations and for ambulatory and non-ambulatory victims at a hazardous materials/WMD incident, given a hazardous materials/WMD incident requiring technical decontamination, an assignment in an IAP (formal or informal), and applicable policies and procedures, PPE, tools, and equipment provided by the AHJ, so that appropriate technical decontamination procedures are selected, set up, implemented, evaluated, and terminated, suitable PPE is used, safety procedures are followed, hazards are avoided or minimized, emergency responders are not contaminated, and personnel, tools, and equipment are decontaminated.

(A) Requisite Knowledge. Capabilities and limitations of available PPE, advantages and limitations of operations and methods of technical decontamination, applicable policies and procedures, tools and equipment provided by the AHJ, procedures for technical decontamination, safety precautions, procedures for communicating with crowds provided by the AHJ, and crowd management techniques,

(B) Requisite Skills. Selecting and using suitable PPE, selecting suitable technical decontamination procedure, setting up and implementing technical decontamination operations for ambulatory and non-ambulatory victims, determining if victims have been fully decontaminated, and completing reporting and documentation requirements of the AHJ.

7.4.5* Evidence Preservation and Public Safety Sampling.

7.5 Evaluating and Reporting Progress.
Evaluate the progress of the IAP for a hazardous materials/WMD incident, given a hazardous materials/WMD incident, an assignment in an IAP (formal and informal), an IAP, progress reports, and communication equipment provided by the AHJ, so that the actions taken are evaluated to determine whether the response objectives are being accomplished, the IAP is adjusted as needed, and progress of the IAP is communicated.
(A) **Requisite Knowledge.** Components of an IAP, the significance of the components of a progress report on evaluating progress of the IAP, resources for identifying improving, static, or deteriorating conditions based on the response objectives and response options set forth, and communication procedures and communication equipment provided by the authority having jurisdiction.

(B) **Requisite Skills.** Determining the whether the response objectives are being accomplished, communicating the status of response objectives using communications equipment provided by the AHJ, and revising an action plan based on conditions found during the incident status review.

### 7.6 Terminating the Incident.

Terminate a hazardous materials/WMD incident, given a hazardous materials/WMD incident, an assignment in an IAP (formal or informal), an assignment in an IAP (formal or informal), incident reports and supporting documentation, and applicable policies and procedures of the AHJ, so that assistance in scheduled debriefings and critiques of the incident are provided, required reports and supporting documentation are completed, and records required are filed and maintained.

(A) **Requisite Knowledge.** Purpose of debriefings and critiques, including key topics for debriefings and critiques, when they should take place, who should be involved, and what written documents to be prepared as a result of debriefings and critiques, reports and supporting documentation required by the AHJ, importance of reporting and documenting an incident, including what records are to be kept (personnel exposure records, debriefing records, and critique records) requirements for compiling records, including activity logs, exposure records, hot zone entry and exit logs, personal protective equipment logs, and requirements for filing documents and maintaining records.

(B) **Requisite Skills.** Communicating incident information as requested at a debriefing or critique, completing the reports and supporting documentation required by the AHJ, and filing and maintaining records required by the AHJ.

### Chapter 8 Incident Commander.

**Incident Commander.** The individual that is responsible for all incident activities, including the development of strategies and tactics and the ordering and the release of resources.

#### 8.1 General.

8.1.1 For qualification as an Incident Commander at a hazardous materials/WMD incident, the candidate shall meet the job performance requirements (JPRs) at the Awareness and Operations – Core levels, the general knowledge requirements (*), the general skill requirements (*), and the job performance requirements (JPRs) defined in Sections (*) through (*).

- Incident Analysis.
  - Hazard and Response Information Collection and Interpretation. (see 8.2.1)
  - Outcome Estimates. (see 8.2.2).
- Response Planning.
  - Response Objectives. (see 8.3.1)
8.1.2 General Knowledge Requirements. (Reserved)

8.1.3 General Skills Requirements. (Reserved)

8.2 Incident Analysis. Analyze a hazardous materials/WMD incident to determine the complexity of the problem and the potential outcomes.

8.2.1* Hazard and Response Information Collection and Interpretation.

Collect and interpret hazard and response information from sources other than the DOT Emergency Response Guidebook or a Safety Data Sheet (SDS), given a hazardous materials/WMD incident, an assignment in an IAP (formal or informal), resources including hazardous materials databases, monitoring equipment, reference manuals, technical information centers (i.e., CHEMTREC/CANUTEC/SETIQ and local, state, and federal authorities), and technical information specialists, applicable policies and procedures, and available tools and equipment including computers, printers, etc, so that hazard and response information is collected and interpreted.

(A) Requisite Knowledge. Types of hazard and response information available from specified resources including hazardous materials databases, monitoring equipment, reference manuals, technical information centers, technical information specialists, advantages and limitations of these resources, and significance and application of hazard and response terms including corrosive (acids and bases/alkaline), air reactivity, autorefrigiration, biological agents and biological toxins, blood agents, catalyst, chemical change, chemical interactions, compound, mixture, concentration, critical temperature and pressure, dissociation (acid/base), dose, dose response, expansion ratio, fire point, half-life, halogenated hydrocarbon, ignition (autoignition) temperature, inhibitor, instability, ionic and covalent compounds, irritants (riot control agents), maximum safe storage temperature (MSST), melting point and freezing point, miscibility, nerve agents, organic and inorganic, oxidation potential, physical change, polymerization, radioactivity, reactivity, riot control agents, saturated, unsaturated (straight and branched), and aromatic hydrocarbons, self-accelerating decomposition temperature (SADT), solubility, solution and slurry, strength, sublimation, temperature of product, vesicants (blister agents), viscosity, and volatility.

(B) Requisite Skills. Collecting and interpreting hazard and response information and explaining the significance and application of hazard and response terms.

8.2.2 Outcome Estimates.
Estimate the likely outcomes at a hazardous materials/WMD incident, given an incident involving hazardous materials/WMD, an assignment in an IAP (formal or informal), results of the incident size-up including weather conditions (current and projected), terrain, time of day, etc. (buildings, people, bodies of water, etc.), results of hazard and response information collection, results of air monitoring and sampling, condition of container, predicted behavior, printed and technical resources, computer databases, specialists in the field, and applicable policies and procedures, so that the size and shape of the endangered area are determined, number and types of exposures within the endangered area are identified, concentrations of materials within the endangered area are measured or predicted, physical, health, and safety hazards within the endangered area are identified, areas of potential harm in the endangered area are identified, potential outcomes within the areas of potential harm in endangered area are identified, and potential outcomes are communicated as necessary.

(A) Requisite Knowledge. Resources for dispersion pattern prediction and modeling including computers, monitoring equipment, or specialists in the field, methods for determining the dimensions of the endangered area, methods for identifying the number and types of exposures within the endangered area, methods for determining concentrations of materials within the endangered area, methods for identifying physical, health, and safety hazards within the endangered area, health hazard terms and exposure values and their significance in the analysis process including counts per minute (cpm) and kilocounts per minute (kcpm), immediately dangerous to life and health (IDLH) value, incubation period, infectious dose, lethal concentrations (LC50), lethal dose (LD50), parts per billion (ppb), parts per million (ppm), permissible exposure limit (PEL), radiation absorbed dose (rad), roentgen equivalent man (rem), millirem (mrem), microrem (μrem), threshold limit value ceiling (TLV-C), threshold limit value short-term exposure limit (TLV-STEL), threshold limit value time-weighted average (TLV-TWA), methods for identifying areas of potential harm within the endangered area, methods for identifying potential outcomes in the areas of potential harm within the endangered area, and procedures for communicating potential outcomes.

(B) Requisite Skills. Determining the dimensions of the endangered area, estimating the number of exposures within the endangered area, measuring or predicting concentrations of materials within the endangered area, estimating the physical, health, and safety hazards within the endangered area, identifying the areas of potential harm in the endangered area, estimating the potential outcomes within the areas of potential in endangered area, and communicating the potential outcomes.

8.3 Response Planning. Plan a response within the capabilities of available personnel, PPE, and control (tools and) equipment.

8.3.1 Response Objectives.

Develop response objectives and response options, given a hazardous materials/WMD incident, an assignment in an IAP (formal or informal), results of the incident size-up including incident-related information, life safety risks, environmental risks, and property risks, available resources, and applicable policies and procedures, so that response objectives are identified for the incident and response options are identified for each response objective.

(A) Requisite Knowledge. Steps for developing response objectives and for identifying response options for each objective.
(B) Requisite Skills. Developing response objectives for a hazardous materials incident and identifying response options for each objective.

8.3.2 PPE Approval.

Approve the level of personal protective equipment, given a hazardous materials/WMD incident, an assignment in an IAP, results of the incident size-up including incident-related information, life safety risks, environmental risks, and property risks, available resources, and applicable policies and procedures, so that levels of PPE are approved for each response option in the IAP.

(A) Requisite Knowledge. Four levels of personal protective equipment (specified by EPA/OSHA), equipment required for each level, application of each level, significance of degradation, penetration, and permeation on the selection of chemical-protective clothing, safety considerations for personnel working in personal protective equipment, and physiological and psychological stresses on users of personal protective equipment.

(B) Requisite Skills. Approving the level of PPE for response options specified in the IAP.

8.3.3 IAP Development.

Develop an IAP including site safety and control plan component, given a hazardous materials/WMD incident, an assignment in an IAP, results of the incident size-up including incident-related information, life safety risks, environmental risks, and property risks, available resources including ICS forms and documentation, and applicable policies and procedures, so that the plan is consistent with AHJ policies and procedures and within the capabilities of available personnel, personal protective equipment, and control equipment, strategic objectives are defined and communicated, safe operating practices and procedures are identified, a safety briefing is provided to all working on the incident, incident command structure is adjusted as necessary (from general to incident specific), resources are deployed to meet the goals of the plan, and the plan is documented in writing in the format established by the AHJ.

(A) Requisite Knowledge. NIMS, ICS, jurisdictional authority and boundaries, scope of responsibility for the IC and involved agencies, roles of various people and resources within the ICS, components of an IAP, applicable response objectives (strategies) and response options (tactics) for various types of incidents, safety considerations for incident operations, safety precautions for search and rescue missions, atmospheric and physical hazards associated with confined space operations, contents of a safety briefing, advantages, limitations, and use of decontamination methods including absorption, adsorption, chemical degradation, dilution, disinfecting, evaporation, isolation and disposal, neutralization, solidification, sterilization, vacuuming, and washing, and identification of approved personal protective equipment (JPR 8.3.2).

(B) Requisite Skills. Making effective decisions, using applicable ICS forms and documentation, prioritizing needs and actions based on rapidly changing conditions, and developing an incident safety plan.

8.4 IAP Implementation. Implement the planned response consistent with the IAP.

8.4.1 IMS/ICS Implementation.
Develop and manage an incident management organization capable of accomplishing strategic objectives, given a hazardous materials/WMD incident, an IAP, results of the incident size-up including incident-related information, life safety risks, environmental risks, and property risks, available resources including a communication system, and applicable policies and procedures, so that the IMS/ICS organization is established and maintained, applicable span of control is maintained, resources and personnel cooperating in incident objectives are obtained and managed effectively, adjustments are made in the command structure when necessary, and the command structure remains in place until the incident is terminated.

(A) Requisite Knowledge. NIMS, ICS, IMS forms and documentation, unity of command, knowledge of how an incident management team functions, policies and procedures of the AHJ, responsibilities and authority of the IC, command staff, and other personnel under NIMS IMS/ICS, elements of the National Response Framework, principles of unified command, procedures for ordering resources specific to the AHJ, communications protocols, kinds and type of resources available to the AHJ, resource management techniques, roles, and responsibilities, and authority of responders and response agencies available to the AHJ.

(B) Requisite Skills. Completing IMS/ICS forms and documentation, operating incident communications equipment, deploying applicable resources for incident-specific functions, and determining changing incident situations and matching the IMS/ICS structure and resources to meet them.

8.4.2 Communications.

Communicate relevant information to internal and external stakeholders, given a hazardous materials/WMD incident, an IAP, incident status information, available resources including a communication system, applicable policies and procedures, and internal and external stakeholders, so that support staff duties are delegated, incoming resources and section chiefs are briefed, hazardous situations are communicated, and incident objectives are validated and revised. [NFPA 1026, 2009]

(A) Requisite Knowledge. Potential internal and external stakeholders, AHJ communications SOPs, procedures for establishing communications systems, sources for communications equipment and technical assistance, difference between relevant and irrelevant information, and communications protocols. [NFPA 1026, 2009]

(B) Requisite Skills. Completing IMS/ICS forms and documentation, operating incident communications equipment, deploying applicable resources for incident-specific functions, and determining changing incident situations and matching the IMS/ICS structure and resources to meet them. [NFPA 1026, 2009]

8.4.3 Direct Resources.

Implement and monitor incident assignments, given a hazardous materials/WMD incident, incident assignments in an IAP, incident status information, available resources including a communication system, and applicable policies and procedures, so that organizational entities are established to accomplish tactical and support tasks, specific work tasks are assigned to specific individuals, applicable span of control is maintained, plans and/or assignments are modified as directed by incident conditions, resources needs for personnel assigned are obtained, and command and general staff are notified of changes necessary to the IAP. [NFPA 1026, 2009]
(A) **Requisite Knowledge.** IMS/ICS organization structure expansion procedures, communication skills, span of control procedures, tactics for the incident, accountability, and transfer of duty procedures. [NFPA 1026, 2009]

(B) **Requisite Skills.** Communicating by radio or other means and knowing accountability procedures and tactical operations specific to the incident. [NFPA 1026, 2009]

### 8.5 Evaluate Progress.

Evaluate the progress of the IAP and make adjustments as necessary, given a hazardous materials/WMD incident, an IAP, incident status information, available resources including a communication system, and applicable policies and procedures, so that changing incident conditions are identified, the effectiveness of the IAP is determined to be appropriate, plans and/or assignments are modified as directed by incident conditions, resource needs for personnel assigned are obtained, the IAP is kept current, and command and general staff are notified of changes necessary to the IAP.

(A) **Requisite Knowledge.** NIMS, ICS, IMS forms and documentation, unity of command, knowledge of how an incident management team functions, policies and procedures of the AHJ, responsibilities and authority of the IC, command staff, and other personnel under NIMS IMS/ICS, elements of the National Response Framework, principles of unified command, procedures for ordering resources specific to the AHJ, communications protocols, kinds and type of resources available to the AHJ, resource management techniques, roles, and responsibilities, and authority of responders and response agencies available to the AHJ.

(B) **Requisite Skills.** Completing IMS/ICS forms and documentation, operating incident communications equipment, deploying applicable resources for incident-specific functions, and determining changing incident situations and matching the IMS/ICS structure and resources to meet them.

### 8.6 Terminating the Incident.

#### 8.6.1 Transfer of Command.

Manage the transfer of command at an incident, given a hazardous materials/WMD incident, established command structure in an IAP, current incident status information, command post, incident documentation, available resources including a communication system (operational procedures), and applicable policies and procedures, so that incident information is exchanged, reports and plans for the subsequent operational period are completed, the new IC is fully briefed on the incident, and new incident management team members are identified to all personnel and stakeholders.

(A) **Requisite Knowledge.** Who are the affected internal and external stakeholders at an incident, transfer of command procedures, knowledge of how an incident management team functions, policies and procedures of the AHJ, responsibilities and authority of the IC, command staff, and other personnel under NIMS IMS/ICS, elements of the National Response Framework, principles of unified command, appropriate response objectives (strategies) and response options (tactics) for various types of incidents, capabilities of resources assigned to an incident, various command documentation used by the AHJ, principles of unified command, and identification of affected stakeholders.
(B) Requisite Skills. Completing ICS forms, developing and reading incident scene maps, recognizing the need to expand and/or transfer command in the IMS/ICS structure, reviewing and understanding documents use for transfer of command, and identifying affected stakeholders and determining perceived needs.

8.6.2 Debrief and Critiques.

Direct after-action review, debriefings, and critiques (internal or external), given a hazardous materials/WMD incident, incident records and reports, documentation procedures used by the AHJ, and personnel who were assigned to the incident, so that the effectiveness of incident operations is measured to improve future operations, completion of response objectives is determined, performance evaluations are discussed with subordinates and other participants, and after incident reports are prepared and submitted according to the AHJ.

(A) Requisite Knowledge. NIMS, IMS/ICS, purpose and operation of an IAP, components, key topics, and procedures for conducting a debriefing, components, and procedures for conducting a critiques, when a debriefing should take place, who should be involved in the debriefing, who should be involved in the critique, reporting requirements of federal, state, and local agencies, including training records, exposure records, incident reports, critique reports, activity log, standard operating procedures of the AHJ, and incident reporting and documentation procedures used by the AHJ (filing documents and maintaining records; legal documentation and chain of custody and continuity).

(B) Requisite Skills. Using form, programs, and equipment for documenting incident outcomes, conducting an after-action meeting (debriefing, internal critique, external critique), recording information during the course of a meeting, and handling people with strong or conflicting opinions.
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.1.1.1 Outside the United States, hazardous materials might be called dangerous goods (see Annex X). Weapons of mass destruction (WMD) are known by many different abbreviations and acronyms, including CBRNE (chemical, biological, radiological, nuclear, explosive), B-NICE (biological, nuclear, incendiary, chemical, explosive), COBRA (chemical, ordinance, biological, radiological agents), and NBC (nuclear, biological, chemical).

A.1.2 The committee believes that this document specifies the minimum job performance requirements for emergency response personnel to hazardous materials/weapons of mass destruction incidents given specific levels. The committee recognizes that emergency services organizations might have to invest considerable resources to provide the equipment and training needed to perform at hazardous materials/weapons of mass destruction incidents safely and efficiently. The committee does not mean to imply that organizations with limited resources cannot provide hazardous materials/weapons of mass destruction emergency response services, only that the individuals charged with performing hazardous materials/weapons of mass destruction responsibilities are qualified to specific levels according to this standard.

A.1.2.3 Organization/management responsibilities should be addressed by the agency that the emergency response personnel represent. The authority having jurisdiction should define the agency requirements for progression to positions of management responsibility.

A.1.2.5 See Annex B.

A.1.2.6 Continuing education or training is necessary to ensure that all remain current and up to date with their knowledge and skills by attending workshops and seminars, undergoing competency testing, participating in recurring proficiency evolutions, and/or accessing professional publications as determined by the AHJ. Nationally recognized certification is one means of demonstrating proficiency in current practices.

A.1.3.2 See Annex B.

A.1.3.3 It is recommended, where practical, that evaluators be individuals who were not directly involved as instructors for the requirement being evaluated.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the AHJ may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The AHJ may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase “authority having jurisdiction,” or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a police chief, sheriff, fire chief; fire marshal; chief of a fire prevention bureau, labor
department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

**A.3.2.3 Listed.** The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

**A.3.3.1 Allied Professional.** Examples could include Certified Safety Professional (CSP), Certified Health Physicist (CHP), Certified Industrial Hygienist (CIH), Radiation Safety Officer (RSO) or similar credentialed or competent individuals as determined by the AHJ. May also be referred to as a Subject Matter Expert (SME) in a mission-specific area. [472, 2013]

**A.3.3.8 Confined Space.** Additionally, a confined space is further defined as having one or more of the following characteristics:

1. The area contains or has the potential to contain a hazardous atmosphere, including an oxygen-deficient atmosphere.
2. The area contains a material with the potential to engulf a member.
3. The area has an internal configuration such that a member could be trapped by inwardly converging walls or a floor that slopes downward and tapers to a small cross section.
4. The area contains any other recognized serious hazard. [472, 2013]

**A.3.3.15 Control Zones.** Law enforcement agencies might utilize different terminology for site control, for example, inner and outer perimeters as opposed to hot or cold zones. The operations level responder should be familiar with the terminology and procedures used by the AHJ and coordinate on-scene site control operations with law enforcement.

Many terms are used to describe these control zones; however, for the purposes of this standard, these zones are defined as the hot, warm, and cold zones. [472, 2013]

**A.3.3.15.4 Warm Zone.** The warm zone includes control points for the decontamination corridor, thus helping to reduce the spread of contamination. This support may include staging of backup personnel and equipment, staging of evidence, and personnel and equipment decontamination. Additionally, portions of this area may be used as a safe refuge for initial patient evacuation and triage. [472, 2013]

**A.3.3.17 Decontamination.** There are two types of decontamination (commonly known as “decon”) performed by emergency responders: gross and technical. Gross decontamination is performed on the following:

1. Entry team members before their technical decontamination
2. Victims during emergency decontamination
3. Persons requiring mass decontamination

Technical decontamination is performed on entry team members. Decontamination sometimes performed on victims in a hospital setting is generally referred to as definitive decontamination, but is not covered in this standard.
The types of decontamination (except definitive decontamination) are further defined in A.3.3.17.1 through A.3.3.17.4. [472, 2013]

**A.3.3.17.1 Emergency Decontamination.** This process can be as simple as removal of outer or all garments from the individual to washing down with water from a fire hose or emergency safety shower. The sole purpose is to quickly separate as much of the contaminant as possible from the individual to minimize exposure and injury. [472, 2013]

**A.3.3.17.2 Gross Decontamination.** Victims of a hazardous material release that is potentially life threatening due to continued exposure from contamination are initially put through a gross decontamination, which will significantly reduce the amount of additional exposure. This is usually accomplished by mechanical removal of the contaminant or initial rinsing from handheld hose lines, emergency showers, or other nearby sources of water. Responders operating in a contaminated zone in personal protective equipment (PPE) are put through gross decontamination, which will make it safer for them to remove the PPE without exposure and for members assisting them. [472, 2013]

**A.3.3.17.3 Mass Decontamination.** Mass decontamination is initiated where the number of victims and time constraints do not allow the establishment of an in-depth decontamination process. Mass decontamination is a gross decontamination process utilizing large volumes of low-pressure water to reduce the level of contamination. A soap-and-water solution or universal decontamination solution would be more effective; however, availability of such solutions in sufficient quantities cannot always be ensured.

Extensive research into mass decontamination operations at terrorist incidents involving hazardous materials and chemical warfare agents has been conducted by the U.S. Army's Research, Development, and Engineering Command (RDECOM), and the resulting guidelines and documents are available on the Internet (see X.1.2.5).

Mass decontamination should be established quickly to reduce the harm being done to the victims by the contaminants. Initial operations will likely be through handheld hose lines or master streams supplied from fire apparatus while a more formal process is being set up. Examples of mass decontamination methods are the ladder pipe decontamination system and the emergency decontamination corridor system, both of which are described in RDECOM's guidelines. [472, 2013]

**A.3.3.17.4 Technical Decontamination.** Technical decontamination is the process subsequent to gross decontamination designed to remove contaminants from responders, their equipment, and victims. It is intended to minimize the spread of contamination and ensure responder safety. Technical decontamination is normally established in support of emergency responder entry operations at a hazardous materials incident, with the scope and level of technical decontamination based on the type and properties of the contaminants involved. In non life-threatening contamination incidents, technical decontamination can also be used on victims of the initial release. Examples of technical decontamination methods are the following:

1. Absorption
2. Adsorption
3. Chemical degradation
4. Dilution
5. Disinfecting
(6) Evaporation
(7) Isolation and disposal
(8) Neutralization
(9) Solidification
(10) Sterilization
(11) Vacuuming
(12) Washing

The specific decontamination procedure to be used at an incident is typically selected by a hazardous materials technician (see NFPA 472 - 7.3.4) and is subject to the approval of the incident commander. [472, 2013]

A.3.3.19 Demonstrate. This performance can be supplemented by simulation, explanation, illustration, or a combination of these. [472, 2013]

A.3.3.25 Exposure. The magnitude of exposure is dependent primarily on the duration of exposure and the concentration of the hazardous material. This term is also used to describe a person, animal, the environment, or a piece of equipment. The exposure can be external, internal, or both. [472, 2013]

A.3.3.26 Fissile Material. Department of Transportation (DOT) regulations define fissile material as plutonium-239, plutonium-242, uranium-233, uranium-235, or any combination of these radionuclides. This material is usually transported with additional shipping controls that limit the quantity of material in any one shipment. Packaging used for fissile material is designed and tested to prevent a fission reaction from occurring during normal transport conditions as well as hypothetical accident conditions. [472, 2013]

A.3.3.28 Hazardous Material. The following are explanations of several CBRN-related terms:

(1) *CBRN*. An abbreviation for chemicals, biological agents, and radiological particulate hazards.

(2) *CBRN terrorism agents*. Chemicals, biological agents, and radiological particulates that could be released as the result of a terrorist attack. Chemical terrorism agents include solid, liquid, and gaseous chemical warfare agents and toxic industrial chemicals. Chemical warfare agents include, but are not limited to, GB (Sarin), GD (Soman), HD (sulfur mustard), VX, and specific toxic industrial chemicals. Many toxic industrial chemicals (e.g., chlorine and ammonia) are identified as potential chemical terrorism agents because of their availability and the degree of injury they could inflict. Biological agents are bacteria, viruses, or the toxins derived from biological material.

(3) *Chemical terrorism agents*. Liquid, solid, gaseous, and vapor chemical warfare agents and toxic industrial chemicals used to inflict lethal or incapacitating casualties, generally on a civilian population as a result of a terrorist attack.

(4) *Biological terrorism agents*. Liquid or particulate agents that can consist of a biologically derived toxin or pathogen to inflict lethal or incapacitating casualties.

(5) *Radiological particulate terrorism agents*. Particles that emit ionizing radiation in excess of normal background levels used to inflict lethal or incapacitating casualties, generally on a civilian population, as the result of a terrorist attack.

(6) *Toxic industrial chemicals*. Highly toxic solid, liquid, or gaseous chemicals, which have
been identified as mass casualty threats that could be used to inflict casualties, generally on a civilian population, during a terrorist attack. [472, 2013]

A.3.3.29 Hazardous Materials Branch/Group. This function is directed by a hazardous materials officer and deals principally with the technical aspects of the incident. [472, 2013]

A.3.3.30 Hazardous Materials Officer. This individual might also serve as a technical specialist for incidents that involve hazardous materials/WMD. [472, 2013]

A.3.3.31 Hazardous Materials Response Team (HMRT). The team members respond to releases or potential releases of hazardous materials/WMD for the purpose of control or stabilization of the incident. [472, 2013]

A.3.3.32 Hazardous Materials Safety Officer. The hazardous materials safety officer will be called on to provide technical advice or assistance regarding safety issues to the hazardous materials officer and incident safety officer at a hazardous materials/WMD incident. [472, 2013]

A.3.3.33 Hazardous Materials Technician. These persons might have additional competencies that are specific to their response mission, expected tasks, and equipment and training as determined by the AHJ. [472, 2013]

A.3.3.33.1 Hazardous Materials Technician with a Cargo Tank Specialty. The hazardous materials technicians are expected to use specialized chemical-protective clothing and specialized control equipment. [472, 2013]

A.3.3.33.3 Hazardous Materials Technician with an Intermodal Tank Specialty. See A.3.3.33.1. [472, 2013]

A.3.3.33.4 Hazardous Materials Technician with a Tank Car Specialty. See A.3.3.33.1. [472, 2013]

A.3.3.36 Incident Commander (IC). This position is equivalent to the on-scene incident commander as defined in OSHA 1910.120(8), Hazardous Waste Operations and Emergency Response. The IC has overall authority and responsibility for conducting incident operations and is responsible for the management of all incident operations at the incident site. [472, 2013]

A.3.3.38 Incident Management System (IMS). The IMS provides a consistent approach for all levels of government, private sector, and volunteer organizations to work effectively and efficiently together to prepare for, respond to, and recover from domestic incidents, regardless of cause, size, or complexity. An IMS provides for interoperability and compatibility among all capability levels of government, the private sector, and volunteer organizations. The IMS includes a core set of concepts, principles, terminology, and technologies covering the incident command system, multiagency coordination systems, training, and identification and management of resources. [472, 2013]

A.3.3.40 Material Safety Data Sheet (MSDS). Under the Global Harmonization System, the MSDS is known as an SDS (Safety Data Sheet) and contains more detailed information. [472, 2013]

A.3.3.43 Packaging. Packaging for hazardous materials includes bulk and nonbulk packaging. [472, 2013]

A.3.3.43.1 Bulk Packaging. Bulk packaging can be either placed on or in a transport vehicle or vessel or constructed as an integral part of the transport vehicle. [472, 2013]

A.3.3.43.3 Radioactive Materials Packaging. Excepted packaging is packaging used to transport materials with extremely low levels of radioactivity that meet only general design
requirements for any hazardous material. Excepted packaging ranges from a product’s fiberboard box to a sturdy wooden or steel crate, and typical shipments include limited quantities of materials, instruments, and articles such as smoke detectors. Excepted packaging will contain non-life-endangering amounts of radioactive material.

Industrial packaging is used to transport materials that present limited hazard to the public and environment. Examples of these materials are contaminated equipment and radioactive waste solidified in materials such as concrete. This packaging is grouped into three categories (IP-1, IP-2, IP-3), based on the strength of packaging. Industrial packaging will contain non-life-endangering amounts of radioactive material.

Type A packaging is used to transport radioactive materials with concentrations of radioactivity not exceeding the limits established in 49, CFR, Part 173.431. Typically, Type A packaging has an inner containment vessel made of glass, plastic, or metal and packing material made of polyethylene, rubber, or vermiculite. Examples of materials shipped in Type A packaging include radiopharmaceuticals and low-level radioactive waste. Type A packaging will contain non-life-endangering amounts of radioactive material.

Type B packaging is used to transport radioactive materials with radioactivity levels higher than those allowed in Type A packaging, such as spent fuel and high-level radioactive waste. Limits on activity contained in a Type B packaging are provided in Title 49, CFR 173.431. Type B packaging ranges from small drums [55 gal (208 L)], to heavily shielded steel casks that sometimes weigh more than 98 tons (100 metric tons). Type B packaging can contain potentially life-endangering amounts of radioactive material.

Type C packaging is used for consignments, transported by aircraft, of high-activity radioactive materials that have not been certified as “low dispersible radioactive material” (including plutonium). They are designed to withstand severe accident conditions associated with air transport without loss of containment or significant increase in external radiation levels. The Type C packaging performance requirements are significantly more stringent than those for Type B packaging. Type C packaging is not authorized for domestic use but can be authorized for international shipments of these high-activity radioactive material consignments. Regulations require that both Type B and Type C packaging be marked with a trefoil symbol to ensure that the package can be positively identified as carrying radioactive material. The trefoil symbol must be resistant to the effects of both fire and water so that it will be likely to survive a severe accident and serve as a warning to emergency responders.

The performance requirements for Type C packaging include those applicable to Type B packaging with enhancements on some tests that are significantly more stringent than those for Type B packaging. For example, a 200 mph (321.8 km/hr) impact onto an unyielding target is required instead of the 30 ft (9.1 m) drop test required of a Type B packaging; a 60-minute fire test is required instead of the 30-minute test for Type B packaging; and a puncture/tearing test is required. These stringent tests are expected to result in packaging designs that will survive more severe aircraft accidents than Type B packaging designs. [472, 2013]

**A.3.3.46 Personal Protective Equipment.** Personal protective equipment includes both personal protective clothing and respiratory protection. Adequate personal protective equipment should protect the respiratory system, skin, eyes, face, hands, feet, head, body, and hearing. [472, 2013] Personal protective equipment includes both personal protective clothing and respiratory protection. Adequate personal protective equipment should protect the respiratory system, skin, eyes, face, hands, feet, head, body, and hearing.
A.3.3.48.1 **Emergency Response Plan.** Emergency response plans can be developed at organizational, agency, local, state, and federal levels. [472, 2013]

A.3.3.48.2 **Incident Action Plan.** It can include the identification of operational resources and assignments. It can also include attachments that provide direction and important information for management of the incident during one or more operational periods. [472, 2013]

A.3.3.49 **Planned Response.** The following site safety plan considerations are from the EPA’s Standard Operating Safety Guides:

1. Site description
2. Entry objectives
3. On-site organization
4. On-site control
5. Hazard evaluations
6. Personal protective equipment
7. On-site work plans
8. Communication procedures
9. Decontamination procedures
10. Site safety and health plan [472, 2013]

3.3.XX **Policies and procedures.** Personal protective equipment includes both personal protective clothing and respiratory protection. Adequate personal protective equipment should protect the respiratory system, skin, eyes, face, hands, feet, head, body, and hearing.

A.3.3.50 **Protective Clothing.** Protective clothing is divided into three types:

1. Structural fire-fighting protective clothing
2. High temperature–protective clothing
3. Chemical-protective clothing
   - (a) Liquid splash–protective clothing
   - (b) Vapor-protective clothing [472, 2013]

A.3.3.50.1 **Chemical-Protective Clothing.** Chemical-protective clothing (garments) can be constructed as a single- or multipiece garment. The garment can completely enclose the wearer either by itself or in combination with the wearer's respiratory protection, attached or detachable hood, gloves, and boots. [472, 2013]

A.3.3.50.2 **High Temperature–Protective Clothing.** This type of clothing is usually of limited use in dealing with chemical commodities. [472, 2013]

A.3.3.50.3 **Liquid Splash–Protective Clothing.** This type of protective clothing is a component of EPA Level B chemical protection. Liquid splash–protective clothing should meet the requirements of NFPA 1992, *Standard on Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies*. [472, 2013]

A.3.3.50.4 **Structural Fire-Fighting Protective Clothing.** Structural fire-fighting protective clothing provides limited protection from heat but might not provide adequate protection from the harmful gases, vapors, liquids, or dusts that are encountered during hazardous materials/WMD incidents. [472, 2013]
A.3.3.50.5 Vapor-Protective Clothing. This type of protective clothing is a component of EPA Level A chemical protection. Vapor-protective clothing should meet the requirements of NFPA 1991, Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies. [472, 2013]

A.3.3.52 Respiratory Protection. Respiratory protection is divided into three types:

1. Positive pressure self-contained breathing apparatus
2. Positive pressure air-line respirators
3. Air-purifying respirators [472, 2013]

A.3.3.53 Response. The activities in the response portion of a hazardous materials/WMD incident include analyzing the incident, planning the response, implementing the planned response, evaluating progress, and terminating the emergency phase of the incident. [472, 2013]

A.3.3.58.1 Specialist Employee A. Consistent with the organization's emergency response plan and/or standard operating procedures, the specialist employee A is able to analyze an incident involving chemicals within the organization's area of specialization, plan a response to that incident, implement the planned response within the capabilities of the resources available, and evaluate the progress of the planned response. Specialist employees are those persons who, in the course of their regular job duties, work with or are trained in the hazards of specific chemicals or containers within their organization's area of specialization. In response to emergencies involving hazardous materials/WMD in their organization's area of specialization, they could be called on to provide technical advice or assistance to the incident commander relative to specific chemicals or containers for chemicals. Specialist employees should receive training or demonstrate competency in their area of specialization annually. Specialist employees also should receive additional training to meet applicable DOT, OSHA, EPA, and other appropriate state, local, or provincial occupational health and safety regulatory requirements. Specialist employees respond to hazardous materials/WMD incidents under differing circumstances. They respond to incidents within their facility, inside and outside their assigned work area, and outside their facility.Persons responding away from the facility or within the facility outside their assigned work area respond as members of a hazardous materials response team or as specialist employees as outlined in this definition and in NFPA 472, Chapter 9. When responding to incidents away from their assigned work area, specialist employees should be permitted to perform only at the response level at which they have been trained. Persons responding to a hazardous materials/WMD incident within their work area are not required to be trained to the levels specified by this chapter. Persons within their work area who have informed the incident management structure of an emergency as defined in the emergency response plan who have adequate personal protective equipment and adequate training in the procedures they are to perform and who have employed the buddy system can take limited action in the danger area (e.g., turning a valve) before the emergency response team arrives. The limited action taken should be addressed in the emergency response plan. Once the emergency response team arrives, these persons should be restricted to the actions that their training level allows and should operate under the incident command structure. [472, 2013]

A.3.3.58.2 Specialist Employee B. Because of the employee's education, training, or work experience, the specialist employee B can be called on to respond to incidents involving specific chemicals or containers. The specialist employee B can be used to gather and record information, provide technical advice, and provide technical assistance (including work within the hot zone)
at the incident consistent with the organization's emergency response plan and/or standard
operating procedures and the emergency response plan. See NFPA 472 - 3.3.47.1. [472, 2013]

A.3.3.58.3 Specialist Employee C. Consistent with the organization's emergency response plan
and/or standard operating procedures, the specialist employee C can be called on to gather and
record information, provide technical advice, and/or arrange for technical assistance. A specialist
employee C does not enter the hot or warm zone at an emergency. See NFPA 472 - 3.3.15. [472,
2013]

A.3.3.60 Termination. Termination is divided into three phases: debriefing the incident, post
incident analysis, and critiquing the incident. [472, 2013]

A.3.3.61 UN/NA Identification Number. United Nations (UN) numbers are four-digit numbers
used in international commerce and transportation to identify hazardous chemicals or classes of
hazardous materials. These numbers generally range between 0000 and 3500 and usually are
preceded by the letters “UN” (e.g., “UN1005”) to avoid confusion with number codes.
North American (NA) numbers are identical to UN numbers. If a material does not have a UN
number, it may be assigned an NA number. These usually are preceded by “NA” followed by a
four-digit number starting with 8 or 9. [472, 2013]

A.3.3.63 Weapon of Mass Destruction (WMD). The source of this definition is 18 USC
2332a. [472, 2013]

A.3.3.63.1 Radiological Weapons of Mass Destruction. The intent of this annex material is to
provide information on the different types of radiological/nuclear devices that can be used as a
weapon by those with malicious intent. [472, 2013]

A.3.3.63.1.1 Radiation Exposure Device. Sealed source means radioactive material encased in
a capsule or closely bonded to another material in order to contain the radioactive material and
prevent its leakage or escape under normal conditions of intended use. Radioactive material may
be in a sealed or unsealed (dispersible) form. Shipments of sealed and dispersible forms of
radioactive material are made in accordance with Department of Transportation regulations in a
variety of packaging dependent on the physical and chemical form of the material, quantity of
radioactive material present, and associated radiation levels on the exterior of the packaging. An
RED may cause a few deaths, but normally would not cause widespread radiological
contamination.

An RED may be concealed in public transportation (under a bus or subway seat), a busy
shopping mall (the food court, for example), movie theater, or any other location where a large
number of people may sit, stand, or pass close by individuals who come in contact with, touch,
or sit on a radioactive material container do not become contaminated. The danger is from
exposure, for extended periods of time, to high levels of radiation close to the radioactive
material or generating device. If radioactive material was used in the RED and it was to break
open, some of the radioactive material could be released, causing contamination. If this occurs,
the RED becomes a Radiological Dispersal Device (RDD), and people coming in contact with
the radioactive material could spread contamination elsewhere. [472, 2013]

A.3.3.64.2 Radiation Dispersal Device. Any device that intentionally spreads radioactive
material across an area with the intent to cause harm, without a nuclear explosion occurring. An
RDD that uses explosives for spreading or dispersing radioactive material is commonly referred
to as a “dirty bomb” or “explosive RDD.” Non-explosive RDDs could spread radioactive
material using common items such as pressurized containers, fans, building air-handling systems, sprayers, crop dusters, or even spreading by hand. [472, 2013]

**A.3.3.64.3 Improvised Nuclear Device.** The nuclear explosion from an IND produces extreme heat, powerful shockwaves, and prompt radiation that would be acutely lethal for a significant distance. It also produces potentially lethal radioactive fallout, which may spread and deposit over very large areas. A nuclear detonation in an urban area could result in over 100,000 fatalities (and many more injured), massive infrastructure damage, and thousands of square kilometers of contaminated land. If the IND fails to work correctly and does not create a nuclear explosion, then the detonation of the conventional explosives would likely disperse radioactive material like an explosive Radiological Dispersal Device (RDD). [472, 2013]

**A.3.4.4 Operations Level Responders.** The source of this definition is 29 CFR 1910.120. These responders can have additional competencies that are specific to their response mission, expected tasks, and equipment and training as determined by the AHJ. [472, 2013]

**A.4.2(A)** Including indicators of terrorist attacks and other potentials. Instructors should emphasize that if you can smell it, taste it or feel it you are now (or may be) part of the problem.

**A.4.3(B)** Including evacuation and protect-in-place.

**A.4.4 Wear assigned safety and PPE provided as required by AHJ policies and procedures; define monitoring**

**A.4.4(A)** Liquid-splash protective clothing and vapor-protective clothing are examples of chemical protective clothing.

**A.4.4(B)** Something about wearing assigned safety and PPE provided by the AHJ.

**A.5.2 Minimum list of references sources to be identified in Annex, including material safety data sheets, other reference sources, shipper/manufacturer contacts, the Emergency Response Guidebook, CHEMTREC/ CANUTEC/SETIQ and governmental authorities, items that are included in a survey – location, weather conditions, topography, populated buildings, bodies of water, other buildings, remedial actions taken, container/ package, contents, release, terms with significance and effect on behavior.**

**A.5.2(A)** From material safety data sheets, other reference sources, shipper/manufacturer contacts, the Emergency Response Guidebook, CHEMTREC/ CANUTEC/SETIQ and governmental authorities, methods for describing the potential behavior of the hazardous material and its container in the incident, process for estimating outcomes; need to differentiate between estimating and potential harm used under requisite skills

**A.5.2(B)** Weather conditions current and projected, terrain, time of day, etc, from material safety data sheets, other reference sources, shipper/manufacturer contacts, the Emergency Response Guidebook, CHEMTREC/ CANUTEC/SETIQ and governmental authorities.

**A.5.3 Results of the size-up – an indication of the risk assessment], the ERG or other reference sources may provide operations level responders with the actions to be followed in the initial response to a hazardous material incident. The recommendations provided in the ERG or equivalent guides can be used as the basis for an incident action plan. Operations Level responders are not expected to formalize an incident action plan or implement an incident action plan as an incident commander
A.5.3(A) Need to know what information is going to be provided from the action plan and how - explain that planning must be accomplished to meet an assignment – decisions about objectives, options, safety procedures, etc. -- even though they may not be formalized, including positive pressure self-contained breathing apparatus, positive pressure air-line respirator with required escape unit, closed circuit SCBA, powered air-purifying respirator (PAPR), air-purifying respirator (APR), and particulate respirator, including chemical protective clothing (liquid-splash protective clothing and vapor-protective clothing), high-temperature protective clothing (proximity and entry suits), and structural firefighting protective clothing.

A.5.4(A) Over and above what is discussed at the awareness level

A.5.5 Emergency decontamination is the physical process of immediately reducing contamination of individuals in potentially life-threatening situations with or without the formal establishment of a decontamination corridor. That can be decontaminated by firefighters in firefighting PPE with equipment readily available to firefighters See 6.3.1.1 and 6.3.1.2.

A.5.6 Methods of exposure protection during decontamination.

A.5.6(A) Provide examples of resources

A.6.2(B) This includes using the incident action plan (including product involved), policies and procedures for PPE, and other resources available.

A.6.3.1(A) Explanation

A.6.3.1(B) Select the PPE required to support mass decontamination based on local procedures, using resources available – list resources, victims – defined to include animals

A.6.3.2(A) Explanation

A.6.3.2(B) Select the PPE required to support technical decontamination based on local procedures, using resources available – list resources, victims – defined to include animals

A.6.4 Criminal statutes could include local, state, or federal statutes, such as 18 USC § 2332a - Use of weapons of mass destruction

A.6.5.1 Absorption, adsorption, damming, diking, dilution, diversion, retention, remote valve shut-off, vapor dispersion, and vapor suppression; control of fire or not?; with WMD type incidents, multiple variables may be present and multiple modes of product control may need to be performed. Spill control and leak control; based on product(s) involved, applicable policies and procedures and available personnel, PPE, and control equipment, including foam, provided by the AHJ

A.6.5.1(A) Absorption, adsorption, damming, diking, dilution, diversion, retention, remote valve shut-off, vapor dispersion, and vapor suppression: Aqueous film-forming foam, alcohol-resistant foam, fluoroprotein foam, high-expansion foam, special purpose or hazard suppressing foams or agents supplied by the AHJ
A.6.5.1(B) Meet requirements of JPR 6.2]; List other “agents”; Absorption, adsorption, damming, diking, dilution, diversion, retention, remote valve shut-off, vapor dispersion, and vapor suppression; using available tools and equipment and following policies and procedures of the AHJ.

A.6.5.2 Including fixed facility or transportation situations; based on product(s) involved, applicable policies and procedures and available personnel, PPE, control equipment, and extinguishing agents (including foams) provided by the AHJ; explanation of proper control method options which include, but are not limited to, withdrawal, letting the fire burn, as well as using extinguishing foams and agents.

A.6.5.2(A) Aqueous film-forming foam, alcohol-resistant foam, fluoroprotein foam, high-expansion foam, special purpose or hazard suppressing foams or agents supplied by the AHJ.

A.6.5.3 Including fixed facility or transportation situations; based on product(s) involved, applicable policies and procedures and available personnel, PPE, control equipment, and extinguishing agents provided by the AHJ; Explanation of proper control method options which include, but are not limited to, withdrawal, letting the fire burn, as well as using extinguishing foams and agents.

A.6.5.3(A) Including contacts to have shut off devices activated on pipeline, distribution; considerations for product control prior to extinguishment as to avoid reignition or flash conditions, i.e., control the release before you put the fire out.

A.6.6 Explanation of air monitoring, detection, and sampling; within the capabilities of available personnel, PPE, and tools, air monitoring, detection, and sampling equipment; examples, in an atmosphere where there is a risk of dust explosion, ignition sources are eliminated and or isolated – intrinsically safe equipment.

A.6.6(A) Identify “process”.

A.6.7(A) Risk vs. benefit, available personnel and rescue equipment; self directed rescue, directed rescue.

A.6.8(A) Definitions of types of laboratories

A.6.8(B) Define tactical enforcement personnel decontamination above technical decontamination.

A.7.2.1 Capacity of the containers is determined using markings on the container, shipping papers accompanying the shipment in transportation, or facility documentation or resources.

A.7.2.4 Specific minimum resources to be listed in Annex.

A.7.2.4(A) which ones – specific NIOSH Pocket Guide, CHRIS minimum standard.

A.7.2.5(B) Might have to use protective equipment to determine actual quantity of material and pressure involved; might have to use detection equipment to determine whether a breach has occurred - JPR on air monitoring which brings in the PPE issue.

A.7.3.1 Defensive, offensive, nonintervention.

A.7.3.2 Clothing, hood, boots, gloves designed to protect the wearer’s torso, head, arms, legs,
hands, and feet from hazardous materials” – see definition 3.3.46 and 3.3.50, specifically .1 - .5) and any specialized PPE provided by the AHJ.

A.7.3.3 Decontamination operations include emergency, mass, technical, equipment. Decontamination methods include absorption, adsorption, chemical degradation, dilution, disinfecting, evaporation, isolation and disposal, neutralization, solidification, sterilization, vacuuming, and washing.

A.7.4.1 Duties of those A.7.4.1. Role of the HMT.

A. 7.4.2 Respiratory protection and liquid splash-protective and vapor-protective chemical-protective clothing ensembles and any other specialized PPE provided by the AHJ.

A.7.4.3 Product control includes the procedures, techniques, and methods used in the mitigation of hazardous materials/weapons of mass destruction (WMD) incidents, including containment, extinguishment, and confinement. Confinement is keeping a material, once released, in a defined or local area. Containment includes the actions taken to keep a material in its container (e.g., stop a release of the material or reduce the amount being released). Extinguishment is not defined in 472.

A.7.4.3.1 Control of fire; with WMD type incidents, multiple variables may be present and multiple modes of product control may need to be performed. Spill control and leak control; based on product(s) involved, applicable policies and procedures and available personnel, PPE, and control equipment, including foam, provided by the AHJ.

A.7.4.3.1(A) Aqueous film-forming foam, alcohol-resistant foam, fluoroprotein foam, high-expansion foam, special purpose or hazard suppressing foams or agents supplied by the AHJ; identify other “agents”.

A.7.4.3.1(B) Absorption, adsorption, damming, diking, dilution, diversion, retention, remote valve shut-off, vapor dispersion, and vapor suppression. Using available tools and equipment and following policies and procedures of the AHJ.

A.7.4.3.2 Including fixed facility or transportation situations; based on product(s) involved, applicable policies and procedures and available personnel, PPE, control equipment, and extinguishing agents (including foams) provided by the AHJ; Explanation of proper control method which include, but are not limited to, withdrawal, letting the fire burn, as well as using extinguishing foams and agents.

A.7.4.3.2(A) Aqueous film-forming foam, alcohol-resistant foam, fluoroprotein foam, high-expansion foam, special purpose or hazard suppressing foams or agents supplied by the AHJ.

A.7.4.3.3 Including fixed facility or transportation situations; based on product(s) involved, applicable policies and procedures and available personnel, PPE, control equipment, and extinguishing agents provided by the AHJ; explanation of proper control method which include, but are not limited to, withdrawal, letting the fire burn, as well as using extinguishing foams and agents.

A.7.4.3.3(A) Including contacts to have shut off devices activated on pipeline, distribution; considerations for product control prior to extinguishment as to avoid reignition or flash conditions, i.e., control the release before you put the fire out.
A.7.4.3.2 Define pressure vessels, pressure container.

A.7.4.3.4 Need to define “other” method

A.7.4.4.2 Is this too much to meet 7.3.5.5. And if so, what stays and what goes – Salient part go to Monitoring section – rest will be deleted.

A.7.4.5 Explanation of evidence preservation and sampling; aimed at law enforcement, regulatory agencies, etc. Material identical to Chapter 6 material for same topic

A. 8.2.1 Specific minimum resources to be listed in Annex.

A.8.3.1 Defensive, offensive, nonintervention.

Annex B Explanation of the Standard and Concepts of JPRs

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Explanation of the Standard and Concepts of Job Performance Requirements (JPRs).

The primary benefit of establishing national professional qualification standards is to provide both public and private sectors with a framework of the job requirements for the fire service. Other benefits include enhancement of the profession, individual as well as organizational growth and development, and standardization of practices.

NFPA professional qualifications standards identify the minimum JPRs for specific fire service positions. The standards can be used for training design and evaluation, certification, measuring and critiquing on-the-job performance, defining hiring practices, and setting organizational policies, procedures, and goals. (Other applications are encouraged.)

Professional qualifications standards for a specific job are organized by major areas of responsibility defined as duties. For example, the fire fighter’s duties might include fire suppression, rescue, and water supply, and the public fire educator’s duties might include education, planning and development, and administration. Duties are major functional areas of responsibility within a job.

The professional qualifications standards are written as JPRs. JPRs describe the performance required for a specific job. JPRs are grouped according to the duties of a job. The complete list of JPRs for each duty defines what an individual must be able to do in order to successfully perform that duty. Together, the duties and their JPRs define the job parameters — that is, the standard as a whole is a description of a job.

B.2 Breaking Down the Components of a JPR.

The JPR is the assembly of three critical components. (See Table B.2.) These components are as follows:
Table B.2  Example of a JPR

<table>
<thead>
<tr>
<th>(1) Task</th>
<th>(1) Ventilate a pitched roof</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2) Tools, equipment, or materials</td>
<td>(2) Given an ax, a pike pole, an extension ladder, and a roof ladder</td>
</tr>
<tr>
<td>(3) Evaluation parameters and performance outcomes</td>
<td>(3) So that a 4 ft × 4 ft (1.22 m × 1.22 m) hole is created; all ventilation barriers are removed; ladders are properly positioned for ventilation; ventilation holes are correctly placed; and smoke, heat, and combustion by-products are released from the structure</td>
</tr>
</tbody>
</table>

B.2.1  The Task to Be Performed. The first component is a concise, brief statement of what the person is supposed to do.

B.2.2  Tools, Equipment, or Materials That Must be Provided to Successfully Complete the Task. This component ensures that all individuals completing the task are given the same minimal tools, equipment, or materials when being evaluated. By listing these items, the performer and evaluator know what must be provided in order to complete the task.

B.2.3  Evaluation Parameters and/or Performance Outcomes. This component defines how well one must perform each task — for both the performer and the evaluator. The JPR guides performance towards successful completion by identifying evaluation parameters and/or performance outcomes. This portion of the JPR promotes consistency in evaluation by reducing the variables used to gauge performance.

In addition to these three components, the JPR contains requisite knowledge and skills. Just as the term requisite suggests, these are the necessary knowledge and skills one must have prior to being able to perform the task. Requisite knowledge and skills are the foundation for task performance.

Once the components and requisites are put together, the JPR might read as follows.

B.2.3.1  Example 1. The Fire Fighter I shall ventilate a pitched roof, given an ax, a pike pole, an extension ladder, and a roof ladder, so that a 4 ft × 4 ft (1.22 m × 1.22 m) hole is created, all ventilation barriers are removed, ladders are properly positioned for ventilation, and ventilation holes are correctly placed.

(A)  Requisite Knowledge. Pitched roof construction, safety considerations with roof ventilation, the dangers associated with improper ventilation, knowledge of ventilation tools, the effects of ventilation on fire growth, smoke movement in structures, signs of backdraft, and the knowledge of vertical and forced ventilation.
(B) Requisite Skills. The ability to remove roof covering; properly initiate roof cuts; use the pike pole to clear ventilation barriers; use ax properly for sounding, cutting, and stripping; position ladders; and climb and position self on ladder.

B.2.3.2 Example 2. The Fire Investigator shall interpret burn patterns, given standard equipment and tools and some structural/content remains, so that each individual pattern is evaluated with respect to the burning characteristics of the material involved.

(A) Requisite Knowledge. Knowledge of fire development and the interrelationship of heat release rate, form, and ignitibility of materials.

(B) Requisite Skills. The ability to interpret the effects of burning characteristics on different types of materials.

B.3 Examples of Potential Uses.

B.3.1 Certification. JPRs can be used to establish the evaluation criteria for certification at a specific job level. When used for certification, evaluation must be based on the successful completion of JPRs.

First, the evaluator would verify the attainment of requisite knowledge and skills prior to JPR evaluation. Verification might be accomplished through documentation review or testing.

Next, the candidate would be evaluated on completing the JPRs. The candidate would perform the task and be evaluated based on the evaluation parameters, the performance outcomes, or both. This performance-based evaluation can be either practical (for psychomotor skills such as “ventilate a roof”) or written (for cognitive skills such as “interpret burn patterns”).

Note that psychomotor skills are those physical skills that can be demonstrated or observed. Cognitive skills (or mental skills) cannot be observed, but are rather evaluated on how one completes the task (process oriented) or the task outcome (product oriented).

Using Example 1, a practical performance-based evaluation would measure one’s ability to “ventilate a pitched roof.” The candidate passes this particular evaluation if the standard was met — that is, a 4 ft × 4 ft (1.22 m × 1.22 m) hole was created; all ventilation barriers were removed; ladders were properly positioned for ventilation; ventilation holes were correctly placed; and smoke, heat, and combustion by-products were released from the structure.

For Example 2, when evaluating the task “interpret burn patterns,” the candidate could be given a written assessment in the form of a scenario, photographs, and drawings and then be asked to respond to specific written questions related to the JPR’s evaluation parameters.

Remember, when evaluating performance, you must give the person the tools, equipment, or materials listed in the JPRs — for example, an ax, a pike pole, an extension ladder, and a roof ladder — before he or she can be properly evaluated.

B.3.2 Curriculum Development/Training Design and Evaluation. The statements contained in this document that refer to job performance were designed and written as JPRs. Although a resemblance to instructional objectives might be present, these statements should not be used in a teaching situation until after they have been modified for instructional use.
JPRs state the behaviors required to perform specific skill(s) on the job, as opposed to a learning situation. These statements should be converted into instructional objectives with behaviors, conditions, and standards that can be measured within the teaching/learning environment. A JPR that requires a fire fighter to “ventilate a pitched roof” should be converted into a measurable instructional objective for use when teaching the skill. [See Figure B.3.2(a).]

****INSERT FIGURE HERE****

FIGURE B.3.2(a) Converting JPRs into Instructional Objectives.

Using Example 1, a terminal instructional objective might read as follows:

The learner will ventilate a pitched roof, given a simulated roof, an ax, a pike pole, an extension ladder, and a roof ladder, so that 100 percent accuracy is attained on a skills checklist. (At a minimum, the skills checklist should include each of the measurement criterion from the JPRs.)

Figure B.3.2(b) is a sample checklist for use in evaluating this objective.

****INSERT FIGURE HERE****

FIGURE B.3.2(b) Sample Skills Checklist.

While the differences between JPRs and instructional objectives are subtle in appearance, the purpose of each statement differs greatly. JPRs state what is necessary to perform the job in the “real world.” Instructional objectives, however, are used to identify what students must do at the end of a training session and are stated in behavioral terms that are measurable in the training environment.

By converting JPRs into instructional objectives, instructors will be able to clarify performance expectations and avoid confusion related to using statements designed for purposes other than teaching. Additionally, instructors will be able to add local/state/regional elements of performance into the standards as intended by the developers.

Requisite skills and knowledge should be converted into enabling objectives. These help to define the course content. The course content would include each of the requisite knowledge and skills. Using the above example, the enabling objectives would be pitched roof construction, safety considerations with roof ventilation, removal of roof covering, properly initiated roof cuts, and so on. This ensures that the course content supports the terminal objective.

Note that it is assumed that the reader is familiar with curriculum development or training design and evaluation.

B.4 Other Uses.

While the professional qualifications standards are principally used to guide the development of training and certification programs, there are a number of other potential uses for the documents. Because the documents are written in JPR terms, they lend themselves well to any area of the profession where a level of performance or expertise must be determined. These areas might include the following:
(1) **Employee Evaluation/Performance Critiquing.** The JPRs can be used as a guide by both the supervisor and the employee during an evaluation. The JPRs for a specific job define tasks that are essential to perform on the job as well as the evaluation criteria to measure when those tasks are completed.

(2) **Establishing Hiring Criteria.** The professional qualifications standards can be used in a number of ways to further the establishment of hiring criteria. The AHJ could simply require certification at a specific job level — for example, Fire Fighter I. The JPRs could also be used as the basis for pre-employment screening by establishing essential minimal tasks and the related evaluation criteria. An added benefit is that individuals interested in employment can work towards the minimal hiring criteria at local colleges.

(3) **Employee Development.** The professional qualifications standards can be useful to both the employee and the employer in developing a plan for the individual’s growth within the organization. The JPRs and the associated requisite knowledge and skills can be used as a guide to determine additional training and education required for the employee to master his or her job or profession.

(4) **Succession Planning.** Succession planning or career pathing addresses the efficient placement of people into jobs in response to current needs and anticipated future needs. A career development path can be established for targeted individuals to prepare them for growth within the organization. The JPRs and requisite knowledge and skills could then be used to develop an educational path to aid in the individual’s advancement within the organization or profession.

(5) **Establishing Organizational Policies, Procedures, and Goals.** The JPRs can be incorporated into organizational policies, procedures, and goals where employee performance is addressed.

---

**Annex C Informational References**

**C.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 requirements of this document unless also listed in Chapter 2 for other reasons.

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


**C.1.2 Other Publications.**

**C.1.2.1 American Chemistry Council (formerly Chemical Manufacturers Association) Publications.** American Chemistry Council, 1300 Wilson Blvd., Arlington, VA 22209.

*Recommended Terms for Personal Protective Equipment*, 1985.

**C.1.2.2 API Publications.** American Petroleum Institute, 1220 L Street, N.W., Washington, DC 20005-4070.


**C.1.2.3 ASTM Publications.** ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.


**C.1.2.4 IMO Publications.** International Maritime Organization, 4 Albert Embankment, London SE1 7SR, UK.


*MARPOL 73/78*.

*Safety of Life at Sea* (SOLAS).


National Incident Management System (NIMS), *Site Safety and Control Plan* (formerly ICS 208 HM)


Title 18, U.S. Code, Section 2332a, “Use of Weapons of Mass Destruction.”

Title 29, Code of Federal Regulations, Parts 1910.119–1910.120.


Title 46, Code of federal Regulations, “Shipping.”


C.1.2.7 Additional Publications.


C.2 Informational References. The following documents or portions thereof are listed here as informational resources only. They are not a part of the requirements of this document.

C.2.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.


C.2.2 ASTM Publication. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA, 19428-2959.


C.3 References for Extracts in Informational Sections. (Reserved)
Item 14-3-24
From: Beach, Denise  
Sent: Thursday, December 19, 2013 4:48 PM  
To: Fuller, Linda  
Cc: Colonna, Guy; fswitzer@s-afe.com  
Subject: NFPA 56 Request for Change in Cycle

Linda,

On behalf of the technical committee on Gas Process Safety, I am requesting a change in cycle for NFPA 56 from Annual 2016 to Fall 2016. The committee voted to extend the cycle to give users more time to utilize the current edition in the field before the Public Input deadline.

Please let me know if you need any further information from me.

Best Regards,

Denise

Denise Beach  
*Senior Engineer*  
National Fire Protection Association  
Ph. 617/984-7501  
Fax. 617/984-7110  
www.nfpa.org
Linda, we are not going to complete action on all the Public Comments for NFPA 652 at this meeting, so with the last date to meet next Friday, we will not be able to complete work on the agenda within the F2014 cycle in which we are currently slated.

So, this is a request to slip cycle from F2014 to A2015 (since we might have received NITMAM, we might have defaulted to the A2015 ATM anyway, this just makes that happen sooner). We already have new meeting dates to continue the 2nd draft process and are not planning on re-opening call for Public Comment (we have plenty already).

Please advise if you need anything further from me to confirm this request.

Thanks

Guy

Guy R. Colonna, P.E.
Division Manager
NFPA
1 Batterymarch Park
Quincy, MA 02169
617-984-7435
gcolonna@nfpa.org

Check out NFPA on social media... www.nfpa.org/socialmedia
Subject: FAE-SCE request to move cycle for 1953

Linda,

The Technical Committee for PPE Special Operations, FAE-SCE, requests the Standards Council to approve a move from Fall 2014 SD to Annual 2015 SD, pursuant to 4.4.13(b) of the Rules and Regulations. They request to not open the document for further Public Comment pursuant to 4.4.14(a) of the Rules and Regulations.

Thank You -

Chris Farrell
National Fire Protection Association
Public Fire Protection Division
1 Batterymarch Park
Quincy, Ma. 02169-7471
617-984-7325- Office

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Fuller, Linda

Subject: FW: NFPA 18 Revision Cycle

From: Brandao, Armand [mailto:armand.brandao@fmapprovals.com]
Sent: Wednesday, February 19, 2014 2:08 PM
To: Wilmot, Jacqueline
Subject: NFPA 18 Revision Cycle

Ms. Wilmot,

Per our telephone conversation today, I hereby request that we address NFPA 18, 18A, and 1150 in the Fall 2016 revision cycle. This will allow us to deal with all three in the same series of meetings, with an eye to rationalizing and consolidating them down to two. It would also provide more opportunity to obtain information from the ongoing research program to upgrade the requirements of 18A.

Regards,
Armand Brandao
Chairman, NFPA 18

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Item 14-3-30
MEMORANDUM

To: Linda Fuller

From: Chris Farrell, Staff Liaison, Public Fire Protection Division

Re: proposed standard 1858 ballot results

Proposed standard 1858 has passed ballot from both the TC and the CC. The TC requests a Fall 2017 revision cycle for the proposed standard.

Thank You -
MEMORANDUM

TO: NFPA Technical Committee on Special Operations Protective Clothing and Equipment

FROM: Yvonne Smith, Project Administrator

DATE: February 10, 2014

SUBJECT: NFPA 1858 Draft Release TC Final Ballot Results

The Final Results of the NFPA 1858 Draft Release (for F2017 Cycle):

25 Members Eligible to Vote
8 Not Returned (Allen, Byrne, Dacey, Davis, Stanhope, Stinton, Klaren, McCurley)
17 Affirmative on All
0 Negatives
0 Abstentions

There are two criteria necessary to pass ballot [(1) affirmative 2/3 vote and (2) simple majority].

(1) The number of affirmative votes needed for the proposal/comment to pass is 12.
   (25 eligible to vote - 8 not returned - 0 abstentions = 17 × 0.66 = 11.22)

(2) In all cases, an affirmative vote of at least a simple majority of the total membership eligible to vote is required. This is the calculation for simple majority:
   [25 eligible ÷ 2 = 12.5 = (13)]

Reasons for negative votes, etc. from alternate members are not included unless the ballot from the principal member was not received.

According to the final ballot results, all ballot items received the necessary 2/3 required affirmative votes to pass ballot.
MEMORANDUM

TO: NFPA Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment

FROM: Yvonne Smith, Project Administrator

DATE: February 18, 2014

SUBJECT: NFPA 1858 Draft Release Ballot Results (F2017)

The Final Results of the NFPA 1858 CC Letter Ballot to Release the Draft are as follows:

27 Members Eligible to Vote
6 Not Returned (Arrington, Legendre, Putorti, Reall, Tomlinson, Winer)

21 Affirmative
0 Negatives
0 Abstentions

There are two criteria necessary to pass ballot [(1) affirmative \(\frac{3}{4}\) vote and (2) simple majority].

(1) The number of affirmative votes needed for the Release Ballot to pass is 16.
   \((27 \text{ eligible to vote} - 6 \text{ not returned} - 0 \text{ abstentions} = 21 \times 0.75 = 15.75)\)

(2) In all cases, an affirmative vote of at least a simple majority of the total membership eligible to vote is required. This is the calculation for simple majority:
   \([27 \text{ eligible} \div 2 = 13.5 = 14]\)

Reasons for negative votes, etc. are attached for your review. Ballots received from alternate members are not included unless the ballot from the principal member was not received.

According to the final ballot results, all ballot items received the necessary \(\frac{3}{4}\) required affirmative votes to pass ballot.
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NFPA® 1858

Standard on
Selection, Care, and Maintenance of Life Safety Rope and Equipment for Emergency Services

2017 Edition

Origin and Development of NFPA 1858
Chair

Alternates

, NFPA Staff Liaison

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A. Information on referenced publications can be found in Chapter 2 and Annex B.
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NFPA 1858

Standard on
Selection, Care, and Maintenance of Life Safety Rope and Equipment for Emergency Services

2017 Edition

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard shall specify the minimum selection, care, and maintenance requirements for life safety rope, escape rope and webbing, water rescue throwlines, moderate elongation laid life saving rope, life safety harnesses, belts, auxiliary equipment, litters, and victim extrication devices for emergency services personnel that are compliant with NFPA 1983.

1.1.2 This standard shall also specify minimum selection, care, and maintenance requirements for life safety rope, escape rope and webbing, water rescue throwlines, moderate elongation laid life saving rope, life safety harnesses, belts, auxiliary equipment, litters, and victim extrication devices for emergency services personnel that are compliant with the previous editions of NFPA 1983.

1.1.3 This standard shall not specify requirements for any accessories that could be attached to the certified product and are not necessary for the certified product to meet the requirements of this standard.

1.1.4 This standard shall not specify requirements for any utility rope.

1.1.5 This standard shall not specify requirements for any rope or associated equipment designed for mountain rescue, cave rescue, lead climbing operations, or where expected hazards and situations dictate other performance requirements.

1.1.6 This standard shall not specify requirements for any rope or equipment for fall protection pertaining to employees of general industry or the construction and demolition industry.

1.1.7 This standard shall not be construed as addressing all the safety concerns associated with the use of life safety rope and equipment. It shall be the responsibility of the persons and organizations that use compliant life safety rope and equipment to establish safety and health practices and to determine the applicability of regulatory limitations prior to use.

1.1.8 This standard shall not be construed as addressing all the safety concerns, if any, associated with the use of this standard by testing or repair facilities.

1.1.9 Nothing herein shall restrict any jurisdiction from exceeding these minimum requirements.

1.2 Purpose.

1.2.1 The purpose of this standard shall be to establish a program for life safety rope and equipment to reduce the risks and hazards associated with the selection, maintenance, improper use of, or damage to life safety rope and equipment.

1.2.2 The purpose of this standard shall also be to establish basic criteria for selection, inspection, cleaning, decontamination, repair, storage, and retirement of life safety rope, escape rope and webbing, water rescue throwlines, moderate elongation laid life saving rope, life safety harnesses, belts, auxiliary equipment, litters, and victim extrication devices for emergency services personnel elements.

1.3 Application.

1.3.1 This standard shall apply to life safety rope, escape rope and webbing, water rescue throwlines, moderate elongation laid life saving rope, life safety harnesses, belts, auxiliary equipment, litters, and victim extrication devices certified as compliant with NFPA 1983.

1.3.2 The requirements of this standard shall not apply to accessories attached to any element of the technical rescue protective ensemble unless specifically addressed herein.

1.4 Units.

1.4.1 In this standard, values for measurement are followed by an equivalent in parentheses, but only the first stated value shall be regarded as the requirement.

1.4.2 Equivalent values in parentheses shall not be considered as the requirement because those values are approximate.

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.


2.3 Other Publications.

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


2.3.2 Cordage Institute Publications. Cordage Institute, 994 Old Eagle School, Wayne, PA 19087-1866.

- CI 1202, Terminology for Fiber Rope, February 2003.

3.3.2 Positioning Attachment Point. Point on a harness or belt that is used for connection to an anchor system that will support a person’s weight for work at height.

3.3.4 Auxiliary Equipment. Equipment items that are load bearing and designed to be utilized with life safety rope and harness, such as ascending devices, carabiners, descent control devices, rope grab devices, and snap links.

3.3.5 Belt. An equipment item configured as a device that fastens around the waist only and designated as a ladder belt or an escape belt.

3.3.5.1 Escape Belt. A compliant equipment item that is intended for use by the wearer only as an emergency self-rescue device.

3.3.6 Carabiner. An auxiliary equipment system item that is a load-bearing connector with a self-closing gate used to join other components of life safety rope.

3.3.7 Certification Organization. An independent, third-party organization that determines product compliance with the requirements of this standard with a labeling/listing/follow-up program.

3.3.8 Certified. A designation whereby a certification organization has determined that a manufacturer has demonstrated the ability to produce a product that complies with the requirements of this standard, authorizes the manufacturer to use a label on listed products that comply with the requirements of this standard, and establishes a follow-up program conducted by the certification organization as a check on the methods the manufacturer uses to determine compliance with the requirements of this standard.

3.3.9 Compliant. Certified as meeting or exceeding all applicable requirements of this standard.

3.3.10 Corrosion. A condition exhibiting signs of deterioration, including pitting or loss of metal.

3.3.11 Descent Control Device. See 3.3.13.2.

3.3.12 Design Load. See 3.3.29.1.

3.3.13 Device.

3.3.13.1 Ascending Device. Auxiliary equipment that is a type of rope grab; a friction or mechanical device utilized to allow ascending a fixed line.

3.3.13.2 Descent Control Device. An auxiliary equipment item that is a friction or mechanical device used with rope to control descent.

3.3.13.2.1 Escape Descent Control Device. An auxiliary equipment system component that is a friction or mechanical device used with escape rope to control descent.

3.3.13.3 Rope Grab Device. An auxiliary equipment device used to grasp a life safety rope for the purpose of supporting loads; includes ascending devices.

3.3.14 Diameter (Rope). See 3.3.34.1.

3.3.15 Elongation. The increase in length, expressed in a percent of the original gauge length, that occurs in a sample of new rope when tested as specified herein.

3.3.16 Escape. Immediate self-rescue of a single fire or emergency services person from a life-threatening emergency situation, generally above ground, using system components or manufactured systems designed for self-rescue.
3.3.17 Escape Belt. See 3.3.5.1.

3.3.18 Escape Descent Control Device. See 3.3.13.2.1.

3.3.19 Escape Rope. See 3.3.34.2.

3.3.20† Fall Factor. A measure of fall severity calculated by dividing the distance fallen by the length of rope used to arrest the fall.

3.3.21 Follow-Up Program. The sampling, inspections, tests, or other measures conducted by the certification organization on a periodic basis to determine the continued compliance of labeled and listed products that are being produced by the manufacturer to the requirements of this standard.

3.3.22 General Use. One designation of equipment item or manufactured system designed for general-use loads, light-use loads, and escape based on design loads and performance requirements.

3.3.23 Hardware. Nonfabric components of protective clothing or equipment, including but not limited to those made of metal or plastic.

3.3.24 Harness. See 3.3.25.

3.3.25 Life Safety Harness. An equipment item that is an arrangement of materials secured about the body and used to support a person.

3.3.26 Life Safety Rope. See 3.3.34.3.

3.3.27 Light Use. Designation of an equipment item or manufactured system designed for light-use loads and escape based on design loads and performance requirements.

3.3.28 Line. See 3.3.34.4.

3.3.29 Load.

3.3.29.1 Design Load. The load for which a given piece of equipment or manufactured system was engineered for under normal static conditions.

3.3.30 Manufactured System. Preassembled system sold as a unit by the manufacturer and tested as a complete assembly.

3.3.31 Manufacturer. The entity that directs and controls any of the following: compliant product design, compliant product manufacturing, or compliant product quality assurance; or the entity that assumes liability for the compliant product or provides the warranty for the compliant product.

3.3.32 Manufacturer’s Lot. <<NEED DEFINITION>>

3.3.33 Melting. Response of a material to heat resulting in evidence of flowing or dripping.

3.3.34 Rope. A compact but flexible, torsionally balanced, continuous structure of fibers produced from strands that are twisted, plaited, or braided together that serves primarily to support a load or transmit a force from the point of origin to the point of application.

3.3.34.1 Diameter. The length of a straight line through the center of the cross section of the rope.

3.3.34.2 Escape Rope. A single-purpose, emergency self-escape (self-rescue) rope; not classified as a life safety rope.

3.3.34.3 Life Safety Rope. Rope dedicated solely for the purpose of supporting a person or persons during rescue, firefighting, or other emergency operations or during training evolutions.

3.3.34.4 Line. Rope when in use.

3.3.34.4.1 Throwline. A floating rope that is intended to be thrown to a person during water rescues or as a tether for rescuers entering the water.

3.3.34.5 Moderate Elongation Laid Life Saving Rope. Rope dedicated solely for the purpose of supporting people during rescue at fire-fighting operations or training evolutions.

3.3.35 Rope Grab Device. See 3.3.3.3.

3.3.36 Sample. An element, item, component, or composite that is conditioned for subsequent testing; an amount of the material, product, or assembly to be tested that is representative of the item as a whole.

3.3.37 Snap Link. An auxiliary equipment system component that is a self-closing, gated, load-bearing connector.

3.3.38 Throwline. See 3.3.34.1.

3.3.39 Waist. The area above the hips and below the xiphoid process.

3.3.40 Webbing. Woven material in the form of a long strip; can be of flat or tubular weave.

Chapter 4 Program

4.1 General.

4.1.1 The organization shall develop and implement a program for the selection, care, and maintenance of life safety rope and equipment used by the members of the organization in the performance of their assigned functions.

4.1.2 This program shall have the goal of providing life safety rope and equipment that are suitable and appropriate for the intended use; maintaining life safety rope and equipment in a safe, usable condition to provide the intended protection to the user; removing from use such life safety rope and equipment that, because their condition, could cause or contribute to user injury, illness, or death; and reconditioning, repairing, or retiring such life safety rope and equipment.

4.1.3 Where this program for the selection, care, and maintenance of life safety rope and equipment is part of an organization’s overall program on protective clothing and protective equipment, the portion of the organization’s overall program that affects life safety rope and equipment shall be in accordance with Section 4.2.

4.2 Program Organization for Life Safety Rope and Equipment.

4.2.1 The organization’s program specified in Section 4.1 shall incorporate at least the requirements in Chapters 4 through 10 of this standard.

4.2.2 The organization shall develop written standard operating procedures (SOPs) that shall identify and define the various parts of the program, specified in Table 4.2.2, and the various roles and responsibilities of the organization and of the members in the program parts.

4.2.3 The organization shall develop specific criteria for removal of life safety rope and equipment from service, in accordance with Chapter 10. The criteria for retirement shall include but not be limited to issues that are specific to the life
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safety rope and equipment being used by the organization, the manufacturers’ instructions, and the experience of the organization.

4.3 Records.

4.3.1 The organization shall compile and maintain records on its life safety rope and equipment.

4.3.2* At least the following records shall be kept for each life safety rope and equipment item:

1. Equipment identification
2. Date of purchase
3. Date placed in service
4. Manufacturer and model number
5. Month and year of manufacture
6. Dates of use, including how used, weather conditions, potential damage, and other circumstances relating to use
7. Dates of cleaning and inspection
8. Removal from service and date of return

4.4 Manufacturer’s Instructions.

4.4.1 When issuing new life safety rope and equipment, the organization shall provide users with the instructions provided by the manufacturer on the care, use, and maintenance of the life safety rope and equipment, including any warnings provided by the manufacturer.

4.4.2 Where the manufacturer’s instructions regarding the care or maintenance of the life safety rope and equipment differ from a specific requirement(s) in this standard, the manufacturer’s instructions shall be followed for that requirement(s).

4.4.3 The organization shall retain and make accessible to organization personnel a copy of manufacturers’ instructions regarding the care, use, and maintenance of the life safety rope and equipment for reference purposes.

4.5 Product Failure.

4.5.1 The organization shall report all life safety rope and equipment health and safety concerns if caused by a known or suspected product failure to the manufacturer and the certification organization.

4.5.2 The organization shall notify the manufacturer and the certification organization in writing.

4.5.3 The organization shall request written acknowledgment from the manufacturer and certification organization within 30 days.

Chapter 5 Selection

5.1 Selection and Purchase.

5.1.1* Prior to starting the selection process for life safety rope and equipment, the organization shall evaluate and determine the level at which the organization shall train and respond to meet the requirements established by the AHJ.

5.1.2 The organization shall refer to its risk and hazard assessment of the response area to determine the types of incidents requiring life safety rope and equipment that could be encountered:

1. Type of technical rescue incidents to which the organization plans to respond
2. Level of operational capability for technical rescue incidents: awareness, operational, technician
3. The organization’s established acceptable safety factors for technical rescue operations
4. Geographic location and conditions

5.1.3* The organization shall refer to its risk and hazard assessment of the response area to determine the organization’s protocols for an emergency escape from an elevated location.

5.1.4* The organization shall ensure that elements under consideration are certified as being compliant with the current edition of NFPA 1983.

5.1.5 Based on the levels of operational capability established by the AHJ, the organization shall compile and evaluate information on the comparative advantages and disadvantages of the life safety rope and equipment under consideration.

5.1.6 The organization shall ensure that the life safety rope and equipment under consideration interface properly with other personal protective items in use within the organization.

5.1.7 Where a field evaluation of life safety rope and equipment is conducted, the organization shall establish criteria to ensure a systematic method of comparing products in a manner related to their intended use and assessing the products’ performance relative to the organization’s expectations.

5.1.8 Where the organization develops purchase specifications, the following criteria, as a minimum, shall be included:

1. Purchase specifications shall require that the life safety rope and equipment to be purchased shall be compliant with the current edition of NFPA 1983.
2. Where the organization selects criteria that exceed the minimum requirements of the current edition of NFPA 1983, such criteria shall be stipulated in the purchase specifications.
3. Purchase specifications shall require that manufacturers’ bids include substantiation of certification for each product and model stated in the bid.
4. Where applicable, the purchase specifications shall define the process for determining proper compatibility with the organization’s other NFPA 1983-compliant life safety rope and equipment components.
5. The organization shall compare each bid submittal against purchase specifications.
5.1 Upon receipt, the organization shall inspect purchased life safety rope and equipment to determine that the products meet the organization’s specifications and were not damaged during shipment. The organization shall also verify the quantity and sizes of the life safety rope and equipment received.

5.1.10 The organization shall examine information supplied with the products, such as instructions, warranties, and technical data.

5.1.11 Before placing new equipment into service, the organization shall determine that all components are compatible and will function as intended with the technical rescue systems and escape systems on which the organization’s personnel are trained.

5.1.12 Procedures shall be established for returning unsatisfactory products or products that do not meet the organization’s specifications.

5.2 Life Safety Rope. The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.2.1 through 5.2.12.

5.2.1* Specific performance or specific features shall be selected based upon the intended application of the rope being purchased. If the organization has multiple intended applications for life safety rope, the purchase of multiple ropes shall be considered that best fit those applications.

5.2.2* Type of fiber, including but not limited to nylon, poly-ester, or para-aramid, shall be considered.

5.2.3* Construction, including but not limited to kernmantle, double braid, single braid, or braided, shall be considered.

5.2.4* Elongation, including but not limited to low stretch or static, shall be considered.

5.2.5* The required minimum breaking strength (MBS) to provide a sufficient safety factor for the intended application(s) shall be specified to ensure adequate strength.

5.2.6* The diameter shall be considered to ensure compatibility with the other components used in the system and the ability to grip the rope.

5.2.7* The total weight to be carried shall be considered since it determines the necessary length, diameter, and material of the rope.

5.2.8* The hand shall be considered for ease of tying knots, smoothness running through gear, and abrasion resistance.

5.2.9* The sheath’s color shall be considered for the ability to be seen or camouflaged, as well as the ability for one rope to be distinguished from another when rigged side by side.

5.2.10* The length shall be considered, including but not limited to lengths sufficient to rig the longest anticipated site with additional rope length for anchoring, mechanical advantage systems, or other rigging needs.

5.2.11* The heat resistance shall be considered, including but not limited to melting point, critical temperature, and friction.

5.2.12* For construction that includes a sheath, the sheath shall be considered, including but not limited to the number of yarns, braid pattern, thickness, and tightness as they apply to the hand; the abrasion resistance; and the amount of sheath slippage.

5.3 Escape and Fire Escape Rope. In the purchase specifications, the organization shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983 such as the following:

5.3.1* The organization shall consider the following performance factors when making the evaluations: Escape rope, fire escape rope, and equipment are available as individual NFPA 1983–compliant components or NFPA 1983–compliant manufactured escape systems. It is the responsibility of the organization to ensure that components, manufactured systems, and any other associated personal protective equipment (PPE) are compatible.

5.3.2 The organization shall consider the manner of use in the escape rope, such as the following:

1*Selection of fire escape rope if the anticipated environment will expose the rope to elevated temperatures
2*Type of termination at the anchor end of the rope
3*Compatibility with the descent control device
4*Ability to control the descent with the type of gloves worn
5*Ability of the escape rope or escape system to absorb energy in a fall
6*Whether the AHJ has determined that the body belt or similar method is to be used as the escape or bail-out method of the organization If the AHJ determines that the body belt or similar method is to be used as the escape or bail-out method of the organization, it is important to recognize the wide range of user gripping abilities, user fatigue, and environmental conditions presented by using this technique. Organizations should evaluate these factors and study the effectiveness of the body belt technique in their organization and the operational risk factors.

5.4* Life Safety Harness. The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.4.1 through 5.4.7.

5.4.1* The organization shall select a Class II or Class III harness depending on the type of life safety operations the users will be conducting. In some cases, the organization may require both types.

5.4.2* The organization shall select the attachment point or points appropriate for the intended use of the harness based on type and on location.

5.4.3* The organization shall evaluate the harness for comfort and for ease of donning.

5.4.4* The organization shall consider the use of materials in the construction if the harness will be heated by heat, flame, chemicals, or water.

5.4.5 The organization shall evaluate which accessories to select to maximize the usefulness of the harness, including but not limited to gear loops, pockets, or methods for holding the loose ends of the webbing.
5.4.6* The organization shall evaluate the function of each type of harness selected in the manner that it will be used.

5.4.7 Where a harness is integrated with bunker gear ensemble, it shall not compromise the integrity of the protective garment as outlined in NFPA 1971.

5.5* Ladder Belts and Escape Belts. The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.5.1 through 5.5.8.

5.5.1 If the organization selects a belt for fall protection during ladder operations, the organization shall select a ladder belt.

5.5.2 If the organization selects a belt rather than a harness for fire ground or elevated operations, the organization shall select an escape belt.

5.5.3 The organization shall select the attachment point or points appropriate for the intended use of the belt based on type and on location.

5.5.4 The organization shall evaluate belts for comfort and for ease of donning in the intended manner of use.

5.5.5 The organization shall consider the use of materials in the construction if the belt will be exposed to heat, flame, and chemicals.

5.5.6 The organization shall evaluate which accessories to select to maximize the usefulness of the belt.

5.5.7 The organization shall evaluate the function of each type of belt selected in the manner that it will be used.

5.5.8 Where an escape belt is integrated with bunker gear ensemble, it shall not compromise the integrity of the protective garment as outlined in NFPA 1971.

5.5* Carabiners. The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.5.1 through 5.5.4.

5.6.1* The organization shall determine the needs of a general-use–or a technical-use–rated carabiner depending on the performance needs determined by the risk assessment and the organization’s needs, training, and capabilities.

5.6.2* The organization shall select the type of gate function that meets the operational needs of the organization.

5.6.3* The organization shall select the carabiner material that meets the operational needs of the organization regarding carabiner strength and exposure to corrosive atmospheres.

5.6.4* The organization shall select the size and shape of the carabiner that meet the operational needs of the organization.

5.7* Rope Grabs and Ascenders. The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.7.1 through 5.7.4.

5.7.1* The organization shall determine its requirements for a general use– or technical-use–rated rope grab depending on the performance needs determined by the risk assessment and the organization’s needs, training, and capabilities.

5.7.2* The organization shall select the type of rope gripping function that meets the operational needs of the organization.

5.7.3* The organization shall select the rope grab material that meets the operational needs of the organization regarding carabiner strength and exposure to corrosive atmospheres.

5.7.4* The organization shall select the rope grab shape that meets the operational needs of the organization regarding strength of the device and possible rope damage under high loads.

5.8 Throwlines. The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.8.1 through 5.8.6.

5.8.1* The organization shall determine if the intended use of a throwline will require greater than the minimum performance specification for tensile strength listed in NFPA 1983.

5.8.2* The organization shall determine if the intended use of a throwline will require greater than the minimum performance specification for diameter listed in NFPA 1983.

5.8.3* The organization shall determine if the intended use of a throwline will require greater than the minimum performance specification for diameter listed in NFPA 1983.

5.8.4* The organization shall select a throwline that will handle well during the intended use.

5.8.5* The organization shall determine what length throwline will meet the requirements of the intended use.

5.8.6* The organization shall select throwline storage that will meet the requirements of the intended use.

5.9 Descent Control Devices. The organization’s purchase specifications shall consider the organization’s needs for performance or features in excess of the minimum requirements for descent control devices listed in NFPA 1983, such as those given in 5.9.1 through 5.9.5.

5.9.1* The organization shall determine the operational requirements of the descent control device for the following actions:

(1) Nonemergency rappel or single-person descent
(2) Emergency rappel or bailout
(3) For lowering a rescuer, a litter, or both
(4) Belay device
(5) Any combination of the above

5.9.2* The organization shall determine the selection of general- or technical-use descent control devices based on anticipated loads, acceptable safety margins as established by the AHJ, and the experience level of the rescuers.

5.9.3* The organization shall evaluate the design and performance specifications to determine the descent control device or devices that meet its requirements.

(1) Manual device or auto-locking device
(2) Size and weight of the device
(3) Compatibility with the organization’s life safety ropes for rappel or belay
(4) Compatibility with the organization’s escape rope or webbing
(5) Material of construction
(6) Ability to dissipate heat

5.9.4* The organization shall evaluate the levels of personnel competency and training to determine the descent control device or devices that meet its requirements.
5.9.5 The organization shall evaluate the function of each descent control device selected by the department in the manner that it will be used while the evaluator is wearing the clothing and PPE for that operation.

5.10 Portable Anchors. The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.10.1 through 5.10.6.

5.10.1 The organization shall determine the need for a portable anchor device based on a risk assessment, equipment needs, training, and the organization’s response capabilities.

5.10.2 The organization shall determine the selection of general- or technical-use portable anchors based on anticipated loads, acceptable safety margins as established by the AHJ, and the experience level of the rescuers.

5.10.3 The portable anchor shall be evaluated by the organization for a means to package and store the device.

5.10.4 The portable anchor shall be evaluated by the organization for component assembly.

5.10.5 The portable anchor shall be evaluated by the organization for the adjustability to meet the anticipated types of incidents.

5.10.6 The organization shall evaluate the footing for the portable anchor based on the surfaces encountered during the anticipated incidents.

5.11 Pulleys. The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements for pulleys in NFPA 1983, such as those given in 5.11.1 through 5.11.3.

5.11.1 The organization shall determine the need for a pulleys based on a risk assessment, equipment needs, training, and response capabilities.

5.11.2 The organization shall determine the selection of general- or technical-use pulleys based on anticipated loads and acceptable safety margins as established by the AHJ as well as the experience level of the rescuers.

5.11.3 The organization’s selection of pulleys shall be based on the intended use, and the following criteria shall be considered.

- Efficiency
- Single or double
- Ratchet
- Size
- Sheave width

5.12 Belay Devices. The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.12.1 through 5.12.5.

5.12.1 The organization shall determine the selection of general- or technical-use belay device based on anticipated loads and acceptable safety margins as established by the AHJ and the experience level of the organization’s rescuers.

5.12.2 The organization shall select a maximum impact load and arrest distance for its belay system.

5.12.3 The organization shall determine the maximum allowable static load for the belay device.

5.12.4 The organization shall select a belay device that is within the operational and training levels of the users.

5.12.5 The organization shall consider operational conditions, such as weight and environment.

5.13 End-to-End and Multiple Configuration Straps. The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of, such as those given in 5.13.1 through 5.13.3.

5.13.1 The organization shall determine the selection of general- or technical-use end-to-end and multiple configuration straps based on anticipated loads and acceptable safety margins as established by the AHJ as well as the experience level of the organization’s rescuers.

5.13.2 The organization’s selection of end-to-end and multiple configuration straps shall be based on the intended use and shall consider the following performance and design features:

- Length
- Width
- Weight
- Terminations
- Material
- Adjustability
- Color

5.13.3 The organization shall evaluate the performance of end-to-end straps in the manner of intended use.

5.14 Litters. The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983.

5.14.1 The organization’s selection of litters shall be based on the intended use and shall consider the following performance and design features:

- Material of construction
- One-piece or two-piece design
- Rigid or semi-rigid design
- Integrated attachment points
- Means of securing victim
- Shape of litter
- Size of litter
- Litter accessories

5.15 Manufactured Systems. The organization’s purchase specifications for manufactured systems shall consider the organization’s needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.15.1 and 5.15.2.

5.15.1 The organization shall refer to the appropriate sections of this document for information regarding the choices of components comprised by a manufactured system.

5.15.2 The organization shall evaluate the performance of the manufactured system in the manner of intended use.

5.16 Escape and Fire Escape Systems. The organization’s purchase specifications for escape systems shall consider the organization’s needs for performance or features in excess of the
minimum requirements of NFPA 1983, such as those given in 5.16.1 through 5.16.13.

5.16.1* The organization shall consider the manner of use of the escape system.

5.16.2* The organization shall consider selecting a system that is pre-connected to the fire fighter or will be connected immediately prior to use.

5.16.3* The organization shall consider selecting an escape rope–based system or an escape webbing–based system.

5.16.4* The organization shall consider selecting a fire escape system or an escape system.

5.16.5 The organization shall consider the method of deployment that will meet the time acceptable to the organization.

5.16.6* The organization shall consider whether the payout force is within the organization’s parameters.

5.16.7* The organization shall consider selecting a system that is sealed or repackable.

5.16.8* The organization shall determine whether the individual components of the escape system meet its expectations for initial training as well as recurrent training.

5.16.9 In selecting a system, the organization shall evaluate which type of descent control device best meets the level of initial training and recurrent training.

5.16.10* The organization shall evaluate the structures and hazards in its response area to determine the operational length of the rope or webbing for the escape system in order to reach the surface or a safe area.

5.16.11* In selecting a system, the organization shall evaluate which type of anchoring method best meets the levels of initial training and recurrent training.

5.16.12* The organization shall consider the use and maintenance requirements of the escape system.

5.16.13* The organization shall evaluate the function of the escape system considered by the organization in the manner that it will be used while the evaluator is wearing full clothing and PPE.

5.17 Escape and Fire Escape Webbing The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.17.1 and 5.17.2.

5.17.1* The organization shall consider the following performance factors when making the evaluations: Escape webbing, fire escape webbing, and equipment is available as individual NFPA 1983–compliant components or as NFPA 1983–compliant manufactured escape systems. It is the responsibility of the organization to ensure that components, manufactured systems, and any other associated PPE are compatible.

5.17.2 The organization shall consider the manner of use in the escape webbing, such as the following:

1) The type of webbing selected by the organization if the anticipated environment will expose the webbing to elevated temperatures
2) Type of termination at the anchor end of the webbing
3) Compatibility with the descent control device
4) Ability to control the descent with the type of gloves worn
5) When used with a body belay technique or similar method, deployment of the escape webbing in the time acceptable to the organization

5.18* Escape Anchor Devices. The organization’s purchase specifications for an escape anchor device shall consider the organization’s needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.18.1 and 5.18.2.

5.18.1 The organization shall refer to its risk and hazard assessment of the response area to determine the types of incidents requiring the use of escape anchor device and take into account the following considerations:

1) Security when the anchor device is deployed
2) How the escape anchor will be carried by the firefighter
3) The ease of deployment of the escape anchor to determine if the time to deploy is acceptable to the organization
4) Whether the escape anchor device is compatible with the escape rope or webbing selected by the organization
5) The primary and secondary locations:
   a) Distance from window
   b) Time it takes to set the device
   c) Ability of individuals to set the device
   d) Storage location

5.18.2 The organization shall evaluate the function of each descent control device selected by the department in the manner that it will be used while the evaluator is wearing full clothing and PPE for that operation.

5.19* Victim Extrication Device. The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.19.1 through 5.19.7.

5.19.1 Because NFPA 1983 specification, design and performance requirements are limited to determining minimum device strength and the security of the patient, the organization shall refer to its medical control or standards to comply with medical specifications, requirements, or performance metrics.

5.19.2 The organization shall determine the specific needs for selecting a victim extrication device by evaluating the device for multiple rescue situations, which can include, but are not limited to, confined space rescues, high-/low-angle rope rescues, vehicle/machinery rescue, and rescuing a downed fire fighter or victim in a structure.

5.19.3* The organization shall determine whether a Class II or a Class III victim extrication device is needed to meet its victim extrication requirements.

5.19.4 Victim extrication devices shall be evaluated based on ease of use, construction features, ease of transportation to rescue site, and storage requirements. These devices often
consist of a means to secure straps, belts and hardware around the victim.

5.19.4.1 Evaluation on ease of use of these shall be performed with PPE donned and vision obscured.

5.19.5 The method of transportation of a victim with the victim extrication device shall be evaluated based on the manufacturer’s instructions on intended use and shall be based on the following considerations:

1. Providing a secure means of attachment to a rope rescue system (if so equipped)
2. Ease of packaging and securing the victim in the device by the use of straps, buckles, or other mechanisms
3. Ease of transporting the victim in the device over various terrains, up and down stairs, and in and out of confined spaces
4. The ability of the device to prevent unnecessary movement to the victim

5.19.6 The components of the victim extrication device shall be evaluated for the following:

1. Durability of materials in the manner of use specified by the manufacturer
2. For components that might be exposed to corrosive environments, resistance to corrosive forces

5.19.7 The device shall be evaluated on ease of cleaning and decontamination following the manufacturer’s instructions.

5.20* Moderate Elongation Laid Life Saving Rope The organization’s purchase specifications shall consider its needs for performance or features in excess of the minimum requirements of NFPA 1983, such as those given in 5.20.1 and 5.20.2.

5.20.1* Specific performance or features shall be selected based upon the intended application of the rope being purchased.

5.20.2 If the organization has multiple intended applications for moderate elongation laid life saving rope, the purchase of multiple ropes shall be considered that best fit those applications:

1. Fiber type: Nylon, polyester, para-aramid
2. Construction: Laid construction of continuous filament yarn twisted into three or more strands
3. Elongation: Moderate (10 percent to 15 percent) at 10 percent MBS
4. Strength: Required MBS to provide a sufficient safety factor based on current NFPA guidelines
5. Diameter: Compatible with other components used in the system
6. Weight: Total weight to be carried affected by the length, diameter, and material
7. Hand: Ease of tying knots, smoothness running through gear, and abrasion resistance
8. Color: Per the requirements of the AHJ
9. Length: Per the requirements of the AHJ The actual length of certain materials can change over time due to natural shrinkage after several years in the field. Check with the ropes’ manufacturers for specific information on individual materials.

Chapter 6 Inspection

6.1 General.

6.1.1 Universal precautions shall be observed, as appropriate, in the handling of life safety rope and equipment that was exposed to contamination during use.

6.1.2 Any life safety rope and equipment that is found to be soiled or contaminated shall be cleaned or decontaminated before any additional inspection is initiated. If decontamination is not possible or warranted, contaminated life safety rope and equipment shall be retired.

6.1.3 The organization shall establish guidelines for its members to follow in determining if an element is soiled to an extent that cleaning is necessary.

6.1.4 The organization shall determine appropriate actions to be taken if life safety rope and equipment is found to be in need of cleaning, decontamination, or repair.

6.1.4.1 As a minimum, any necessary cleaning or decontamination shall be done in accordance with the requirements specified in Chapter 7.

6.1.4.2 As a minimum, any necessary repairs shall be made in accordance with the requirements specified in Chapter 8.

6.2 Periodic Inspection.

6.2.1* Life safety rope and equipment shall be inspected periodically according to the organization’s policy for inspecting life safety rope and equipment.

6.2.2 After each use, life safety rope and equipment shall be inspected by an inspector meeting the organization’s requirements for inspection of life safety rope and equipment.

6.2.3 The date of the inspection and the results of the inspection shall be recorded in the appropriate log or on a tag attached to the life safety rope and equipment for that purpose.

6.2.4 Each user shall be trained to conduct a safety and serviceability inspection of life safety rope and equipment immediately prior to use.

6.2.5 Inspection shall include, as a minimum, the inspections specified in 6.2.5.1 through 6.2.5.15.

6.2.5.1* Life safety rope shall be retired from service if any of the following defects is found:

1. Soiling
2. Contamination
3. Physical damage
   (a) Cuts, chaffing, broken fibers, or soft or hard spots on the sheath
   (b) Thermal or chemical damage that can be detected by sight, feel, or smell, such as melted fibers, glazed surfaces, or discoloration
   (c) Any variation in the rope diameter
   (d) A history in the rope log of shock load, fall load, or static load in excess of the design load
4. Excessive age

6.2.5.2* Escape and fire escape rope shall be retired from service if any of the following defects is found:

1. Soiling
2. Contamination
3. Physical damage
   (a) Cuts, chaffing, broken fibers, or soft or hard spots on the sheath
   (b) Thermal or chemical damage on the sheath, such as melted fibers, glazed surfaces, or discoloration
   (c) Any variation in the rope diameter
   (d) A history in the rope log of shock load, fall load, or static load in excess of the design load
(4) Excessive age

6.2.5.3 Life safety harnesses, ladder belts, and escape belts shall be repaired or retired from service if any of the following defects is found:

(1) Soiling
(2) Contamination
(3) Physical damage to the webbing components
   (a) Cuts, worn or frayed areas, broken fibers, or soft or hard spots
   (b) Thermal or chemical damage such as melted fibers, glazed surfaces, or discoloration
   (c) Pulled threads, abrasions, or breaks in the stitching
(4) Physical damage to the hardware components
   (a) Damage, sharp edges, or missing components
   (b) Improper operation
(5) Excessive age

6.2.5.4 Carabiners and snap links shall be repaired or retired from service if any of the following defects is found:

(1) Soiling
(2) Contamination
(3) Physical damage
   (a) Damage, sharp edges, missing components
   (b) Improper operation of the gate or locking mechanism

6.2.5.5 End-to-end and multiple-configuration straps shall be repaired or retired from service if any of the following defects is found:

(1) Soiling
(2) Contamination
(3) Physical damage
   (a) Cuts, worn or frayed areas, broken fibers, or soft or hard spots
   (b) Thermal or chemical damage such as melted fibers, glazed surfaces, or discoloration
   (c) Pulled threads, abrasions, or breaks in the stitching
(4) Physical damage to the hardware components
   (a) Damage, sharp edges, missing components
   (b) Improper operation
(5) Excessive age

6.2.5.6 Rope grabs and ascending devices shall be repaired or retired from service if any of the following defects is found:

(1) Soiling
(2) Contamination
(3) Physical damage
   (a) Damage, sharp edges, missing components
   (b) Improper operation of the cam or rope gripping component

6.2.5.7 Throwlines shall be repaired or retired from service if any of the following defects is found:

(1) Soiling
(2) Contamination
(3) Physical damage
   (a) Cuts, chaffing, broken fibers, or soft or hard spots on the sheath

6.2.5.8 Descent control devices and belay devices shall be repaired or retired from service if any of the following defects is found:

(1) Soiling
(2) Contamination
(3) Physical damage
   (a) Damage, sharp edges, missing components
   (b) Improper operation of any moving component
   (c) Improper operation of any self-locking system

6.2.5.9 Portable anchors shall be repaired or retired from service if any of the following defects is found:

(1) Soiling
(2) Contamination
(3) Physical damage
   (a) Damage, sharp edges, broken welds, fabric or plastic tears
   (b) Damaged or cracked attachment points
   (c) Damaged or inoperable leg assemblies

6.2.5.10 Pulleys shall be repaired or retired from service if any of the following defects is found:

(1) Soiling
(2) Contamination
(3) Physical damage
   (a) Damage, sharp edges, missing components
   (b) Damaged or cracked attachment points
   (c) Improper operation of any self-locking system

6.2.5.11 Litters and victim extrication devices shall be repaired or retired from service if any of the following defects is found:

(1) Soiling
(2) Contamination
(3) Physical damage
   (a) Damage, sharp edges, broken welds, fabric or plastic tears
   (b) Damaged or cracked attachment points
   (c) Damaged or unsafe inserts, patient straps, or patient surfaces

6.2.5.12 Escape and fire escape webbing shall be retired from service if any of the following defects is found:

(1) Soiling
(2) Contamination
(3) Physical damage
   (a) Cuts, worn or frayed areas, broken fibers, or soft or hard spots
   (b) Thermal or chemical damage such as melted fibers, glazed surfaces, or discoloration
   (c) Any variation in the rope diameter
   (d) History in the rope log of shock load, fall load, or static load in excess of the design load
(4) Excessive age

6.2.5.13 Escape anchor devices shall be repaired or retired from service if any of the following defects is found:

(1) Soiling
(2) Contamination
(3) Physical damage
   (a) Damage, cracks, sharp edges, missing components
   (b) Improper operation of any moving parts
   (c) Dulling of any points required to be sharp

6.2.5.14 Moderate elongation laid life saving rope shall be repaired or retired from service if any of the following defects is found:
(1) Soiling
(2) Contamination
(3) Physical damage
   (a) Cuts, chaffing, broken fibers, or soft or hard spots on the surface
   (b) Thermal or chemical damage on the surface, such as melted fibers, glazed surfaces, or discoloration
(4) History in the rope log of shock load, fall load, or static load in excess of the design load
(5) Excessive age

6.2.5.15 Manufactured systems and escape systems shall be repaired or retired from service if any of the following defects is found:
(1) Soiling
(2) Contamination
(3) Any component defect as described in 6.2.5.1 through 6.2.5.14
(4) Incompatibility of subcomponents

Chapter 7 Cleaning and Decontamination

7.1 General.
7.1.1 Organizations shall provide a means for having life safety rope and equipment cleaned and decontaminated.
7.1.2 Life safety rope and equipment shall be evaluated by the user for application of appropriate cleaning level after each use.

7.1.3 Life safety rope and equipment that are known to be or suspected to be contaminated with hazardous materials shall be evaluated on the incident scene by members of the organization authorized to conduct a preliminary assessment of the extent of contamination and the need for life safety rope and equipment to be isolated, tagged, and bagged at the incident scene.

7.1.4 Life safety rope and equipment that are known to be or suspected to be contaminated with body fluids shall be evaluated on the incident scene by members of the organization authorized to conduct a preliminary assessment of the extent of contamination and the need for life safety rope and equipment to be isolated, tagged, and bagged at the incident scene.

7.1.5 Organizations shall have written procedures detailing the decontamination and cleaning processes for life safety rope and equipment contaminated with body fluids. Universal precautions shall be observed at all times by members handling life safety rope and equipment known to be or suspected to be contaminated with body fluids.

7.1.6 Soiled or contaminated life safety rope and equipment shall not be brought into a home, washed in a home laundry, or washed in a public laundry unless the public laundry has a dedicated business to handle life safety rope and equipment.

7.1.7 If the organization does not have a means to decontaminate life safety rope, webbing, or other absorbent equipment, the contaminated life safety rope and equipment shall be disposed of following the organization’s procedure for the disposal of equipment contaminated by hazardous materials or body fluids.

7.2 Cleaning.
7.2.1 The end users shall be responsible for the routine cleaning of their issued life safety rope and equipment.

7.2.2 Organizations shall examine the manufacturer’s label and user information for instructions on cleaning and drying that the manufacturer provided with the life safety rope and equipment. In the absence of manufacturer’s instructions or the approval of alternative procedures for the life safety rope and equipment, the routine cleaning and drying procedures provided in this section shall be used.

7.2.3 Cleaning Process for Life Safety Rope and Webbing.
7.2.3.1 The organization shall determine its requirements for when rope or webbing shall be cleaned.
7.2.3.2 The cleaning procedure shall be as follows:
   (1) Remove as much debris, dirt, and mud as possible at the scene.
   (2) Rinse off any excess dirt with a hose.
   (3) Soak the rope for about 30 minutes in a plastic tub of water with nondetergent soap added.
   (4) Rinse the rope by pulling it through a rope washing device twice.
   (5) Hang the rope in a cool, shady place to dry.

7.2.4 Decontamination of Rope and Webbing.
7.2.4.1 The organization shall determine requirements pertaining to rope or webbing being taken out of service due to contamination.
7.2.4.2 Rope that has come into contact with blood or other body fluids shall be decontaminated using cleaners approved for removing biohazards according to the organization’s protocols for decontaminating PPE.

7.2.5 Cleaning Process for Equipment.
7.2.5.1 The organization shall determine requirements pertaining to equipment being taken out of service due to damage or contamination.
7.2.5.2 The cleaning procedure shall be as follows:

1. Wash the equipment in warm soapy water.
2. Remove all dirt from any moving parts.
3. Rinse, then towel or blow dry.
4. If lubrication of moving parts is necessary, a dry or nonstick lubricant shall be used following washing.

7.2.6 Decontamination of Equipment.

7.2.6.1 The organization shall determine the requirements pertaining to equipment being taken out of service due to contamination.

7.2.6.2 Equipment that has come into contact with blood or other body fluids shall be decontaminated using cleaners approved for removing biohazards according to the organization's protocols for decontaminating PPE.

Chapter 8 Repair

8.1 Rope and Webbing. When damage to rope or webbing is detected, the rope or webbing shall be removed from service and destroyed.

8.2 Other Equipment. Equipment other than rope or webbing that appears repairable shall be returned to the manufacturer for repair.

Chapter 9 Storage

9.1 Storage of Life Safety Rope, Moderate Elongation Laid Life Saving Rope, Escape Rope, Escape Webbing, and Throw-ropes.

9.1.1* Rope and webbing shall be stored in a clean, dry, well-ventilated place away from direct sunlight and away from heat.

9.1.2 Rope shall be kept off of the floor and never stored on dirt or concrete floors without ventilation underneath.

9.1.3 Rope shall never be placed in areas where acids or alkalies are stored.

9.2* Storage of Equipment. Equipment shall be stored in such a manner as to prevent damage contact with other equipment and to prevent exposure to chemicals and atmospheres that can contribute to rust, corrosion, or oxidation.

Chapter 10 Retirement and Disposition Procedures

10.1* Retirement of Life Safety Textile Products.

10.1.1* The organization shall develop specific criteria for the removal of textile products from service based on the manufacturer’s instructions and the experience of the organization.

10.1.2* Textile products shall be retired in accordance with 10.2.1 no more than 10 years from the date of manufacture.

10.1.3 Textile products that are no longer of use to the organization shall be decontaminated and then retired in accordance with 10.2.1.

10.1.4 Textile products that are contaminated to the extent that the organization deems it not possible or cost effective to decontaminate them shall be retired in accordance with 10.2.1.

10.1.5 Textile products that are no longer of use to the organization for emergency operations service but are not contaminated, defective, or damaged shall be retired in accordance with 10.2.1 or 10.2.2.

10.2* Disposition of Textile Products.

10.2.1 Retired textile products shall be destroyed or disposed of in a manner ensuring that they will not be used in any life safety or emergency activities, including training.

10.2.2 Retired textile products as determined in 10.1.5 shall be permitted to be used as follows:

1. For training, if a textile product has been inspected per 6.2.5 and meets the organization’s criteria for life support
2. As determined by the organization

10.3* Retirement of Life Safety Hardware.

10.3.1 The organization shall develop specific criteria for the removal of hardware from service based on the manufacturer’s instructions and the experience of the organization.

10.3.2* Hardware that is worn or damaged to the extent that the organization deems it not possible or cost effective to repair it shall be retired in accordance with 10.3.1.

10.4 Disposition of Hardware. Retired hardware shall be destroyed or disposed of in a manner ensuring that it will not be used in any life safety or emergency activities, including training.

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.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the AHJ may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The AHJ may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase “authority having jurisdiction,” or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the AHJ may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the AHJ. In many circumstances, the property owner or his or her des
ignited agent assumes the role of the AHJ; at government installations, the commanding officer or departmental official may be the AHJ.

**A.3.2.4 Listed.** The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The AHJ should utilize the system employed by the listing organization to identify a listed product.

**A.3.3.20 Fall Factor.** Fall factors (see Figure A.3.3.20) are calculated by dividing the distance the person attached to the rope will fall by the length of the rope between the person and the rope anchor or belay. Thus, a 305 mm (1 ft) fall on a 150 mm (½ ft) rope would be a fall factor of 2.0; a 305 mm (1 ft) fall on a 305 mm (1 ft) rope would be a 1.0 fall factor; a 305 mm (1 ft) fall on a 1.12 m (4 ft) rope would be a 0.25 fall factor; and a 305 mm (1 ft) fall on a 12.2 m (40 ft) rope would be a 0.025 fall factor. Note as well that a 7.6 m (25 ft) fall on a 30.5 m (100 ft) rope is also a 0.25 fall factor. This formula assumes the fall takes place in free air without rope drag across building edges or through intermediate equipment.

When fall factors of greater than 0.25 are anticipated, such as are possible in lead climbing, dynamic ropes specifically designed for climbing should be considered. Only ropes certified to appropriate climbing rope standards (e.g., the International Mountaineering and Climbing Federation (UIAA) and European Community (CE)) are appropriate for this use. Dynamic climbing ropes should be stored, maintained, inspected, and use-logged in a manner similar to that required for static/low-stretch rope. Such operations are outside the scope of this document. A fall factor of 0.25 is the maximum considered for NFPA 1983.

Recent testing indicates that the formula for calculating fall factors may not translate perfectly from dynamic ropes to the more static design ropes used for fire service operations.

**A.4.3.2** For more information on recording rope history, see ASTM F 1740, *Standard Guide for Nylon, Polyester, or Nylon/Polyester Blend or Both Kernmantle Rope*.

**A.5.1.1** Refer to NFPA 1670 for guidance in determining the requirements for life safety rope and equipment for technical rescue incidents involving any of the following:

1. Rope rescue
2. Confined space search and rescue
3. Structural collapse search and rescue
4. Water search and rescue
5. Wilderness search and rescue
6. Trench and excavation search and rescue
7. Cave search and rescue
8. Mine and tunnel search and rescue

Other resources include the following:

1. NFPA 1500
2. NFPA 1407
3. NFPA 1006
4. OSHA or state occupational safety and health standards applicable to technical rescue
5. Standards or procedures developed by the AHJ or the organization

**A.5.1.2(1)** The type of technical rescue incidents to which the organization will respond determines the choices of life safety rope and equipment having the same functional capability. In most cases, the same equipment can be used for several different types of responses. In other cases, incident location and environmental conditions might require more specialized equipment. Examples of incident types include the following:

1. High angle rescues
2. Low angle or over-the-bank rescues
3. Confined space rescues
4. Subterranean rescues
5. Industrial rescues, including structural tower rescues
6. Wilderness or remote access rescues
7. Water, flood, and swift water rescues
8. Ice rescues

**A.5.1.2(3)** NFPA 1983 divides life safety rope and equipment into two designations: general use and technical use. Rescue organizations can elect to use either technical use– or general use–labeled equipment based on the anticipated loads of the incident and the AHJ’s established acceptable safety factors. Safety factors are based on the types of technical rescues and the corresponding level of operational capability of the organization. The AHJ should compile and evaluate information on the comparative advantages and disadvantages of the life safety rope and equipment under consideration. For example, an organization at the operational level performing a simple rescue might require the higher margin of safety that could be gained from general-use equipment. A highly trained or specialized organization performing more complicated rescues might benefit from the lighter weight of technical-use equipment but, due to the level of training, can maintain an acceptable safety factor while increasing the efficiency of its operations. General-use equipment can provide greater durability
and possibly an advantage for incidents in which the anticipated system loads are difficult to estimate.

A.5.1.2(4) The organization’s geographic areas should include mutual aid or auto aid responses into other districts. Conditions include environmental factors that can make a rescue more difficult such as weather, terrain, vegetation, and distance from vehicular support.

A.5.1.3 The organization should take into account the following considerations in the risk and hazard assessment. While primarily considered an emergency means of egress from height for firefighters, escape capability is also appropriate for other emergency responders.

2. Escape situations that could occur in mutual aid and auto aid response areas. Consider type of escape situation that may occur in districts other than your own.
3. The organization’s policy on staging for high rise or mid-rise structures. This will determine the length of the escape rope or webbing, whether purchased separately or as part of an escape system.
4. The level of initial and ongoing training of the organization’s personnel. This will determine the type of descent method, descent control device, and system. Different levels of training are required for the different escape devices and systems. For example, a larger-diameter escape rope is easier to grip, but it is bulkier and heavier for carrying.
5. The type of operations conducted by the organization. For example, structural firefighting with its PPE might require a different escape system than an operation that does not have the potential for elevated temperatures but may still require emergency egress.
6. The anticipated level of initial and ongoing training. This will determine the type of escape anchor device to be selected. A line around a solid object and secured by a carabiner is very secure but takes more time than other options. A hook or bar in the window allows for a rapid exit maneuver but is much less secure and requires a higher level of training.
7. The compatibility of the escape system during transport, deployment, and use with the PPE worn by the organization’s personnel. Evaluation of escape systems should be done with the evaluator wearing full PPE and SCBA or any other equipment normally carried.
8. The situational use of the escape system. For example, the evaluator might want to start the escape system deployment while on knees or hands and knees.
9. The type of structures and construction in the response area. Organizations should choose the anchor device best suited for the prevalent type of construction in their areas, such as interior anchor points, window framing of wood or brick, kinds of furniture, or exterior walkways or railings.

A.5.1.4 From time to time, NFPA receives complaints that certain items of fire and emergency services protective clothing or protective equipment could be carrying labels falsely identifying them as compliant with an NFPA standard. The requirement for placing the certification organization’s mark on or next to the product label is to help ensure that the purchaser can readily determine compliance of the respective product through independent third-party certification.

NFPA advises those purchasing life safety rope or equipment to be aware that for life safety rope or equipment items to meet the requirements of NFPA 1983, they must be certified by an independent third-party certification organization. In addition, the item must carry the label, symbol, or other identifying mark of that certification organization.

A life safety rope or equipment item that does not bear the mark of an independent third-party certification organization is not compliant with NFPA 1983, even if the product label states that the item is compliant.

For further information about certification and product labeling, see Chapters 4 and 5 of NFPA 1983. Also, the definitions for certification organization, certified, labeled, and listed in Chapter 3 of this standard should be reviewed.

Third-party certification is an important means of ensuring the quality of emergency services protective clothing and equipment. To be certain that an item is properly certified, labeled, and listed, NFPA recommends that prospective purchasers require appropriate evidence of certification for the specific product and model from the manufacturer before purchasing. Prospective purchasers should also contact the certification organizations and request copies of the certification organization’s list of products certified to the appropriate NFPA standard. Such a “listing” is a requirement of third-party certification by this standard and is a service performed by the certification organization.

All NFPA standards on fire and emergency services protective clothing and equipment require that the item be certified by an independent third-party certification organization, and all items of fire and emergency services protective clothing and equipment must carry the label, symbol, or other identifying mark of that certification organization.

Any item of protective clothing or protective equipment covered by an NFPA standard that does not bear the mark of an independent third-party certification organization is not compliant with the appropriate NFPA standard, even if the product label states that the item is compliant.

A.5.2.1 Typically the intended application of life safety rope is for protection of a person from fall or for actual access to or from height. While design for these applications might seem to be close, specific choices of life safety rope should be made for specific applications. Choices that the AHJ might make include but are not limited to material, construction, elongation, strength, diameter, weight, hand, color, and length. For example, a fall protection rope that has the ability to absorb energy safely might be more important than other qualities for protecting someone at risk of falling from height, while in a rope lowering or raising operation, a less elastic rope might be a better operational efficiency choice.

A.5.2.2 Cordage. Cordage typically used in life safety ropes are nylon, polyester, and para-aramids.

Nylon. Nylon for ropes comes in two types, Type 6 and Type 6.6. They have similar properties, but nylon 6.6 has less elongation and a slightly higher melting temperature (258°C) than Type 6. Type 6 nylon is often chosen if more elongation is desired (see A.5.2.4) and maximum strength (see A.5.2.5) and temperature resistance are not as important. Nylon, with a specific gravity of 1.14, is resistant to weak acids, decomposed by strong mineral acids, resistant to alkalis, resistant to organic solvents, and soluble in phenols and formic acid.

Nylon life safety ropes are very durable, usually have good handling qualities, and usually have a higher elongation percentage than other fibers. Nylon also absorbs water, resulting in increased weight and decreased strength.
**Polyester.** Polyester is lower in elongation than nylon, has about the same strength and temperature range as nylon 6,6, and has a specific gravity of 1.38. Polyester life safety ropes are selected if extremely low elongation is desired or the rope is expected to be used in wet conditions.

Life safety rope with a polyester sheath and nylon core has been available for several years and provides some of the advantages and disadvantages of each. Not as common and not around as long, nylon sheath and polyester core might have unique advantages for certain applications.

**Para-aramids.** Para-aramids include Kevlar®, Twaron®, and Technora®, among others. All of these fibers are much stronger than nylon and polyester and have very low elongation. They do not melt but decompose around 500°C. The specific gravity is over 1.39. Para-aramid ropes are selected when high temperature or flame resistance is required, often the choice for escape rope.

**UHMWPE.** Ultra high molecular weight polyethylene fibers include Spectra® and Dynema®. The low melt point (150°C) of these yarns does not allow it to qualify for life safety rope, but its low specific gravity (0.97) and high strength make it a common choice for water rescue throwlines.

### A.5.2.3 Rope construction is the method of assembling the yarn bundles into ropes. Different assembly types have various properties, making some constructions better than others for a particular application. NFPA 1983 does not specify any one particular rope construction type or material but provides performance requirements for a certified rope. Typical constructions found in emergency services are laid rope, double braid, and kernmantle (see Figure A.5.2.3)

**Braid.** A rope or textile structure formed by a braiding process. [CI 1202, used with permission]

There are many subcategories of braids, each having its own advantages and disadvantages for use in rescue.

**Braid Pattern.** A description of the manner in which the strands of a braided rope are interwoven. A plain (diamond) pattern is when one strand (or multiple strand) of one direction of rotation about the axis passes over one strand in the opposite direction and it in turn passes under the next strand of the opposite direction. A twill pattern is when one strand (or multiple strand) of one direction of rotation about the axis passes over two strands of the opposite direction and it in turn passes under the next two strands of the opposite direction. [CI 1202, used with permission]

The diamond braid pattern is more common in life safety rope applications, but either pattern is permitted by NFPA 1983.

**Hollow Braid.** A single braided rope having a hollow center consisting of multiple strands which may be braided in a plain or twill pattern. A 12-strand braid is commonly used. [CI 1202, used with permission]

Hollow braids are the simplest of all braids to make. Their low strength compared to other constructions and soft hand make them seldom used in life safety rope applications, but they are found in utility fire service applications such as ladder halyards. Hollow braids lack the protective feature of a load-bearing core protected by an outer braid.

**Double Braid.** A rope constructed from an inner hollow braided rope (core) surrounded by another hollow braided rope (cover). Also called Braid-on-Braid, 2 in 1 Braid. [CI 1202, used with permission]

Double braids were popular with some fire rescue operations in the past. Their typical easy hand runs well in rigging gear such as pulley systems. Because the generally looser construction is easier to snag and abrade on rough surfaces, the double braids are no longer a selected as a life safety rope for fire ground or remote rescue operations.

**Solid Braid.** A cylindrical braid in which each strand alternately passes under and over one or more of the other strands of the rope while all strands are rotating around the axis with the same direction of rotation. On the surface, all strands appear to be parallel to the axis. [CI 1202, used with permission]

Solid braid is one of the more economical methods of manufacturing ropes, and many utility ropes in smaller diameters can be found in this construction style. They are often seen in water rescue ropes and hardware store general-duty small ropes.

**Laid.** Ropes made by twisting of three or more strands together with the twist direction opposite that of the strands. [CI 1202, used with permission]

Laid ropes are probably one of the earliest tools known. First made of natural plant fibers such as grass, they are now available in modern fibers like nylon and polyester. It is important to note any wear on the outside fibers because they are all twisted together without an independent inside core, unlike kernmantle and double braid constructions. Laid ropes are higher elongation than many other construction types. Elongation provides energy absorption in a fall but also makes for more work in haul and lower systems due to the same stretch. The built-in twist in laid ropes can also be a management problem for the user in fire rescue operations.

**Kernmantle.** A rope design consisting of two elements: an interior core (kern) and an outer sheath (mantle). The core supports the major portion of the load; and may be of parallel strands, braided strands or braided. The sheath serves primarily to protect the core and also supports a portion of the load. There are three types: static, low stretch and dynamic. [CI 1202, used with permission]

Typical rescue kernmantle construction is a braided sheath over a continuous parallel core. This design provides relatively low elongation due to the parallel core strands and excellent...
protection of the core fibers from the covering sheath. Various models are available with thicker or thinner sheaths, tighter or looser sheaths, and low or high twist parallel core strands. Additionally, many different choices of materials and blends of materials are available. Most life safety ropes today are of kernmantle construction.

A.5.2.4 Elongation is the ratio of the extension of a rope, under an applied load, to the length of the rope prior to the application of the load expressed as a percentage. Rope increases in length as the load on the rope increases. [CI 1202, used with permission]

A rope’s ability to elongate is important in that elongation can be a critical part of reducing the impact forces on the user and the system in a fall. Fall factors are a means of describing the relationship of the length of a fall to the amount (length) of rope available to absorb the fall’s energy. Should a user fall from his or her position, rope anchored high above the user will provide a much lower fall factor than a rope of the same length anchored below the user.

NFPA 1983 requires manufacturers to provide users with the elongation of certified ropes at 1.35 kN (300 lbf), 2.7 kN (600 lbf), and 4.4 kN (1000 lbf). This information can provide a good comparison between one rope and another as to their elongation to load curves for typical working loads. The more a rope elongates, the more energy it will absorb in a fall. Too much elongation can cause problems such as rope bounce when lowering, excess resets in haul systems, and loss of control in mid-face loading in a pick-off rescue. Typical fire-rescue applications choose ropes classified by the Cordage Institute as either static or low stretch.

**Static Rope.** A rope with a maximum elongation of 6% at 10% of its minimum breaking strength. [CI 1202, used with permission]

Static life safety rope is usually selected when rope stretch will be a problem. This can occur with high lines, guiding lines, long rappels, or rope systems with a long length of rope involved. Static ropes allow a more efficient mechanical advantage haul system because less stretch must be removed from the rope after each reset of the system.

**Low Stretch Rope.** A rope with an elongation greater than 6% and less than 10% at 10% of its minimum breaking strength. [CI 1202, used with permission]

Low stretch life safety rope provides a balance between not too much stretch during use and some elongation to absorb energy should a shock load occur to the system. There is always a trade-off in arresting a falling rescuer or litter — the less distance the fall, the higher the impact force but also the less chance of hitting something on the way down.

**Moderate Stretch Rope.** A rope with elongation greater than 10% and less than 25% of the rope’s minimum breaking strength. [CI 1805, used with permission]

Moderate stretch rope is not classified as life safety rope according to NFPA 1983 because of the greater amount of elongation. Moderate stretch rope is classified as a special-use rope defined by NFPA 1983 as moderate elongation life saving rope. The greater elongation allows for a lower impact force, but there is more movement when the rope is loaded.

**High Stretch Rope.** A rope with an elongation greater than 25% at 10% of the MBS. [CI 1805, used with permission]

High stretch rope is very high elongation rope compared to static and low stretch ropes. Requirements for this rope are based on the UIAA climbing rope standard for mountaineers and are typically outside the scope of NFPA 1983. Dynamic ropes are used to lower the impact load on a climber’s body, the anchors, and the equipment in a roped fall. One use in the fire service is for belaying a rescuer approaching a person who is threatening suicide by jumping from a height.

A.5.2.5 Life safety rope certified to NFPA 1983 must meet a minimum performance level for the intended use. The MBS is a statistical calculation that provides a number in which the user can have confidence that all new ropes of that design will meet or exceed that MBS. The MBS test is a best case test method, and real field applications are not likely to get the same strength.

Edges, knots, age, wear, temperature, moisture and many other factors can lower the real breaking strength of a rope in use. Some factors will change the strength, as when a knot is untied or replaced with a different knot, making the rope stronger or weaker. Others factors such as wear or chemical exposure can cause permanent loss of strength.

Simply specifying “the strongest rope available” is problematic because strength is directly proportional to rope diameter. As the diameter increases, so does the weight of the rope. An understanding of the organization’s system safety factor will determine what strength specification will be sufficient when force multipliers, knot efficiency, possible dynamic loading, and the other system components are considered.

A.5.2.6 For NFPA 1983, the actual diameter of a certified rope is determined according to Section 9.1 of CI 1801, Low Stretch and Static Kernmantle Life Safety Rope, and then rounding to the nearest 0.5 mm (1/64 in.).

Equipment such as pulleys, ascenders, and descent control devices often work correctly only when matched with the correct diameter rope. In some combinations, a very small difference in rope diameters will change the performance of the other devices. The organization must take care to make sure the ropes purchased match the other devices in service or expected to be purchased in the future.

Larger diameter ropes are easier to grip, but they also are heavier.

A.5.2.7 The weight per unit length of a rope is a good indicator of the amount of material used to produce a rope when comparing one rope construction to another. Generally speaking, a rope with a higher per meter weight will be stronger than a rope weighing less per meter when both are made from the same material.

Consideration needs to be given to the length and the diameter of a rope and the weight of a given rope length for deployment and transportation to the site. Bigger is not necessarily better if a rope has to be carried long distances and an adequate safety factor could be provided with a smaller diameter rope.

A.5.2.8 The feel of flexibility and smoothness of a rope when tying knots or running it through equipment such as descent control devices and pulleys is often referred to as “hand.” While a soft hand makes knots in ropes easier to tie, they may not untie after loading as easily if the hand is too soft. Ropes with a soft hand can also overly flatten out over edges and when running through descent control devices and pulleys.

Ropes with a very stiff hand have better abrasion resistance and flatten less in devices, and loaded knots might be easier to untie. The correct choice could be between these extremes, depending on the devices being used with the rope and the environment it will be rigged in.
A.5.2.9 The most common use of color is to differentiate life safety rope while it is in service. For example, the main line would be one color and the belay line a different color — the rope that requires action can be quickly identified by the color.

Other choices for the use of color could be to designate different lengths of rope used by the organization or to indicate the year of purchase.

A.5.2.10 Length is a critical specification in that ropes must reach the ground (or location of the intended load) with enough length to tie into anchors, build haul systems, and allow for operational personnel at the top and bottom to be back from any hazard zone. While ropes can be knotted together to extend the length, passing a knot through a device or system is time consuming and should be avoided if sufficiently long ropes can be deployed. Shorter length ropes can also be carried to aid in rigging.

Organizations performing hazard assessments for their jurisdiction must consider all tall objects from which a rescue might be needed, not just high-rise or multistory buildings. Bridges, dams, radio towers, tunnels, ventilation shafts, and the like are all potential sites for rope rescue. Having adequate rope lengths and numbers are key to a smooth and safe operation. Some rescues off high objects are often best run from the ground requiring more than double the height of the object to operate successfully.

Jurisdictions that have a variety of heights should consider carrying different lengths of rope. For a rescue from a lower height, a shorter rope will reduce the bulk and weight needed to be carried to the rigging area. For rescues from higher structures, longer ropes allow a smoother rescue by avoiding a knot pass through a device or system.

A.5.2.11 NFPA 1983 requires the fiber of a life safety rope to have a melting point of not less than 204°C (400°F) when tested to ASTM E 794. The thermal requirement limits damage to the rope due to heat generated by the friction of the life safety rope running through a descent control device or over edges.

The performance of nylon and polyester life safety ropes will begin to degrade at temperatures below the melting point of the fibers. For that reason, use intended on the fire ground or near high temperatures require some means of protecting the rope.

A.5.2.12 There are many factors to consider in the design of a rope. The AHJ should review, inspect, and compare a rope’s interaction with the organization’s equipment in expected conditions of use. No organization should assume that, given various types of ropes, all rope-related equipment will function or react the same. Rope sheath material, core material, and their interaction with each other should be considered. Rope performance can vary when materials used in the construction of the sheath differ from those used in the core.

Sheath designs, including the braid pattern, number of yarn carriers, and the tightness of the sheath, are critical elements to consider for the interface between the rope and various items of hardware, such as descent control devices, pulleys, ascenders, rope grabs, and belay devices. The organization must evaluate the interaction of its equipment to determine favorable performance for various styles of ropes and their materials and construction features.

Also of importance is the hand and abrasion resistance of the rope. The number of carriers and the tightness of the sheaths braid can affect the hand and the abrasion resistance of the rope. These characteristics should be evaluated by the AHJ to determine the desired performance of a rope.

A.5.3.1 Escape rope is part of an assembly worn by a rescuer and used to descend from a position of height to safety at a lower level. An escape assembly might have an escape anchor device, an escape rope, and an escape descent control device connected to a belt or harness or integrated into a SCBA or the turnout jacket or pants. The assembly might be carried in a pocket or bag attached to the rescuer. The organization should evaluate through practical testing to ensure that all the components are compatible and function as intended. For selection criteria on the other components that might be a part of the escape assembly, see Sections 5.6, 5.9, and 5.18.

A.5.3.1(1) Exposure to elevated temperatures degrades the strength of the any rope, which decreases the time that the rope is able to support the user. Larger diameter ropes provide a greater resistance to failure at elevated temperatures. Greater bulk takes longer for the effect of heat to weaken the rope, allowing more time to complete the egress. The trade-off is greater bulk and weight.

In general, fire escape rope should be used when higher temperatures are anticipated. Escape rope can be chosen when temperatures not requiring PPE for heat are anticipated.

It should be noted that no fiber is fire proof and that fire escape rope, while having a higher working temperature, is still susceptible to the high temperatures typically found in burning structures.

A.5.3.1(2) The termination at the anchor end of the rope determines how the user will connect the rope to a structure for a secure anchor that will support the user’s weight. The end of the rope can be attached to a hook, bar, or carabiner using a knot or sewn termination. Either type of termination reduces the strength of the rope by some factor.

A.5.3.1(3) Not all ropes are tested or certified with all types of descent control devices. The organization should determine that the rope selected is compatible with the type of descent control device selected. The manufacturer of the device should be able to supply the information as to which specific ropes have been determined to function and consulted as to what type of rope was tested or certified with the selected descent control device.

A.5.3.1(4) This is a function of the descent control device selected, the diameter of the rope, and the “gripping” surface of the rope. Proper technique for most escape descent control devices includes operating the device with one hand while the other hand grips the rope. The tension required with the hand gripping the rope depends on the particular descent control device. The more tension that must be held by the hand on the rope, the more important is the ability to grip the rope.

A.5.3.1(5) When making an emergency escape, there is a high probability that the user will impact the escape rope and system in an attempt to exit quickly. It is important that the system or components chosen will limit the impact forces on the user, the anchors, and other components to limit user injury and prevent a failure of the system.

There are a number of ways this can be addressed in the design of an escape system:
A Class 3 harness can be one piece or a combination of a Class 2 harness and a chest harness that connect together. A Class 2 harness used with a separate chest harness provides upper body support but might not transfer the user’s load to the Class 2 harness.

While both types of harnesses are capable of fall arrest, the most commonly used industrial fall protection attachment points are sternal or dorsal, which requires a full body harness.

NFPA 1983 requires that both the Class 2 and Class 3 harnesses pass a head-down drop test to verify the harness will not allow the user to fall out of it.

A.5.4.2 NFPA 1983 provides for two types of attachment points: load bearing and positioning. A load bearing attachment point is designed for a higher static load and for an impact load. A positioning attachment point is intended only to support the user’s weight while the user is sitting in the harness or for travel restraint to prevent the user from reaching a location where a fall could occur.

Load Bearing Attachment Points are usually at the front waist and the sternal and dorsal locations. The front waist attachment point is the most common on life safety harnesses and provides the most useful attachment location for descents and for working in the harness. This attachment point allows the user to sit in the harness and allows maximum mobility for operations such as pick-offs and litter tending.

Because the sternal attachment point is above the user’s center of gravity, it holds the user in a more upright position while transferring the load to the waist and leg straps of the harness. A sternal attachment point would be selected if a more upright position is required, such as for entry into a narrow space or helicopter hoist operations. The sternal point is also used for limited fall arrest, allowing the user to be stopped in a more upright position and facing the life safety rope.

The dorsal attachment point is used for fall arrest system attachment in an industrial-type work situation where space below the user is provided for the arrest.

Positioning attachment points are usually at the side, shoulder, or rear waist. Side attachment points would be selected if the wearer will be leaning back into the harness while attached to a structure. They provide a more stable position than a single attachment point at the front waist.

A Class 3 harness with shoulder attachment points would be selected when there is a requirement to lift the user in linear body position for movement through a narrow space.

The rear waist attachment point is used for travel restraint to prevent a fall when the user is working near an edge.

A.5.4.3 Comfort and ease of donning are both subjective evaluations of harness performance. Due to the human factors involved, practice with different harnesses or review of evaluations by other organizations will be required.

Weight is another function of comfort. A Class 3 harness with multiple attachment points weighs several pounds and while providing the user comfort during suspension, the added weight must be carried when the user is walking or climbing.

A.5.4.4 Specialty fibers are used in construction of a harness to meet exposures not normally found in rescue situations.

Fire-resistant (FR) fibers provide a greater durability when exposed to the heat of fire ground operations and can be an essential specification for harnesses worn for escape. The FR fiber webbing is more expensive and has a shorter service life.

A.5.4.1 NFPA 1983 divides harnesses into two classes, Class 2 and Class 3:

1. A Class 2 life safety harness fits around the waist and around the thighs or under the buttocks. Sometimes referred to as a “sit” or “seat” harness, it is the primary load-bearing surface for both the Class 2 and Class 3 designs. A Class 2 harness provides greater mobility for some rescues and is all that is required for low-angle rescue.

2. A Class 3 life safety harness fastens around the waist, around the thighs or under the buttocks, and over the shoulders; it is also referred to as a “full-body” harness. A Class 3 harness provides greater upper body support, which is useful for vertical operations such as confined space entry and helicopter hoists.

A.5.3.2(4) Because of the smaller diameter of escape ropes and the high-tech fibers that might be selected, fire escape ropes are not as durable as life safety ropes. Generally, escape ropes should have minimal use, such as one or two rappels, to verify the performance and the user’s ability to operate the escape assembly, then annual currency training. If the organization’s protocol calls for greater use, then a larger diameter rope should be selected to increase durability.

A.5.4 Life safety harnesses fulfill a variety of roles for both rescue and fire ground operations. Specialized harnesses might be required for different types of operations and levels of operational capability. Some harnesses are specialized, while other designs are suitable for a wider range of uses. Following is a list of specialized harnesses:

1. An escape harness is intended to be worn during elevated operations and used with an escape system for an emergency descent to a lower position of safety.

2. A rescue harness is designed to provide a safe working platform for a rescuer supporting the load of a victim.

3. A travel restraint harness is a fall protection harness that prevents the wearer from reaching a position where a fall might occur. The rescue version of a travel restraint harness will have travel restraint attachment points.

4. A fall arrest Harness is a fall protection harness that stops a fall and supports the wearer until he or she can self-rescue or be retrieved by others. A rescue harness will have fall arrest attachment points.

A.5.3.2(2) For example, on the firefighter the escape rope might be carried or worn in the turnout pants, in the turnout coat, on the SCBA, or on a belt. The location and the packaging affect the user’s ability to deploy the rope and should be evaluated while the user is wearing full equipment; while the user is in different positions, such as kneeling; and while the user is wearing SCBA and mask. The location of the rope cannot not interfere with the use or performance of other PPE worn by the user.

A.5.4.3 Comfort and ease of donning are both subjective evaluations of harness performance. Due to the human factors involved, practice with different harnesses or review of evaluations by other organizations will be required.

Weight is another function of comfort. A Class 3 harness with multiple attachment points weighs several pounds and while providing the user comfort during suspension, the added weight must be carried when the user is walking or climbing.

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Fire-resistant (FR) fibers provide a greater durability when exposed to the heat of fire ground operations and can be an essential specification for harnesses worn for escape. The FR fiber webbing is more expensive and has a shorter service life.
Hazmat or confined space operations can create an exposure to certain chemicals. If anticipated exposures are known, then webbing made from fiber resistant to that chemical can be specified.

For water and flood rescue operations, water reduces the performance of nylon; a hydrophobic fiber will dry quicker.

A.5.4.6 The personnel conducting the evaluations should wear the harness with the equipment to be used and with other required PPE. The evaluators should conduct simulated operations such as rappels, emergency escape descents, high angle stretcher tending, low angle stretcher tending, and work-at-height operations.

A.5.5 Belts do not provide the support of a harness, and their use must be limited to their specific functions.

A.5.5.2 An escape belt should be used only if the wearer will be suspended for the minimum amount of time necessary to reach a safe area. For most organizations, an escape belt is also used as a tool belt or an equipment belt.

A.5.5.3 A ladder belt has a positioning attachment point at the end of a tether. The maximum length of the tether is specified in NFPA 1983. The gate opening of the carabiner at the end of the attachment tether must be large enough to fit over the intended connection location on the organization’s ladders.

An escape belt requires at least one load-bearing attachment point to which the escape system will be attached. This attachment point selected must be compatible with the escape system.

A.5.5.4 Comfort and ease of donning are subjective evaluations of belt performance. Due to the human factors involved, practice with different belts or a review of evaluations by other organizations might be required. Evaluations should be done with the ensembles intended to be worn by the personnel, taking into consideration whether the belt will be worn over or under a coat, integrated with pants, and compatible with the ensemble to be worn, and with other required PPE. The evaluators should conduct simulated activities such as emergency escape descents or climbing and descending ladders.

A.5.5.5 Specialty fibers are used in construction of a belt to meet exposures not normally found in rescue situations.

FR fibers provide a greater durability when exposed to the heat of fire ground operations and can be an essential specification for a belt worn for escape. The FR fiber webbing is more expensive and has a shorter service life.

Hazmat or confined space operations may create an exposure to certain chemicals. If anticipated exposures are known, then webbing made from fiber resistant to that chemical can be specified.

A.5.5.6 Accessories include but are not limited to loops, holsters, or pockets for carrying tools. Any accessory added to the belt should not interfere with the performance of the belt’s intended function.

A.5.5.7 The personnel conducting the evaluations should wear the belt with any equipment that might be carried, with the ensemble to be worn, and with other required PPE. The evaluators should conduct simulated activities such as emergency escape descents or climbing and descending ladders.

A.5.6 A carabiner is an auxiliary system equipment item used to join other components to life safety rope or other system components. It is a load-bearing connector with a self-closing gate (see Figure A.5.6).

A.5.6.1 For evaluating whether the organization should select general-use or technical-use carabiner, see A.5.1.2(3).

A.5.6.2 Carabiner gates have several different methods of preventing the carabiner from accidently opening during use. The simplest design does not have a locking system and is usually referred to as a nonlocking carabiner. While having a long history of use for life support in the recreational field, nonlocking carabiners are not considered adequate for industrial or fire service use. See 6.5.5 of NFPA 1983.

Manual lock designs require a physical movement to activate the locking mechanism, which can be either a sleeve that screws the gate over the nose or a sleeve that, once activated, snaps into place. A physical movement is required to move the sleeve down to unlock the carabiner. Common names for this type of carabiner lock design include screw gate and manual lock.

An automatic locking gate is designed so that when the gate closes, a spring moves the sleeve up the gate and over the nose. Two or three physical movements are required to unlock the gate. This type of carabiner is usually referred to as auto-locking.

Auto-locking carabiners might be preferred for life safety use because the user does not have to remember to activate the gate-locking mechanism. Manual-lock carabiners have the advantage of easier removal from their storage location because they do not need to be unlocked first. Before relying on the carabiner for life support, the user must verify for both types that they are locked; while the gate might close automatically on the auto-locking model, if webbing or clothing blocks the gate from closing, the carabiner will be unlocked and could even remain open.

A.5.6.3 The most common carabiner materials are steel and aluminum. Steel carabiners generally are the strongest and heaviest, but they weigh more than comparable-sized aluminum carabiners. Carabiners of aluminum and steel meet the general-use performance requirements of NFPA 1983. Consider which criteria must be met: strongest without consideration of weight or lightest while maintaining an acceptable safety margin.

In general, steel carabiners are plated or coated to resist rust and other corrosive effects. The quality of the finish and the expected atmosphere should be considered. Aluminum and stainless steel carabiners are affected less by rust but can be corroded by chemicals and atmospheres. Special or unique operations might require a specific material or additional care.

A.5.6.4 The shape and size of the arc is determined by the anticipated strength requirements and the size of components to which the carabiners will be attached. For example, a cara-
A carabiner with an asymmetrical shape shifts the load toward the spine and away from the gate, resulting in a carabiner that is stronger for its weight and size. As the load moves away from the spine, such as with triaxial loading, the effective strength of the carabiner is reduced. Common asymmetrical shapes are "D" and a modified "D."

A symmetrical carabiner centers the load equally on the gate side and the spine and is less susceptible to strength loss due to triaxial loading. For the same size and weight, the symmetrical carabiner is generally not as strong as an asymmetrical carabiner. Common shapes are oval and pear shaped.

Larger carabiners tend to be stronger due to the larger diameter stock used. They also fit over larger diameter connection points. Some models use an offset or side-swing gate to increase the gate opening for fit over large connection points. Small carabiners also can be very strong and have an advantage in being lighter, allowing more equipment to be carried.

A.5.7 A rope grab is an auxiliary system equipment item used to grasp a life safety rope for the purpose of supporting loads. Rope grabs include ascending devices.

An ascender is a type of rope grab auxiliary equipment that is a friction or mechanical device used to ascent a fixed line. Ascenders typically have a handle or other method of grabbing to allow them to be easily pushed up a rope.

A.5.7.1 For evaluating whether the organization should select general-use or technical-use equipment, see A.5.1.2(3).

A.5.7.2 Rope grabs have several different methods of gripping the rope.

Pressure Plates. Typical fall protection rope grabs used in industrial fall arrest have wide plates that spread the force applied to the rope grab’s attachment point to a large area of the rope compared to other rope grabs. This type of rope grab is often designed to slip on the rope at a force low enough to prevent injury to the user in a fall.

Enclosed Cams. Many technical rope rescue rope grabs have a cam that is also the direct attachment for the load on the rope grab in use. Typically, the cam is removable by a pin that acts as the fulcrum of the cam. The cam applies force by compressing the rope between the cam and the body of the rope grab. These types of rope grabs are often designed not to slip or to slip at a force high enough to allow them to be used in typical mechanical advantage rope systems. They should not be used for fall arrest.

Rope grabs used in hauling systems tend to be the heavier aluminum models that completely close around the rope. These types usually require two hands to place them on or remove them from the rope but are typically mechanically stronger frames because of the enclosed design. Even so, the true strength of a rope grab can be determined only in conjunction with the rope chosen to be used with it, since the action of the rope grab can cause failure in the rope. Some rope grabs are designed to slip at a high load to protect the rope from being cut; others will continue to dig in until the rope fails.

Handled ascending. Rope grabs used as ascenders for personal ascending of a fixed line typically are made to be easily placed on or removed from the rope with one hand. They tend to have a single open side with a safety that prevents the ascender from coming off the rope inadvertently. The cam is often a fixed pivot point with a curved frame to guide the rope and a safety device to prevent accidental removal from the rope. These types of rope grabs (ascenders) typically are not rated as strong as other types and are usually used in pairs for ascending ropes. They should not be used for fall arrest or mechanical advantage rescue systems due to their typically lower strength rating.

A.5.7.3 The most common rope grabs are steel and aluminum. Steel rope grabs generally are the strongest and heaviest, but they weigh more than a comparable-sized aluminum grab. Steel and stainless steel rope grabs typically are found as personal fall protection grabs for industrial use as worker protection. They can be used as self-trailing rope grabs on a second life line when ascending or descending a main life line or as a backup for ladder climbs. Industrial fall protection rope grabs carry an ANSI Z359 or similar certification.

In general, steel rope grabs are plated or coated to resist rust and other corrosive effects. The quality of the finish and the expected atmosphere should be considered. Aluminum and stainless steel rope grabs are affected less by rust but can be corroded by chemicals or atmospheres. Special operations might require a specific material or additional care.

A.5.7.4 Of all the equipment used in technical rope rescue, a rope grab’s performance is affected the most by the rope used with the rope grab. Subtle differences in rope materials, sizes, and construction can give dramatically different strength or slippage results with rope grabs. Rope grabs of aluminum and steel might meet the general-use performance requirements of NFPA 1983, but the user must ensure that the desired strength has been tested on the specific rope that will be used with the rope grab. For that reason, most rope grabs on the market meet only the technical-use performance requirements of NFPA 1983. Consider which criteria must be met: strongest without consideration of weight and slippage or lightest while maintaining an acceptable safety margin.

A.5.8.1 The MBS of approved throwlines is specified in NFPA 1983, but consideration must be given to the possibility of a multi-person load factor when a throwline is used in actual rescue scenarios. Throwlines are designed primarily for the safe capture of single waterborne individuals from a land-based or boat-based platform.

A.5.8.2 The acceptable diameter range of approved throwlines is specified in NFPA 1983. End users must consider both volume (desired length) and grip (diameter and weave) characteristics of throwlines. Larger diameter throwlines require larger containment bags and take up increased storage space, but they offer both increased strength and better grip functions when wet.

A.5.8.3 The ability of throwlines to float, which is required by NFPA 1983, greatly enhances retrieval of a victim from water. Nonfloating throwlines have the disadvantage of increased weight when they become saturated during victim retrieval from a water environment. When rope submerges, it can create a snag hazard, potentially causing a hazardous situation in moving water. For a throwline to float, it must have a specific gravity of less than 1, and the fibers meeting that requirement usually are not as strong as the fibers used in life safety rope. The organization might determine that any throwline selected meets its requirements for floatability.
A.5.8.4 The handling characteristics of a throwline are important because it needs to remain flexible, wet or dry, and be supple enough to be readily repacked in its original form for immediate reuse.

A.5.8.5 The maximum length that a strong person can deploy a throwline using a throwline bag is about 24 m (80 ft). Shorter lengths depend on the width of the water courses in the jurisdiction and how the throwline is transported by the user. Longer lines might be selected for deployment from bridges or by other means. Users operating in boats often select a shorter length due to the greater limits on the distance the bag can be thrown.

A.5.8.6 A water rescue throwline should be stored in a bag that allows ease of transport and also allows the throwline to be deployed farther and with greater accuracy. The bag should have some flotation to help the end of the throwline stay on the surface and for greater visibility in the water. There also should be a means for connecting the throwline to the bag. The bag should be constructed in a manner that allows water to flow through it during deployment and provides air circulation. Other considerations include the ability to attach the bag to the rescuer for transport and attachment points or pockets for a carabiner or lightstick. High visibility materials improve the visibility of the bag when deployed.

A.5.9.1 The function of a descent control device is to control the lowering of a load suspended by a life-safety rope. The descent control device adds variable friction to the rope, allowing one person to control the rate of descent. The operator and the device could be stationary at the top or could be moving along the rope, as in a rappel. Some designs are limited to one type of descent, while others perform well for various applications. For example, a brake bar rack is a popular rappel device for cavers and a common device for the main line for lowering a litter system. The device used for both of those applications is too large and too heavy to be carried as an escape device and would not be the best fit for the smaller rope and webbing used for with the escape device.

A.5.9.2 Anticipated loads could be as high as 4 kN (900 lbf.) for a litter system with a patient and two tenders. For a single-purpose escape descent device, the anticipated maximum load would be limited to 1.33 kN (300 lbf.). For evaluating whether the organization should select general-use or technical-use equipment, see A.5.1.2(3).

A.5.9.3 Many different descent control devices are available to rescuers. It is important to note the vast design and operating differences in traditional variable friction devices to devices with auto-locking and/or panic-stop features. Selection should be based on an evaluation of the interaction of the descent control device with not only the life-safety rope selected but with the entire rescue system. For example, some descent control devices do not need to be removed from the system and can be used as a progress capture pulley during conversion from a lowering system to a mechanical advantage system. The experience of the rescuers and the organization’s standard operating procedures also should be considered to ensure that a system is in place to stop a load from moving unintentionally (e.g., delay system, auto-locking descent control device). The following advantages and disadvantages should be compared when selecting a descent control device:

(1) Manual and auto-locking are the two primary functional types of descent control devices. An auto-locking device requires the operator to activate the device to allow the rope to slide through. If the operator lets go, the rope movement stops. A manual device requires the operator to maintain a grip on the rope during lowering and physically tying off the device when stopped. Most manufacturers of auto-locking devices recommend maintaining a hand grip on the rope as a safety back-up. Manual devices tend to be simpler, have fewer moving parts subject to wear, are easier to inspect, and might be lighter in weight than auto-locking devices. Many of the current auto-locking designs are intended for rappel and might not be robust enough for litter systems.

(2) A descent control device designed for escape or bailout should be small and lightweight for wear with turnouts but still be easy for the rescuer to operate when wearing PPE gloves. A descent control device for a lowering system can be more robust, and weight might be less of a factor if it is used primarily when attached to a vehicle or over the side systems.

(3) Descent control devices are marked with the diameter of life safety rope for which they are designed to be used. Even with the compatible diameter, performance can vary both to the MBS and to their effectiveness. Descent control devices are tested in a manner of function, and the MBS can vary significantly, depending on the life safety rope used. The manufacturer can supply the specifications of the rope for which the descent control device has been tested. The amount of friction generated by the descent control device also varies, depending on the life safety rope used and should be evaluated with field trials.

A.5.9.4 The level of initial training and the frequency of ongoing training are factors in determining which descent control device is best suited for the organization. For example, a technical team that works with a variety of rope rescue equipment and trains regularly will maintain a competency that allows a wider choice of descent control device and might have different types available.

(1) Pre-rigged descent control devices are the preferred choice for escape and bailout primarily because of the requirement for immediate deployment. A pre-rigged descent control device also could be used for basic rope systems in which the response analysis shows a consistent type of rescue. For example, a truck company that responds to over-bank rescues could have the life-safety rope rigged to the descent control device and ready to attach to the anchor and the rescuer when the rope is pulled out of the rope bag.

(2) Auto-locking devices use a lever to vary the friction. Pushing or pulling the lever reduces friction and allows the rope to move through the device faster. Pushing or pulling more increases the rate. If the operator panics and holds the descent control device open, the load will not
be stopped. Some of the auto-locking descent control devices have a panic-stop function in which a full push (or pull) slows or stops the movement. While this safety feature can be valuable, the trade-off is that the descent control device’s “sweet spot,” where the rope runs through best, can be hard to find in some designs.

The organization should evaluate the compatibility of its operational procedures with rigging the rope into the device; manipulating the device to adjust the friction, stop movement, and lock off the descent control device in a safe manner; passing a knot; and converting from a lowering to a raising and back.

A.5.10.4 A portable anchor can have components that are required to be assembled according to the manufacturer’s instructions. Evaluation should be conducted on the ease of assembling the components in the environment in which rescuers will use the device. Components should remain secure once assembled and be easy to disassemble once the operation is complete.

A.5.10.5 A portable anchor should provide the user with multiple configurations and adjustability appropriate to the application. The portable anchor should be evaluated for adjustability of legs and/or arms over both even and uneven terrain. Height adjustability also should be evaluated to ensure that proper attachment point height is achieved in different configurations.

A.5.10.6 Davit-type portable anchors usually are mounted on a portable U-shaped frame or on a pre-installed mount. The frame should be evaluated based on its portability, type of surface it will be used on, and the size opening it must accommodate. Portable anchors with legs, such as tripods, all have some type of foot at the end of each leg. Sharp, pointed legs hold well on soft surfaces and often on rock or asphalt. Flat feet are used where the surface needs protection from penetration, such as on some roofs or floors.

A.5.11 A pulley is a device that allows for a rope to pass over one or two sheaves to apply a multiplication of force or simply to change the direction of the rope. (See Figure A.5.11.)

A.5.11.1 Pulleys are used primarily to set up mechanical advantage systems to increase the ability of personnel to lift a rescuer, litter, victim, or a combination of those. Pulleys are also used to change the direction of a life safety rope to increase the efficiency of a pull, to avoid friction-causing surfaces, to move the life safety rope away from abrasive surfaces, or as a carriage to transport the load along a life safety rope.

A.5.11.2 Pulleys used to change the direction of a life safety rope more than 120 degrees can be subjected to a force two times that of the load. Pulleys in mechanical advantage systems or used for changes in direction less than 120 degrees can see forces lower than the load. For evaluating whether the organization should select general-use or technical-use equipment, see A.5.1.2(3).

A.5.11.3 The selection of the pulley for an intended application requires a consideration of several design features: efficiency, single or double sheaves, ratchet, and size.

(1) Efficiency. Pulley efficiency is essentially the rolling resistance of the sheave and the rope. Many factors affect effi-
ciency, including sheave size, bearings, and side plate interaction. For most applications, a pulley with ball-bearing provides the highest efficiency and the differences efficiency between the ball-bearing pulleys are virtually insignificant.

(2) **Single or Double Sheaves.** Single-sheave pulleys are the most common and are used in most applications. Double pulleys allow a simpler way to rig a higher mechanical advantage and are often seen in pre-rigged pulley systems. Double pulleys can have a becket or attachment point at the bottom. In a mechanical advantage system using double pulleys, one of them usually requires a becket. NFPA 1983 has performance requirements for beackets.

(3) **Ratchet.** A ratchet is a means of holding the life safety rope when the operator releases it. A ratchet can be internal on a self-tending pulley or an independent device rigged with the pulley. Self-tending pulleys should be evaluated on the ratchet’s ability to support the load and the pulley’s ability to be released remotely. Some require the load to be lifted first, others do not. If a Prusik hitch or similar knot is used as an independent ratchet, a flat-bottomed, or “Prusik minding,” pulley might be needed to prevent the knot from jamming between the sheaves.

(4) **Size.** Manufacturers generally recommend that the minimum pulley sheave size be no less than four times the diameter of the rope, to reduce the loss of strength from compression and elongation of the rope fibers. For example, if a ½ in. life safety rope is used, a minimum of a 2 in. pulley should be selected. Smaller pulleys are lighter and more compact, and the strength loss down to a 1 in. pulley is minimal. A pulley with a larger sheave has a slightly higher efficiency than a smaller pulley with the same type bearing, but it is heavier and bulkier to store and transport.

(5) **Sheave Width.** Proper sheave width is necessary to prevent the life safety rope from dragging on the sideplates and reducing the pulley’s efficiency. Most pulleys accommodate 12.5 mm life safety rope and can also be used for 11 mm rope. Consideration should be given if a pulley is sized for 11 mm rope and the organization also uses 12.5 mm rope. If the organization uses 10 mm life safety rope, a wider sheave pulley will be required.

A.5.12 A belay device is an item of equipment that attaches to the belay (safety) rope and grips that rope preventing rope slippage when the belay rope is suddenly tensioned. This usually occurs when a firefighter falls or loses control of a rappel or, in the case of a litter system, a main line failure occurs.

A.5.12.1 Consideration of the anticipated maximum impact loads and the maximum static loads will determine whether a general-use or a technical-use device should be selected. For evaluating whether the organization should select general-use or technical-use equipment, see A.5.1.2(3).

A.5.12.2 If the belay line is not maintained slack free (pre-tensioned) at the time of the fall, a greater impact load will occur on the belay device. This occurs from any slack in the belay system and the elongation in the belay line. The impact force is a function of the potential energy in the fall (mass times the distance fallen) and the total stopping distance once the belay device engages. To prevent injury to the load, the impact force must remain below a certain force level and the total stopping distance minimized to avoid impact with objects below as required in NFPA 1983.

A.5.12.3 Selection is based on the type of rope work that the organization intends to perform. While most belay devices are designed to manage a 200 kg load, specialty belay devices might exist to protect a single person such as during rappel training or two persons such as during a pick-off rescue.

The standard 200 kg load is derived from a worst case situation for a vertical rescue: a litter with a victim and a single tender suspended entirely on the delay line. As the angle of a rescue decreases, additional tenders are needed to support the litter off a slope. Because of the decrease angle, even though the entire load increases, the load on the delay line decreases.

A.5.12.4 Effective operation of the delay device is essential not only to maintain the impact force within safe limits but also to prevent the device from catching or jamming so often that the rescue is delayed. Prior training and experience with different delay devices are required to provide the operational understanding for the selection.

A.5.12.5 Operations that require the user to carry the delay device would suggest selecting a lighter-weight device. The organization should verify that the device will perform in the expected environmental conditions, such as cold and wet.

A.5.13 End-to-end straps typically are straps used to connect a person to the rescue system. Common types are pick-off straps, used to attach a subject to a life safety rope, and stretcher straps, used to connect a litter tender to a litter. Multiple-use straps typically are used to set up anchor points. The term *multiple use* indicates that the strap can be used in an end-to-end, basket hitch, or girth hitch configuration; each of which affects the strength of the strap.

A.5.13.1 End-to-end straps might see only the load of a subject or rescuer. A multiple-configuration strap might be used to anchor the main or belay line for a litter system and could be expected to support a much higher anticipated load than the minimum performance requirements in NFPA 1983. For evaluating whether the organization should select general-use or technical-use equipment, see A.5.1.2(3).

A.5.13.2 Certain design features should be considered in the selection of end-to-end straps: length, width, weight, terminations, material, adjustability, and color.

(1) **Length.** The type of anchor points used help determine what length straps should be purchased and whether several lengths might be needed. Overly long straps waste space, moving the operation of a system away from the anchor. Short straps might not fit around the anchor points encountered. Adjustable straps accommodate different sizes but, because they require enough webbing for the largest size, are bulky and heavy. A strap the right size for wrapping around a vehicle wheel in a basket hitch might also be the right size used in the girth hitch configuration and attached to a hard point under a vehicle.

(2) **Width.** Wider web straps are strong but bulkier and heavier. The additional material usually provides better resistance to abrasions and cuts. A narrow strap can be threaded through narrow openings if the connection point on the end is not too large.

(3) **Weight.** Wide straps provide the greatest strength but are heavier, particularly if they terminate in metal D-rings or O-rings. They might be suitable for vehicle-based rescue but make access difficult if the equipment must be carried or climbed to the rescue.
A litter is designed to secure, protect, and transport a patient. It requires space to store, can be bulky to transport, and can be difficult to fit into tight places. Semi-rigid litters, usually of plastic or cloth, can be rolled into a small package for transport or storage. Most fold around the patient, allowing the litter with the patient to be moved through tighter openings.

(4) **Integrated Attachment Points.** The organization should evaluate the litter for integrated attachment points to ease connection to the rescue system. Both vertical and horizontal orientation attachments should be evaluated. Optional litter rigging slings, whether manufactured or field assembled, should provide for secure means of attachment of the litter to the rescue system.

(5) **Means of Securing the Victim.** Litters can include optional means of securing victims in the litter, such as integrated seatbelts or other webbing. The organization should evaluate such means for the effectiveness of securing the victim to the litter and the rescue system. These components are not included in the performance requirements of NFPA 1983 for litters. Organizations can elect that manufacturer-included straps be used as ancillary attachment in conjunction with other manufactured or field-assembled systems or techniques used to secure the victim to the litter as well as a means of attaching the victim to the rescue system. Organizations should evaluate manufactured systems or field-assembled systems in preventing movement of the victim in multiple orientations of the litter, such as inverted, head-up, head-down, and vertical.

(6) **Shape of Litter.** Litters generally are rectangular or a tapered shape. The organization should evaluate the shape of the litter and determine compatibility with victim immobilization devices that might be used in conjunction with the litter, such as a long spine board.

(7) **Size of Litter.** The organization should evaluate the overall size of the litter to determine if it will meet storage requirements and is compatible with victim immobilization devices. Organizations should note that a standard-size litter might not be adequate for persons of taller stature or larger mass.

(8) **Litter Accessories.** The organization should evaluate the operational needs of optional litter accessories, including, for example, victim face shield, trail wheel attachment, snow ski, and flotation devices. Litter accessories are not included in the performance requirements of NFPA 1983.

A5.15.2 Evaluations should be conducted in a manner replicating the intended use of the manufactured system. Participants should be wearing the equipment and PPE that would be used in an actual incident.

A5.16 Under NFPA 1983, an escape system is a system designed to provide a means of escape from an immediately hazardous environment above grade and is intended for emergency self-rescue. There are two categories of escape system:

(1) A fire escape system is designed to be used in environments involving fire or fire products.

(2) An escape system is designed to be used in environments that do not involve fire or fire products.

A5.16.1 The organization has to evaluate the placement of the escape system: fixed or not fixed to the turnout pant, fixed or not fixed to the turnout coat, fixed or not fixed to the SCBA, drop bag, utility belt, or other location on the firefighter. The location and attachment of the escape system should be evaluated for compatibility with department equipment.

A5.16.2 The ability to deploy the system in a time acceptable to the organization will determine whether to select an escape...
system that is attached to an escape harness or escape belt or one that requires connection to the harness or belt prior to deployment. While a preconnected system might interfere with other operations, it minimizes the time needed to egress the environment. A stored system might provide a lower profile and be less in the way, but it takes a little longer to deploy. The time needed to deploy a system should be evaluated with regard to the department’s protocols and expectations. As part of this evaluation, the means of attachment to the belt or harness should be considered.

A.5.16.3 Webbing-based systems tend to be more compact, allowing a longer length to be carried in the same space. A rope-based system can be easier for the user to grip with the safety hand. The amount of control provided by the escape descent control device can vary between systems and should be part of the webbing and rope evaluation. The construction and the fiber used for either the webbing or the rope should be evaluated regarding resistance to abrasions and cuts.

A.5.16.4 If the escape system will be exposed to temperatures higher than the maximum required for life safety rope, then a fire escape system should be considered. A fire escape system should be manufactured using fire escape rope or fire escape webbing. Other components of the system should also meet the same minimum temperature requirements as the fire escape rope and webbing.

A.5.16.6 Payout force is the force needed to pull the line once the escape system is assembled for use. This affects the ability of the firefighter to move across a floor space if the escape system is not anchored near an exit.

A.5.16.7 The choice between a repackable system and one that is not repackable is a cost factor to the organization for training, spare units, and ease of use. While a repackable system can be used for training, consideration must be given to overuse if the system will be used during fire operations. A system that is not repackable has the advantages of not requiring detailed inspection and eliminating the possibility of being incorrectly repacked. The organization should evaluate the performance differences between sealed package systems and systems used for practice or training.

A.5.16.8 A deciding factor in the selection of the escape system should be the evaluation of each component of the system and the function of those components when considered with the organization’s training or protocols.

A manufactured system usually is not complete, and the organization will need to select additional components that will be compatible with the system and the organization’s training and protocols. For example, many escape systems do not include a harness or belt.

A.5.16.9 Descent control devices come in a variety of types and usually are the key component in deciding which system best meets the organization’s requirements. (See Section 5.9.)

A.5.16.10 Some organizations have the staging area in high-rises two floors below the fire and some do not. Some mid-rise fires have the staging area on the ground level, which could be four stories in height. While a longer line provides greater flexibility, it adds significantly to the bulk and weight that the user must carry.

A.5.16.11 The type and locations of primary anchor points within a structure determine which type of anchor method to select: escape anchor device, carabiner, or loop. Interior anchoring, window anchoring, exterior walls of structure, and furniture are all options for attaching the escape system. Depending on the anchoring location, some methods might be more difficult than others, so the organization must evaluate which anchoring methods are best. (See 5.18.1 for considerations.)

A.5.16.12 The organization should consider whether components can be replaced by the organization or only by the manufacturer. Due to the small diameter of the rope and webbing used, the organization should consider the recommended service life of the escape system and evaluate how realistic that service life is when the organization’s training requirements, frequency of exposure to fire ground elements, and maintenance procedures are considered.

A.5.16.13 The personnel conducting the evaluations should be wearing full turnouts with gloves and SCBA with mask and second-stage regulator in place and be operating in the expected positions, such as on the knees or crawling. This simulates the physical state that users would be in when deploying the escape system due to the heat that would be pushing them to the floor. Performance of payout, handling, and accessibility should be considered.

A.5.17.1 Escape webbing is part of an assembly worn by a rescuer and used to descend from a position of height to safety at a lower level. An escape assembly might have an escape anchor device, escape webbing, and an escape descent control device connected to a belt or harness. The assembly might be carried in a pocket or bag attached to the rescuer. The organization should evaluate through practical testing to ensure that all the components are compatible and function as intended. For selection criteria on the other components that might be part of the escape assembly, see X.X.X for carabiners, X.X.X for escape anchor devices, and X.X.X for descent control devices.

A.5.17.1(1) Exposure to elevated temperatures degrades the strength of the any webbing, which decreases the time that the webbing is able to support the user. Wider-width webbing provides greater resistance to failure at elevated temperatures. Greater bulk takes longer for the effect of heat to weaken the webbing, allowing more time to complete the egress. The trade-off is greater bulk and weight.

In general, fire escape webbing should be used where higher temperatures are anticipated. Escape webbing can be chosen for anticipated temperatures not requiring PPE for heat.

A.5.17.1(2) The termination at the anchor end of the webbing determines how the user will connect the webbing to a structure for a secure anchor that will support the user’s weight. The end of the webbing can be attached to a hook, bar, or carabiner with a knot or sewn termination. Any of those three types of termination reduces the strength of the webbing by some factor.

A.5.17.1(4) Not all webbing is tested or certified with all types of descent control devices. The organization should determine that the webbing selected is compatible with the type of descent control device selected. The manufacturer of the device should be able to supply the information as to which specific webbing has been determined to function and should be consulted as to what type of webbing was tested or certified with the selected descent control device.

A.5.17.1(5) This is a function of the descent control device selected, the diameter of the webbing, and the “gripping” su-
face of the webbing. Proper technique for most escape descent control devices includes operating the device with one hand while the other hand grips the webbing. The tension required with the hand gripping the webbing depends on the particular descent control device. The more tension that must be held by the hand on the webbing, the more important is the ability to grip the webbing.

A.5.17.2(1) Due to the bulk and weight of an escape system, only a certain amount of webbing can reasonably be carried. The height of structures in the response area will help determine a minimum length of webbing for the escape system. If the structures are several stories high, the protocol may be to evacuate to a lower, safe level than completely to the ground.

A.5.17.2(2) For example, on the firefighter the escape webbing might be carried or worn in the turnout pants, in the turnout coat, on the SCBA, or on a belt. The location and the packaging affect the user’s ability to deploy the webbing and should be evaluated while the user is wearing full equipment and SCBA and mask and in different positions, such as kneeling. The location of the webbing should not interfere with the use or performance of other PPE worn by the user.

A.5.17.2(4) Because of the smaller diameter of escape webbing and of the high-tech fibers that might be selected for fire escape webbing, webbing is not as durable as the life safety ropes. Generally, escape webbing has minimal use, such as one or two rappels, to verify performance and the user’s ability to operate the escape assembly; than annual currency training. If the organization’s protocol calls for greater use, wider webbing should be selected to increase durability.

A.5.18 An escape anchor device allows a very fast connection on a wider range of anchor points, sometimes even with the ability to create an anchor point where one does not exist. The two basic types of escape anchor devices are the “hook” and the “T-bar.”

T-bar devices are generally placed in the corner of a window or other opening with the weight of the user on the line holding them in place. The line can also be wrapped around an anchor point and a knot tied around the device.

Hook devices are most secure when wrapped around an anchor point and a knot tied around or through the device. Some have specific design features that allow the knot to be tied quickly. The hook can fit over many objects or pounded through a wall to attach to a stud. The hook can also be placed at the window edge, where, like the T-bar, the weight of the user on the line will hold it in place.

There are two other means of securing the end of an escape line. While slow and very dependent on the user’s skill in high stress situations, the escape line can be simply tied to a solid object. Faster and more secure is a line with an integral carabiner on the end. The line is wrapped around a solid anchor point and the carabiner clipped over the line; in some cases, the carabiner’s size allows it to be connected to an anchor point.

A.5.18.1(1) Escape anchor designs vary widely, from hooks to T-bars. The organization should evaluate the types of structures most likely to be encountered and how the escape anchor device will be attached. This should include an evaluation of circumstances when the firefighter has time to locate and set a secure anchor and when immediate deployment and exit are necessary.

A.5.18.1(2) An escape anchor device can be carried in the turnouts pants, in the turnout coat, on the SCBA, in a drop bag. The location should be considered carefully since it affects the user’s ability to deploy the escape device. The storage location should be comfortable and efficient for everyday use.

A.5.18.1(4) There are several methods of attaching the escape rope or webbing to the escape device. The organization should evaluate the following:

1. How is the rope or webbing to be attached to the device: sewn, swaged, or tied with a knot?
2. Does the attachment meet the necessary strength requirements?
3. Is the connection secure such that it will not disconnect during storage or deployment?
4. Does the connection keep the escape rope or webbing located such that it will not cause the escape anchor device to fail to stay in position?

A.5.18.2 The personnel conducting the evaluations should be in response attire and PPE that will be worn when conducting the operations in which the escape anchor device will be used.

For example, the individual evaluating an escape anchor device should be wearing full turnouts with gloves and SCBA with mask and second-stage regulator in place and operating in the expected positions, such as on the knees or crawling. This simulates the physical state that users would be in when deploying the escape rope and equipment due to the heat that would be pushing them to the floor.

Field evaluations should determine how well the operators are able to set the device into an anchor point or tie off the device around an anchor point.

Field evaluations conducted at an elevation should be protected by a safety line.

A.5.19 NFPA 1983 defines a victim extrication device as a device designed to be secured about the body of a victim in a harness-like manner to provide support to a victim in a head-up or horizontal configuration for the purpose of lifting and transporting the victim with a life safety rope.

A.5.19.3 The specifications for a victim extrication device include Class II and Class III devices:

1. Class II. A Class II device secures around the waist and around the thighs or under the buttocks for victim extrication in an upright position.
2. Class III. A Class III device secures around the waist, around the thighs or under the buttocks, and over the shoulders or otherwise encapsulates a victim for extrication in an upright or horizontal configuration.

Class II devices are best suited for patient transport when the patient is being lifted vertically or can be kept in an upright position during any movement in the horizontal plane. Class III devices, by encapsulating the patient, can be used for a patient in a horizontal position for transport in either a vertical or a horizontal plane.

A.5.20 NFPA 1983 performance requirements for moderate elongation laid life saving rope allows a maximum elongation at 10 percent of the breaking strength up to 25 percent compared to the maximum 10 percent elongation allowed for life safety rope. Life safety ropes are useful where a higher impact load is possible and there is room below the suspended person to safely allow for the extra elongation.

A.5.20.1 See X.X.X.
A.5.20.2(1) See A.5.2.2.
A.5.20.2(2) See A.5.2.3.
A.5.20.2(3) See A.5.2.4.
A.5.20.2(4) See A.5.2.5.
A.5.20.2(5) See A.5.2.6.
A.5.20.2(6) See A.5.2.7.
A.5.20.2(7) See A.5.2.8.
A.5.20.2(8) See A.5.2.9.
A.5.20.2(9) See A.5.2.10.
A.6.2.1 Proper inspection procedures require that organizations develop an inspection policy for their equipment in service. The policy should be based on the information provided by the manufacturer in the manufacturer’s instructions. An organization should identify qualifications for personnel conducting inspections, and inspections should be documented in an inspection log. Inspections should be conducted by a trained user prior to use and by a qualified inspector following use.

A.6.2.5.1 The decision whether to retire a life safety rope or keep it in service relies on good judgment that comes from experience in working with rope. Inspecting a life safety rope involves visually looking for damage, feeling for damage, and checking the rope’s history in the rope log. A complete inspection includes both visual and tactile inspections. Because of the many variations of individual ropes and their use, it is impossible to state exactly when to retire a life safety rope. If there are any doubts about the integrity of a rope, it should be destroyed. Inspection of life safety rope should include the following steps:

1. Visually inspect the sheath to identify chafed areas, glazed surfaces, discoloration, or variations in diameter. These areas should receive additional scrutiny during the tactile inspection. Look for areas of abrasion or cuts in the sheath where the core is exposed or enough of the sheath is worn that its ability to protect the core is compromised. If any of these problems is noted, the rope should be destroyed.
2. The tactile inspection should be done with tension on the rope. Feel for variations in size and soft or hard spots, which could indicate damage to the core or that the rope has been overstressed. If any of these problems are noted, the rope should be destroyed.
3. While performing the tactile inspection, pay attention to strong or odd odors, which might indicate possible chemical contamination, signs of which are not always visible.
4. Review the rope log. If the rope has been subjected to shock loads, fall loads, or use other than normal rappel or rescue use, the rope should be destroyed.
5. Inspect a new rope before it is put into service and then after each use. The inspection should be done by an experienced person deemed qualified by the agency or organization. Each rope should be inspected before being used even if the rope has never been placed in service.

For more information on rope inspection, see ASTM F1740, Guide for Inspection of Nylon, Polyester, or Nylon/Polyester Blend, or Both Kernmantle Rope.

A.6.2.5.2 Rope used for emergency egress is defined as a single-purpose rope. During actual use, the integrity of the rope can be assumed to be compromised, and the rope should be taken out of service and destroyed. Such rope generally is left behind at the scene of the incident, and the degree of exposure to heat and flame is unknown and probably will have substantial damage.

When used in a training context, escape rope should be inspected in the same manner as life safety rope.

Ultra high modulus fiber rope (see A.X.X.X) can lose a significant percentage of their original strength after many fewer cycles than ropes of nylon and polyester fibers. Special care should be taken for more frequent inspections in training with escape ropes made of ultra high modulus fibers.

A.7.1.2 Life safety rope does not require cleaning after every use; in fact, excessive cleaning can be harmful to the rope by removing the lubricant applied to the fibers during the manufacturing process. After most rescues, a minimal removal of dust, dirt, and water usually is all that is required to keep the equipment in good working order.

A.7.2.4 Biohazard cleaning agents can have an adverse effect on the strength of textile products. The organization should determine the risk versus benefit of excessive decontamination of rope. At some point, it is best to take the rope out of service.

A.7.2.5.3 Equipment manufacturers recommend use of a dry or nonsticking lubricant to maintain performance. Petroleum-based products should be avoided because they attract and trap dirt as well as some products can have an adverse effect on textile products.

A.9.1.1 In-service rope and webbing generally are stored in a rope bag or rope pack to allow for transport and deployment.
A.9.2 In-service equipment usually is stored in a gear bag for transport and deployment.

A.10.1 Textile products include but are not limited to rope, webbing, harnesses, straps, and patient extrication devices. Many products combine hardware and textile components, and retirement should be based on the textile standard.

A.10.1.1 Organizations should consider changes in the performance requirements and test methods for textile products when considering retirement or replacement.

A.10.1.2 The consensus of many users and manufacturers of life safety rope is that retirement should be considered after 10 years of service. The age of the rope is just one factor to consider. Much more critical is the exposure of the rope to abrasion, loading, weather, sunlight, chemicals, impact loading during use, and unknown environmental chemical exposure during storage. For more information on inspection and retirement, see ASTM F1740, Standard Guide for Inspection of Nylon, Polyester, or Nylon/Polyester Blend, or Both Kernmantle Rope.

A.10.2 See A.10.1

A.10.3 Life safety hardware includes devices that are not textile. Equipment or systems that contain both textile and hardware components should be retired based on the textile component.

A.10.3.2 While not readily apparent, hardware devices do show adverse effects due to long-term use. Often resulting in stress cracks or fractures, this damage is often difficult to observe during inspection. Organizations might want to consider a 10-year service life for hardware devices and components.
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 requirements of this document unless also listed in 2 for other reasons.

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

B.1.2 Other Publications.

B.1.2.1 ASSE Publications. American Society of Safety Engineers, 1800 E. Oakton Street, Des Plaines, IL 60018.
   - ANSI/ASSE Z359, Fall Protection Code, [[EDITION YEAR TO COME]]

B.1.2.2 ASTM Publications. ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.
   - ASTM F 1740, Standard Guide for Inspection of Nylon, Polyester, or Nylon/Polyester Blend or Both Kernmantle Rope, 1996 (reapproved 2007).

B.1.2.3 Cordage Institute Publications. Cordage Institute, 994 Old Eagle School, Wayne, PA 19087-1866.
   - CI 1202, Terminology for Fiber Rope, February 2003.
   - CI 1801, Low Stretch and Static Kernmantle Life Safety Rope, [[EDITION YEAR TO COME]].